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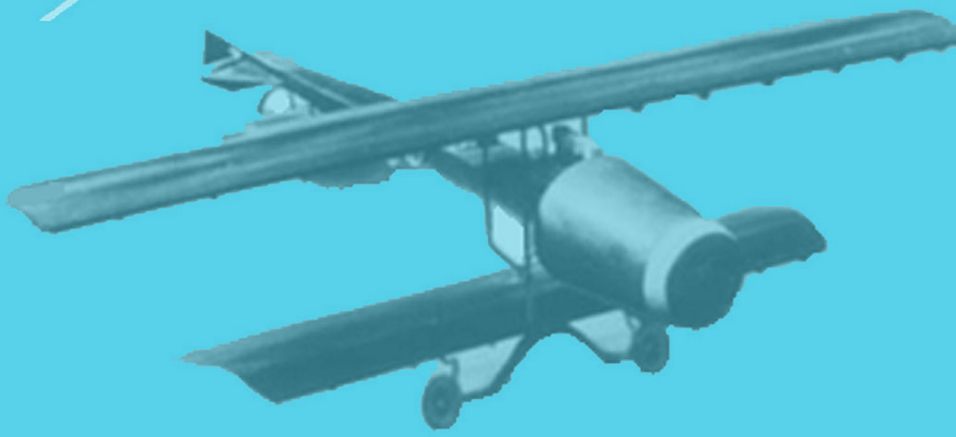

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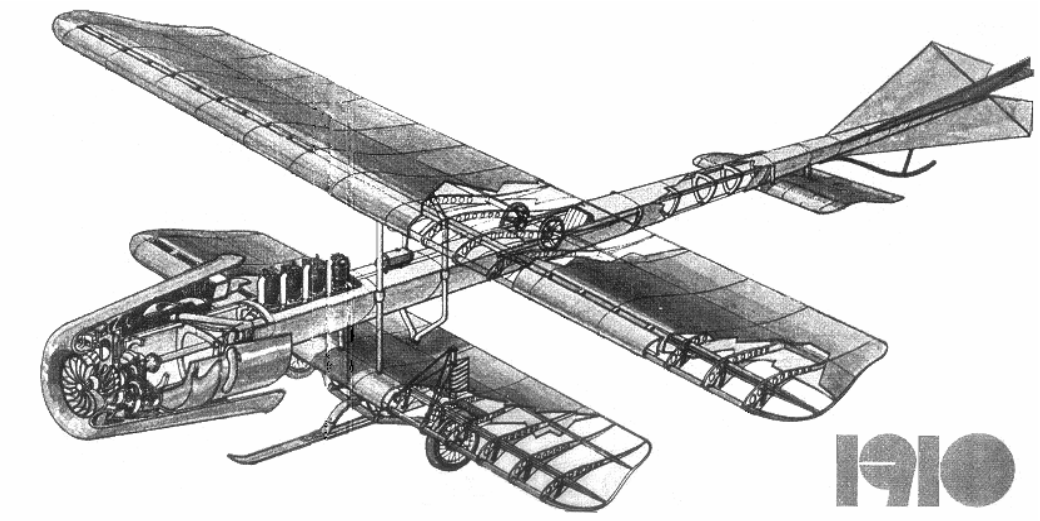

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C O N T E N T S

N-NORM AND N-CONORM IN NEUTROSOPHIC LOGIC AND SET, AND THE NEUTROSOPHIC TOPOLOGIES

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***Abstract**: In this paper we present the N-norms/N-conorms in neutrosophic logic and set as extensions of T-norms/T-conorms in fuzzy logic and set. Also, as an extension of the Intuitionistic Fuzzy Topology we present the Neutrosophic Topologies.*

***Keywords**: neutrosophic logic and set, N-norms, N-conorms, neutrosophic composition k-law, neutrosophic topologies.*

1. DEFINITION OF THE NEUTROSOPHIC LOGIC/SET

Let T, I, F be real standard or non-standard subsets of $]^{-}0,1^{+}[$, with $\sup T = t\sup$, $\inf T = t\inf$, $\sup I = i\sup$, $\inf I = i\inf$, $\sup F = f\sup$, $\inf F = f\inf$, and $n\sup = t\sup + i\sup + f\sup$, $n\inf = t\inf + i\inf + f\inf$.

Let U be a universe of discourse, and M a set included in U. An element x from U is noted with respect to the set M as x(T, I, F) and belongs to M in the following way: it is t% true in the set, i% indeterminate (unknown if it is or not) in the set, and f% false, where t varies in T, i varies in I, f varies in F.

Statically T, I, F are subsets, but dynamically T, I, F are functions/operators depending on many known or unknown parameters.

2. NEUTROSOPHIC LOGIC

In a similar way define the **Neutrosophic Logic**: A logic in which each proposition x is T% true, I% indeterminate, and F% false, and we write it x(T,I,F), where T, I, F are defined above.

3. N-NORMS AND N-CONORMS FOR THE NEUTROSOPHIC LOGIC AND SET

As a generalization of T-norm and T-conorm from the Fuzzy Logic and Set, we now introduce the **N-norms and N-conorms** for the Neutrosophic Logic and Set.

We define a *partial relation order* on the neutrosophic set/logic in the following way: $x(T_1, I_1, F_1) \le y(T_2, I_2, F_2)$ iff (if and only if) $T_1 \le T_2$, $I_1 \ge I_2$, $F_1 \ge F_2$ for crisp components.

And, in general, for subunitary set components: $x(T_1, I_1, F_1) \le y(T_2, I_2, F_2)$ iff

$\inf T_1 \le \inf T_2$, $\sup T_1 \le \sup T_2$,
$\inf I_1 \ge \inf I_2$, $\sup I_1 \ge \sup I_2$,
$\inf F_1 \ge \inf F_2$, $\sup F_1 \ge \sup F_2$.

If we have mixed - crisp and subunitary - components, or only crisp components, we can transform any crisp component, say "a" with a $\dot{I}$ [0,1] or a$\dot{I}$ $]^{-}0, 1^{+}[$, into a subunitary set [a, a]. So, the definitions for sub unitary set components should work in any case.

3.1. N-NORMS

$$Nn : (\,]-0,1+[\times]-0,1+[\times]-0,1+[\,)2?\,]-0,1+[\times]-0,1+[\times]-0,1+[\quad (1)$$

$$Nn\,(x(T1,I1,F1), y(T2,I2,F2)) = (NnT(x,y), NnI(x,y), NnF(x,y)) \quad (2)$$

where $N_nT(.,.)$, $N_nI(.,.)$, $N_nF(.,.)$ are the truth/membership, indeterminacy, and respectively falsehood/nonmembership components.

N_n have to satisfy, for any x, y, z in the neutrosophic logic/set M of the universe of discourse U, the following axioms:

a) Boundary Conditions:

$N_n(x, 0) = 0$, $N_n(x, 1) = x$.

b) Commutativity: $N_n(x, y) = N_n(y, x)$.

c) Monotonicity:

If $x \le y$, then $N_n(x, z) \le N_n(y, z)$.

d) Associativity:

$N_n(N_n(x, y), z) = N_n(x, N_n(y, z))$.

There are cases when not all these axioms are satisfied, for example the associativity when dealing with the neutrosophic normalization after each neutrosophic operation. But, since we work with approximations, we can call these **N-pseudo-norms**, which still give good results in practice.

N_n represent the *and* operator in neutrosophic logic, and respectively the *intersection* operator in neutrosophic set theory.

Let $J \in \{T, I, F\}$ be a component.

Most known N-norms, as in fuzzy logic and set the T-norms, are:

• The Algebraic Product N-norm:

$N_{n-algebraic}J(x, y) = x \cdot y$

• The Bounded N-Norm:

$N_{n-bounded}J(x, y) = \max\{0, x + y - 1\}$

• The Default (min) N-norm:

$N_{n-min}J(x, y) = \min\{x, y\}$.

A general example of N-norm would be this.

Let $x(T_1, I_1, F_1)$ and $y(T_2, I_2, F_2)$ be in the neutrosophic set/logic M. Then:

$$Nn(x, y) = (T1/\backslash T2, I1 \therefore /I2, F1 \therefore /F2) \quad (3)$$

where the "/\" operator, acting on two (standard or non-standard) subunitary sets, is a N-norm (verifying the above N-norms axioms); while the "\/" operator, also acting on two (standard or non-standard) subunitary sets, is a N-conorm (verifying the below N-conorms axioms).

For example, /\ can be the Algebraic Product T-norm/N-norm, so $T_1/\backslash T_2 = T_1 \cdot T_2$ (herein we have a product of two subunitary sets – using simplified notation); and \/ can be the Algebraic Product T-conorm/N-conorm, so $T_1 \backslash / T_2 = T_1 + T_2 - T_1 \cdot T_2$ (herein we have a sum, then a product, and afterwards a subtraction of two subunitary sets).

Or /\ can be any T-norm/N-norm, and \/ any T-conorm/N-conorm from the above and below; for example the easiest way would be to consider the *min* for crisp components (or *inf* for subset components) and respectively *max* for crisp components (or *sup* for subset components).

If we have crisp numbers, we can at the end neutrosophically normalize.

3.2. N-CONORMS

$$Nc : (\,]-0,1+[\times]-0,1+[\times]-0,1+ \\ [\,)2\,?\,]-0,1+[\times]-0,1+[\times]-0,1+[\quad (4)$$

$$Nc\,(x(T1, I1, F1), y(T2, I2, F2)) = \\ (NcT(x, y), NcI(x, y), NcF(x, y)), \quad (5)$$

where $N_nT(.,.)$, $N_nI(.,.)$, $N_nF(.,.)$ are the truth/membership, indeterminacy, and respectively falsehood/nonmembership components.

N_c have to satisfy, for any x, y, z in the neutrosophic logic/set M of universe of discourse U, the following axioms:

a) Boundary Conditions:

$N_c(x, \mathbf{1}) = \mathbf{1}$, $N_c(x, \mathbf{0}) = x$.

b) Commutativity: $N_c(x, y) = N_c(y, x)$.

c) Monotonicity:

if $x \le y$, then $N_c(x, z) \le N_c(y, z)$.

d) Associativity:

$N_c(N_c(x, y), z) = N_c(x, N_c(y, z))$.

There are cases when not all these axioms are satisfied, for example the associativity when dealing with the neutrosophic normalization after each neutrosophic operation. But, since we work with approximations, we can call these **N-pseudo-conorms**, which still give good results in practice.

N_c represent the *or* operator in neutrosophic logic, and respectively the *union* operator in neutrosophic set theory.

Let $J \in \{T, I, F\}$ be a component.

Most known N-conorms, as in fuzzy logic and set the T-conorms, are:

• The Algebraic Product N-conorm:

$N_{c-algebraic}J(x, y) = x + y - x \cdot y$

• The Bounded N-conorm:

$N_{c-bounded}J(x, y) = \min\{1, x + y\}$

• The Default (max) N-conorm:

$N_{c-max}J(x, y) = \max\{x, y\}$.

A general example of N-conorm would be

this. Let $x(T_1, I_1, F_1)$ and $y(T_2, I_2, F_2)$ be in the neutrosophic set/logic M. Then:

$$Nn(x, y) = (T1 \therefore /T2, I1/\backslash I2, F1/\backslash F2) \quad (6)$$

Where – as above - the "/\" operator, acting on two (standard or non-standard) subunitary sets, is a N-norm (verifying the above N-norms axioms); while the "\/" operator, also acting on two (standard or non-standard) subunitary sets, is a N-conorm (verifying the above N-conorms axioms).

For example, /\ can be the Algebraic Product T-norm/N-norm, so $T_1/\backslash T_2 = T_1 \cdot T_2$ (herein we have a product of two subunitary sets); and \/ can be the Algebraic Product T-conorm/N-conorm, so $T_1 \backslash / T_2 = T_1 + T_2 - T_1 \cdot T_2$ (herein we have a sum, then a product, and afterwards a subtraction of two subunitary sets).

Or /\ can be any T-norm/N-norm, and \/ any T-conorm/N-conorm from the above; for example the easiest way would be to consider the *min* for crisp components (or *inf* for subset components) and respectively *max* for crisp components (or *sup* for subset components).

If we have crisp numbers, we can at the end neutrosophically normalize.

Since the min/max (or inf/sup) operators work the best for subunitary set components, let's present their definitions below. They are extensions from subunitary intervals {defined in [3]} to any subunitary sets. Analogously we can do for all neutrosophic operators defined in [3].

Let $x(T_1, I_1, F_1)$ and $y(T_2, I_2, F_2)$ be in the neutrosophic set/logic M.

Neutrosophic Conjunction/Intersection:

$$x/\backslash y = (T/\backslash, I/\backslash, F/\backslash) \quad (7)$$

where $\inf T_{\wedge} = \min\{\inf T_1, \inf T_2\}$
$\sup T_{\wedge} = \min\{\sup T_1, \sup T_2\}$
$\inf I_{\wedge} = \max\{\inf I_1, \inf I_2\}$
$\sup I_{\wedge} = \max\{\sup I_1, \sup I_2\}$
$\inf F_{\wedge} = \max\{\inf F_1, \inf F_2\}$
$\sup F_{\wedge} = \max\{\sup F_1, \sup F_2\}$

Neutrosophic Disjunction/Union:

$$x \backslash /y = (T \therefore /, I \therefore /, F \therefore /) \quad (8)$$

where $\inf T_{\vee} = \max\{\inf T_1, \inf T_2\}$
$\sup T_{\vee} = \max\{\sup T_1, \sup T_2\}$
$\inf I_{\vee} = \min\{\inf I_1, \inf I_2\}$
$\sup I_{\vee} = \min\{\sup I_1, \sup I_2\}$
$\inf F_{\vee} = \min\{\inf F_1, \inf F_2\}$
$\sup F_{\vee} = \min\{\sup F_1, \sup F_2\}$

Neutrosophic Negation/Complement:

$$C(x) = (TC, IC, FC) \quad (9)$$

where $T_C = F_1$
$\inf I_C = 1 - \sup I_1$
$\sup I_C = 1 - \inf I_1$
$F_C = T_1$

Upon the above Neutrosophic Conjunction /Intersection, we can define the Neutrosophic Containment.

Neutrosophic Containment:

We say that the neutrosophic set A is included in the neutrosophic set B of the universe of discourse U, iff for any $x(T_A, I_A, F_A)$ Ĭ A with $x(T_B, I_B, F_B)$ Ĭ B we have:

$\inf T_A \le \inf T_B$; $\sup T_A \le \sup T_B$;
$\inf I_A \ge \inf I_B$; $\sup I_A \ge \sup I_B$;
$\inf F_A \ge \inf F_B$; $\sup F_A \ge \sup F_B$.

3.3. REMARKS

a) The non-standard unit interval $]^-0, 1^+[$ is merely used for philosophical applications, especially when we want to make a distinction between relative truth (truth in at least one world) and absolute truth (truth in all possible worlds), and similarly for distinction between relative or absolute falsehood, and between relative or absolute indeterminacy.

But, for technical applications of neutrosophic logic and set, the domain of definition and range of the N-norm and N-conorm can be restrained to the normal standard real unit interval [0, 1], which is easier to use, therefore: N_n: $([0,1] \times [0,1] \times [0,1])^2 \rightarrow [0,1] \times [0,1] \times [0,1]$ and N_c: $([0,1] \times [0,1] \times [0,1])^2 \rightarrow [0,1] \times [0,1] \times [0,1]$.

b) Since in NL and NS the sum of the components (in the case when T, I, F are crisp numbers, not sets) is not necessary equal to 1 (so the normalization is not required), we can keep the final result un-normalized.

But, if the normalization is needed for special applications, we can normalize at the end by dividing each component by the sum all components. If we work with intuitionistic logic/set (when the information is incomplete, i.e. the sum of the crisp components is less than 1, i.e. *sub-normalized*), or with

paraconsistent logic/set (when the information overlaps and it is contradictory, i.e. the sum of crisp components is greater than 1, i.e. *over-normalized*), we need to define the neutrosophic measure of a proposition/set.

If x(T,I,F) is a NL/NS, and T,I,F are crisp numbers in [0,1], then the **neutrosophic vector norm** of variable/set x is the sum of its components:

$$\text{Nvector-norm}(x) = T + I + F \quad (10)$$

Now, if we apply the N_n and N_c to two propositions/sets which maybe intuitionistic or paraconsistent or normalized (i.e. the sum of components less than 1, bigger than 1, or equal to 1), x and y, what should be the neutrosophic measure of the results $N_n(x,y)$ and $N_c(x,y)$?

Herein again we have more possibilities:

- either the product of neutrosophic measures of x and y: $N_{vector\text{-}norm}(N_n(x,y)) = N_{vector\text{-}norm}(x) \cdot N_{vector\text{-}norm}(y)$,
- or their average: $N_{vector\text{-}norm}(N_n(x,y)) = (N_{vector\text{-}norm}(x) + N_{vector\text{-}norm}(y))/2$,
- or other function of the initial neutrosophic measures: $N_{vector\text{-}norm}(N_n(x,y)) = f(N_{vector\text{-}norm}(x), N_{vector\text{-}norm}(y))$, where f(.,.) is a function to be determined according to each application. Similarly for $N_{vector\text{-}norm}(N_c(x,y))$.

Depending on the adopted neutrosophic vector norm, after applying each neutrosophic operator the result is neutrosophically normalized. We'd like to mention that "**neutrosophically normalizing**" doesn't mean that the sum of the resulting crisp components should be 1 as in fuzzy logic/set or intuitionistic fuzzy logic/set, but the sum of the components should be as above: either equal to the product of neutrosophic vector norms of the initial propositions/sets, or equal to the neutrosophic average of the initial propositions/sets vector norms, etc.

In conclusion, we neutrosophically normalize the resulting crisp components T`,I`,F` by multiplying each neutrosophic component T`, I` ,F` with S/(T`+I`+F`), where $S = N_{vector\text{-}norm}(N_n(x,y))$ for a N-norm or $S = N_{vector\text{-}norm}(N_c(x,y))$ for a N-conorm - as defined above.

c) If T, I, F are subsets of [0, 1] the problem of neutrosophic normalization is more difficult.

i) If sup(T)+sup(I)+sup(F) < 1, we have an *intuitionistic proposition/set*.

ii) If inf(T)+inf(I)+inf(F) > 1, we have a *paraconsistent proposition/set*.

iii) If there exist the crisp numbers $t \in T$, $i \in I$, and $f \in F$ such that t+i+f =1, then we can say that we have a *plausible normalized proposition/set*.

But in many such cases, besides the normalized particular case showed herein, we also have crisp numbers, say $t_1 \in T$, $i_1 \in I$, and $f_1 \in F$ such that $t_1+i_1+f_1 < 1$ (incomplete information) and $t_2 \in T$, $i_2 \in I$, and $f_2 \in F$ such that $t_2+i_2+f_2 > 1$ (paraconsistent information).

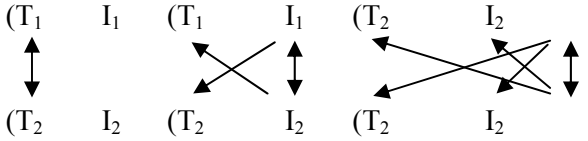
4. EXAMPLES OF NEUTROSOPHIC OPERATORS WHICH ARE N-NORMS OR N-PSEUDONORMS OR, RESPECTIVELY N-CONORMS OR N-PSEUDONORMS

We define a binary **neutrosophic conjunction (intersection)** operator, which is a particular case of a N-norm (neutrosophic norm, a generalization of the fuzzy T-norm):

$$c_N^{TIF} : ([0,1]\times[0,1]\times[0,1])^2 \to [0,1]\times[0,1]\times[0,1] \quad (11)$$

$$c_N^{TIF}(x,y) = (T_1T_2, I_1I_2 + I_1T_2 + T_1I_2, F_1F_2 + F_1I_2 + F_1T_2 + F_2T_1 + F_2I_1) \quad (12)$$

The neutrosophic conjunction (intersection) operator $x \wedge_N y$ component truth, indeterminacy, and falsehood values result from the multiplication $(T_1 + I_1 + F_1)\cdot(T_2 + I_2 + F_2)$ since we consider in a prudent way T p I p F, where "p " is a **neutrosophic relationship** and means "weaker", i.e. the products T_iI_j will go to I, T_iF_j will go to F, and I_iF_j will go to F for all i, j $\in \{1,2\}$, $i \neq j$, while of course the product T_1T_2 will go to T, I_1I_2 will go to I, and F_1F_2 will go to F (or reciprocally we can say that F prevails in front of I which prevails in front of T, and this neutrosophic relationship is transitive):



So, the truth value is T_1T_2, the indeterminacy value is $I_1I_2 + I_1T_2 + T_1I_2$ and the false value is $F_1F_2 + F_1I_2 + F_1T_2 + F_2T_1 + F_2I_1$. The norm of $x \breve{U}_N y$ is $(T_1 + I_1 + F_1)\times(T_2 + I_2 + F_2)$. Thus, if x and y are normalized, then $x \mathring{U}_N y$ is also normalized. Of course, the reader can redefine the neutrosophic conjunction operator, depending on application, in a different way, for example in a more optimistic way, i.e. I p T p F or $_T$ prevails with respect to I, then we get:

$$c_N^{TIF}(x,y) = (T_1T_2 + T_1I_2 + T_2I_1, I_1I_2, F_1F_2 + F_1I_2 + F_1T_2 + F_2T_1 + F_2I_1) \quad (13)$$

Or, the reader can consider the order T p F p I, etc.

Let's also define the unary **neutrosophic negation** operator:

$$n_N : [0,1]\times[0,1]\times[0,1] \to [0,1]\times[0,1]\times[0,1]$$
$$n_N(T,I,F) = (F,I,T) \quad (14)$$

by interchanging the truth T and falsehood F vector components.

Similarly, we now define a binary **neutrosophic disjunction (or union)** operator, where we consider the neutrosophic relationship F p I p T:

$$d_N^{FIT} : ([0,1]\times[0,1]\times[0,1])^2 \to [0,1]\times[0,1]\times[0,1] \quad (15)$$

$$d_N^{FIT}(x,y) = (T_1T_2 + T_1I_2 + T_2I_1 + T_1F_2 + T_2F_1, I_1F_2 + I_2F_1 + I_1I_2, F_1F_2) \quad (16)$$

We consider as neutrosophic norm of the neutrosophic variable x, where $NL(x) = T_1 + I_1 + F_1$, the sum of its components: $T_1 + I_1 + F_1$, which in many cases is 1, but can also be positive <1 or >1.

Or, the reader can consider the order F p T p I, in a pessimistic way, i.e. focusing on indeterminacy I which prevails in front of the truth T, or other **neutrosophic order** of the neutrosophic components T, I, F depending on the application.

Therefore,

$$d_N^{FIT}(x,y) = (T_1T_2 + T_1F_2 + T_2F_1, I_1F_2 + I_2F_1 + I_1I_2 + T_2I_1, F_1F_2) \quad (17)$$

4.1. NEUTROPHIC COMPOSITION k-LAW

Now, we define a more general neutrosophic composition law, named k-law, in order to be able to define neutrosophic k-conjunction/intersection and neutrosophic k-disjunction/union for k variables, where k ≥ 2 is an integer.

Let's consider k ≥ 2 neutrosophic variables, $x_i(T_i, I_i, F_i)$, for all $i \in \{1,2,\ldots k\}$. Let's denote

$$T = (T_1,...,T_k)$$
$$I = (I_1,...,I_k)$$
$$F = (F_1,...,F_k)$$

We now define a neutrosophic composition law o_N in the following way:

$$o_N : \{T,I,F\} \to [0,1] \quad (18)$$

If $z \in \{T,I,F\}$ then $z_{o_N} z = \prod_{i=1}^{k} z_i$

If z, $w \in \{T,I,F\}$ then

$$z_{o_N} w = \sum_{\substack{r=1 \\ \{i_1,...,i_r,j_{r+1},...,j_k\} \\ (i_1,...,i_r)\in C^r(1,2,...,k) \\ (j_{r+1},...,j_k)\in C^{k-r}(1,2,...,k)}}^{k-1} z_{i_1}\ldots z_{i_r} w_{j_r+1}\ldots w_{j_k} \quad (19)$$

where $C^r(1,2,...,k)$ means the set of combinations of the elements $\{1,2,...,k\}$ taken by r. [Similarly for $C^{k-r}(1,2,...,k)$.]

In other words, $z_{o_N} w$ is the sum of all possible products of the components of vectors z and w, such that each product has at least a z_i factor and at least a w_j factor, and each product has exactly k factors where each factor is a different vector component of z or of w. Similarly if we multiply three vectors:

$$T_{o_N} I_{o_N} F = \sum_{\substack{u,v,k-u-v=1 \\ \{i_1,...,i_u,j_{u+1},...,j_{u+v},l_{u+v+1},...,l_k\}\equiv\{1,2,...,k\} \\ (i_1,...,i_u)\in C^u(1,2,...,k),(j_{u+1},...,j_{u+v})\in \\ C^v(1,2,...,k),(l_{u+v+1},...,l_k)\in C^{k-u-v}(1,2,...,k)}}^{k-2} T_{i_1...i_u} I_{j_{u+1}...j_{u+v}} F_{l_{u+v+1}} \quad (20)$$

Let's see an example for $k = 3$.

x_1 (T_1, I_1, F_1)

x_2 (T_2, I_2, F_2)

$x_3\ (T_3, I_3, F_3)$

$T_{o_N} T = T_1T_2T_3, I_{o_N} I = I_1I_2I_3, F_{o_N} F = F_1F_2F_3$

$T_{o_N} I = T_1I_2I_3 + I_1T_2I_3 + I_1I_2T_3 + T_1T_2I_3 +$

$+ T_1I_2T_3 + I_1T_2T_3,$

$T_{o_N} F = T_1F_2F_3 + F_1T_2F_3 +$

$+ F_1F_2T_3 + T_1T_2F_3 + T_1F_2T_3 + F_1T_2T_3$

$I_{o_N} F = I_1F_2F_3 + F_1I_2F_3 + F_1F_2I_3 + I_1I_2F_3 +$

$+ I_1F_2I_3 + F_1I_2I_3,$

$T_{o_N} I_{o_N} F = T_1I_2F_3 +$

$+ T_1F_2I_3 + I_1T_2F_3 + I_1F_2T_3 + F_1I_2T_3 + F_1T_2I_3$

For the case when indeterminacy I is not decomposed in subcomponents {as for example $I = P \cup U$ where P = paradox (true and false simultaneously) and U = uncertainty (true or false, not sure which one)}, the previous formulas can be easily written using only three components as:

$$T_{o_N} I_{o_N} F = \sum_{i,j,r \in P(1,2,3)} T_i I_j F_r \qquad (21)$$

where $\mathcal{P}(1,2,3)$ means the set of permutations of $(1,2,3)$ i.e. {(1,2,3), (1,3,2), (2,1,3), (2,3,1), (3,1,2), (3,2,1)}.

$$z_{o_N} w = \sum_{\substack{i=1 \\ (i,j,r) \equiv (1,2,3) \\ (j,r) \in P^2(1,2,3)}}^{3} z_i w_j w_{j_r} + w_i z_j w_{j_r} \qquad (22)$$

This neurotrophic law is associative and commutative.

4.2. NEUTROPHIC LOGIC AND SET k-OPERATORS

Let's consider the neutrophic logic crispy values of variables x, y, z (so, for k = 3):

$NL(x) = (T_1, I_1, F_1)$ with $0 \le T_1, I_1, F_1 \le 1$

$NL(y) = (T_2, I_2, F_2)$ with $0 \le T_2, I_2, F_2 \le 1$

$NL(z) = (T_3, I_3, F_3)$ with $0 \le T_3, I_3, F_3 \le 1$

In neutrosophic logic it is not necessary to have the sum of components equals to 1, as in intuitionist fuzzy logic, i.e. $T_k + I_k + F_k$ is not necessary 1, for $1 \le k \le 3$.

As a particular case, we define the tri-nary conjunction neutrosophic operator:

$c_{3N}^{TIF} : ([0,1] \times [0,1] \times [0,1])^3 \to$

$[0,1] \times [0,1] \times [0,1]$

$c_{3N}^{TIF}(x, y, z) = (T_{o_N} T, I_{o_N} I + I_{o_N} T,$

$F_{o_N} F + F_{o_N} I + F_{o_N} T)$

If all x, y, z are normalized, then $c_{3N}^{TIF}(x, y, z)$ is also normalized.

If x, y, or y are non-normalized, then $\left| c_{3N}^{TIF}(x, y, z) \right| = |x| \times |y| \times |z|$, where |w| means norm of w.

c_{3N}^{TIF} is a 3-N-norm (neutrosophic norm, i.e. generalization of the fuzzy T-norm).

Again, as a particular case, we define the unary negation neutrosophic operator:

n_N:[0,1]x[0,1]x[0,1] → [0,1]x[0,1]x[0,1]

$n_N(x) = n_N(T_1, I_1, F_1) = (F_1, I_1, T_1)$

Let's consider the vectors:

$$T = \begin{pmatrix} T_1 \\ T_2 \\ T_3 \end{pmatrix}, I = \begin{pmatrix} I_1 \\ I_2 \\ I_3 \end{pmatrix} \text{ and } F = \begin{pmatrix} F_1 \\ F_2 \\ F_3 \end{pmatrix}$$

We note

$$T_{\bar{x}} = \begin{pmatrix} F_1 \\ T_2 \\ T_3 \end{pmatrix}, T_{\bar{y}} = \begin{pmatrix} T_1 \\ F_2 \\ T_3 \end{pmatrix}, T_{\bar{z}} = \begin{pmatrix} T_1 \\ T_2 \\ F_3 \end{pmatrix}, T_{\overline{xy}} = \begin{pmatrix} F_1 \\ F_2 \\ T_3 \end{pmatrix}$$

etc. and similarly

$$F_{\bar{x}} = \begin{pmatrix} T_1 \\ F_2 \\ F_3 \end{pmatrix}, F_{\bar{y}} = \begin{pmatrix} F_1 \\ T_2 \\ F_3 \end{pmatrix}, F_{\overline{xy}} = \begin{pmatrix} T_1 \\ F_2 \\ T_3 \end{pmatrix} \text{ etc.}$$

For shorter and easier notations let's denote $z_{o_N} w = zw$ and respectively $z_{o_N} w_{o_N} v = zwv$ for the vector neutrosophic law defined previously.

Then the neutrosophic trinary conjunction/ intersection of neutrosophic variables x, y, and z is:

$c_{3N}^{TIF}(x, y, z) = (TT, II + IT, FF + FI + FT + FIT) =$

$= (T_1T_2T_3, I_1I_2I_3 + I_1I_2T_3 + T_1I_2I_3 + I_1T_2T_3 + T_1I_2T_3 +$

$+ T_1T_2I_3, F_1F_2F_3 + F_1F_2I_3 + F_1I_2F_3 + I_1F_2F_3 + F_1I_2I_3 +$

$+ I_1F_2I_3 + I_1I_2F_3 + F_1F_2T_3 + F_1T_2F_3 + T_1F_2F_3 +$

$+ F_1T_2T_3 + T_1F_2T_3 + T_1T_2F_3 + T_1I_2F_3 + T_1F_2I_3 +$

$+ I_1F_2T_3 + I_1T_2F_3 + F_1I_2T_3 + F_1T_2F_3)$

Similarly, the neutrosophic tri-nary disjunction/union of neutrosophic variables x, y, and z is:

$d_{3N}^{TIF}(x,y,z) = (TT+TI+TF+TIF,\ II+IF,\ FF) =$
$= (T_1T_2T_3 + T_1T_2I_3 + T_1I_2T_3 + I_1T_2T_3 + T_1I_2I_3 +$
$+ I_1T_2I_3 + I_1I_2T_3 + T_1T_2F_3 + T_1F_2T_3 + F_1T_2T_3 +$
$+ T_1F_2F_3 + F_1T_2F_3 + F_1F_2T_3 + T_1I_2F_3 + T_1F_2I_3 +$
$+ I_1F_2T_3 + I_1T_2F_3 + F_1I_2T_3 + F_1T_2I_3, I_1I_2I_3 + I_1I_2F_3 +$
$+ I_1F_2I_3 + F_1I_2I_3 + I_1F_2F_3 + F_1I_2F_3 + F_1F_2I_3 +$
$+ F_1F_2F_3)$

Surely, other neutrosophic orders can be used for tri-nary conjunctions/intersections and respectively for tri-nary disjunctions/unions among the componenets T, I, F.

5. NEUTROSOPHIC TOPOLOGIES

A) General Definition of NT:

Let M be a non-empty set.

Let $x(T_A, I_A, F_A) \in A$ with $x(T_B, I_B, F_B) \in B$ be in the neutrosophic set/logic M, where A and B are subsets of M. Then (see Section 2.9.1 about N-norms / N-conorms and examples):

$A \cup B = \{x \in M, x(T_A \vee T_B, I_A \wedge I_B, F_A \wedge F_B)\}$,

$A \cap B = \{x \in M, x(T_A \wedge T_B, I_A \vee I_B, F_A \vee F_B)\}$,

$C(A) = \{x \in M, x(F_A, I_A, T_A)\}$.

A General Neutrosophic Topology on the non-empty set M is a family η of Neutrosophic Sets in M satisfying the following axioms:

- $\mathbf{0}(0,0,1)$ and $\mathbf{1}(1,0,0) \in \eta$;
- If $A, B \in \eta$, then $A \cap B \in \eta$;
- If the family $\{A_k, k \in K\} \subset \eta$, then $\bigcup_{k \in K} A_k \in \eta$.

B) An alternative version of NT

We cal also construct a Neutrosophic Topology on NT = $]^-0, 1^+[$, considering the associated family of standard or non-standard subsets included in NT, and the empty set $\emptyset$, called open sets, which is closed under set union and finite intersection.

Let A, B be two such subsets. The union is defined as:

$A \cup B = A+B-A \cdot B$, and the intersection as: $A \cap B = A \cdot B$. The complement of A, $C(A) = \{1^+\}-A$, which is a closed set. {When a non-standard number occurs at an extremity of an internal, one can write "]" instead of "(" and "[" instead of ")"}. The interval NT, endowed with this topology, forms a *neutrosophic topological space*.

In this example we have used the Algebraic Product N-norm/N-conorm. But other Neutrosophic Topologies can be defined by using various N-norm/N-conorm operators.

In the above defined topologies, if all x's are paraconsistent or respectively intuitionistic, then one has a Neutrosophic Paraconsistent Topology, respectively Neutrosophic Intuitionistic Topology.

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PILOT-IN-THE-LOOP PROBLEM AND ITS SOLUTION

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Abstract: *Main purpose of the author is to summarize theoretical backgrounds dealing with mathematical modeling of the human pilot behavior, and to give some approximated models applying Padé approximation method. Importance of this paper is in derivation and application of higher order Padé approximants to model human pilot behavior. This new approach allows to model pilot behavior more precisely than before with applying its first order approximants. The lower and higher model approximants will be analyzed both in time and in frequency domain. The paper deals with derivation of the critical parameters of the human pilot destabilizing the closed loop automatic flight control systems. A new MATLAB® embedded code is generated to analyze the pilot mathematical models, and for both open and closed loop automatic flight control system's analysis.*

Keywords: *human pilot behavior, time delay, critical parameters.*

1. INTRODUCTION & LITERATURE OVERVIEW

Early pioneers of mathematical modeling of the pilots' behavior were McRuer and Krendel. This NATO-report deals with mathematical modeling of human pilots, with analysis of the pilot's behavior in SISO[1] and MIMO[2] automatic flight control systems. In [1] mathematical model of the human pilots depends also on the signals feature to be followed by the pilot. Authors introduced term of the so-called *paper pilot*, which means creation of mathematical model of the pilot as the control element of the automatic flight control systems and widely applied in flight control systems' analysis and preliminary design [1]. Mathematical handbook of G. A. Korn and T. M. Korn is cited as main source for mathematical backgrounds of the problems of approximating time delay [2]. In [3] D. McLean deals with conventional and modern mathematical modeling of the human pilot behavior making difference between aircraft and helicopter pilots. In this textbook time delay of human pilot is approximated using first order Padé approximation, which is in many case may be unsatisfactory and time delay may be approximated by higher order of Padé-approximants. In [4] R. C. Dorf and R. H. Bishop derived mathematical model of the human operator, which has more extended applicability. In that means human operator models can be applied for any kind of drivers (e.g. car, motorcycle, ship, train, ground and air robots etc. drivers and operators). Obviously, the only common thing these models are coinciding is the structure of the mathematical models, while its parameters are quiet different.

Author leans on his scientific papers [5,6,7,8] published before, which are dealing with conventional and modern mathematical methods applied to model human pilot behavior [5], with derivation critical parameters of the human pilot acting in the closed loop automatic flight control system [6, 8], and, with derivation of the complex set of critical parameters of the human pilot in the

[1] Single Input – Single Output
[2] Multi Input – Multi Output

aircraft lateral motion automatic flight control systems [7]

2. PADÉ APPROXIMATION OF THE TIME DELAY

Let us consider the system given in Figure 1 [5,6,7,8]. The transfer function $G(s)$ represents the dynamical system consisting of pure time delay of τ, and transfer function of $G_0(s)$, which is strictly proper and stable. The problem of approximation of the time delay can be formulated as follows: approximate original transfer function of $G(s) = e^{-s\tau}G_0(s)$ by transfer function of $\hat{G}(s) = P_d(s)G_0(s)$, where $P_d(s) = N_d(s)/D_d(s)$ is a rational approximation of time delay of τ. In other words, we want to find $P_d(s)$ so that the closed loop behavior of $\hat{G}(s)$ matches input-output behavior of the original system, of $G(s)$.

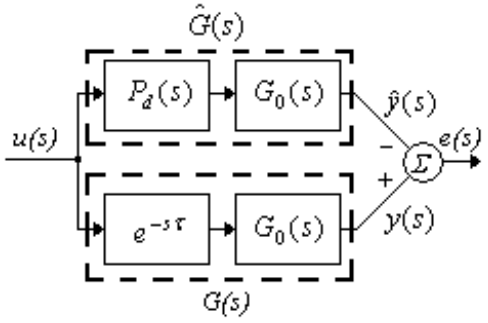

Fig. 1 Block Diagram of the Model Matching Error Problem Formulation

To measure the mismatch we will apply the same input $u(s)$ to both transfer functions of $G(s)$, and $\hat{G}(s)$. By comparing output signals of $y(s)$ and $\hat{y}(s)$ one can derive how $\hat{G}(s)$ approximates $G(s)$, or, how $P_d(s)$ approximates time delay of $e^{-s\tau}$. In control theory, this problem formulated as *model-matching problem.*

The so-called model-matching error (MME) can be given using following equation:

$$\mathrm{MME} \triangleq \sup_{u\neq 0} \frac{\| y - \hat{y} \|_2}{\| u \|_2} \tag{1}$$

In eq (1) $\| y - \hat{y} \|_2$ denotes the energy of the output error $e = y - \hat{y}$ due to an input signal energy of $\| u \|_2$. The largest possible ratio of the output error energy over the input energy is defined to be *model-matching error*. It is well-known from control theory that model matching error can be found using following formula:

$$\mathrm{MME} \equiv \mathrm{MME}_{H_\infty} \equiv \mathrm{MME}_{L_\infty} \tag{2}$$

where

$$\mathrm{MME}_{H_\infty} = \left\| G - \hat{G} \right\|_{H_\infty} \tag{3}$$

$$\begin{aligned} \mathrm{MME}_{L_\infty} &= \sup_{\omega} \left| G(j\omega) - \hat{G}(j\omega) \right| = \\ &= \sup_{\omega} \left\| G_0(j\omega) \right| \cdot \left| e^{-j\omega\tau} - P_d(j\omega) \right\| \end{aligned} \tag{4}$$

It is obvious, that if MME_{L_∞} is small, than difference between the Nyquist plots of the transfer functions of $G(s)$ and $\hat{G}(s)$ is small. This observation is valid if and only if $G_0(s)$ is stable. Therefore, for the given transfer function of $G_0(s)$ we want to find a rational approximation of $P_d(s)$ for time delay derived by $e^{-s\tau}$ so that the approximation error, or in other words, the model-matching error MME_{L_∞} is smaller than a pre-defined tolerance, say $\delta > 0$.

For further discussion for Padé approximation we will use the following formula [5,6]:

$$e^{-s\tau} \cong P_d(s) = \frac{N_d(s)}{D_d(s)} = \frac{\sum_{k=0}^{n} (-1)^k c_k \tau^k s^k}{\sum_{k=0}^{n} c_k \tau^k s^k} \tag{5}$$

where coefficients of eq (5) are defined as follows:

$$c_k = \frac{(2n-k)! \cdot n!}{2n! \cdot k! \cdot (n-k)!} \tag{6}$$

$$n = 1, 2, 3, 4, \cdots; \quad k = 0, 1, 2, 3, \cdots, n$$

Coefficients of the Padé-approximant for $n \le 10$ can be found in Appendix 1.

3. MATHEMATICAL MODELS OF THE HUMAN PILOT BEHAVIOR

The simplest mathematical model of the human operator – supposing single reference signal tracking activity – can be derived using Fig. 2 [3,4,5]:

$$Y_p(s) = \frac{x_{out}(s)}{x_{in}(s)} = K_p e^{-s\tau} \qquad (7)$$

where x_{in} is the input signal to be tracked by the pilot, x_{out} is response signal from the pilot, K_p is pilot gain, and finally, τ is time delay of the pilot.

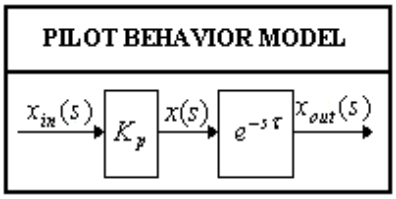

Fig. 2 Mathematical Model of the Pilot Behavior

From eq (7) it is easily can be seen that the human operator behaves as proportional (P) term with pure time delay (TD) [5,6,7,8]. For simplicity let us denote eq (7) for *P-TD*-model. More complicated mathematical model of the human operator – including ability of the pilot to predict events and signals – can be derived using Fig. 3:

$$Y_p(s) = \frac{x_{out}(s)}{x_{in}(s)} = K_p(1+sT_p)e^{-s\tau} \qquad (8)$$

where T_p is the prediction time constant.

From eq (8) it is easily can be derived that the human operator behaves as a proportional-differential (PD) term with pure time delay (TD) [5,6,7,8]. For simplicity let us denote mathematical model of eq (8) as *PD-TD*-model.

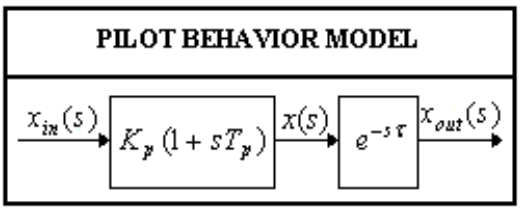

Fig. 3 Mathematical Model of the Pilot Behavior

For further analysis let us consider dynamic model of the muscular acting system of the human operator. Block diagram of the human operator in this particular case can be seen in Fig. 4.

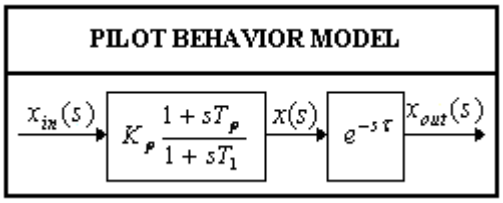

Fig. 4 Mathematical Model of the Human Pilot Behavior

Using Fig. 4 transfer function of the pilot can be derived as it given below:

$$Y_p(s) = \frac{x_{out}(s)}{x_{in}(s)} = K_p \frac{1+sT_p}{1+sT_1} e^{-s\tau} \qquad (9)$$

where T_1 is time constant of the muscular system of the pilot. From eq (9) it easily can be derived that mathematical model of the human operator is proportional-differential (*PD*) first order (1O) term having pure time delay (*TD*) [5,6,7,8]. For further discussions let us denote eq (9) as *PD-1O-TD*-model.

Using Fig. 4 following equation can be derived:

$$\begin{aligned} Y_p(s) &= \frac{x_{out}(s)}{x_{in}(s)} = \frac{x(s)}{x_{in}(s)}\frac{x_{out}(s)}{x(s)} \\ &= K_p \frac{1+sT_p}{1+sT_1} e^{-s\tau} \end{aligned} \qquad (10)$$

Using eq (10) the following formula can be derived:

$$x(s) = K_p \frac{1+sT_p}{1+sT_1} x_{in}(s) \qquad (11)$$

Input signal $x(t)$ of time delay term of τ can be found using following formula:

$$\dot{x} = -\frac{1}{x} + \frac{K_p}{T_1} x_{in} + \frac{K_p T_p}{T_1} \dot{x}_{in} \qquad (12)$$

For approximation of time delay of τ in eqs (9)-(12) we will use first order Padé approximants.

One can write that

$$Y_p(s)=\frac{x_{out}(s)}{x_{in}(s)}=K_p\frac{1+sT_p}{1+sT_1}e^{-s\tau}\cong K_p\frac{1+sT_p}{1+sT_1}\frac{1-\tau/2}{1+\tau/2} \quad (13)$$

Modern mathematical representation of the human operator can be given using its state space representation [5,6,7,8]. During derivation of this dynamical model let us choose the state variables as they are given below:

$$x_1=x_{out}+x \quad (14)$$

$$x_2=x \quad (15)$$

Using eqs (9)-(15) the state and output equations of the human pilot defined on Fig. 3 can be found as follows [5,6,7,8]:

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}+\begin{bmatrix}0\\ -\frac{K_pT_p}{T_1}\end{bmatrix}\dot{x}_{in}=\begin{bmatrix}-\frac{2}{\tau} & \frac{4}{\tau}\\ 0 & -\frac{1}{T_1}\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ \frac{K_p}{T_p}\end{bmatrix}x_{in} \quad (16)$$

$$x_{out}=\begin{bmatrix}1 & -1\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} \quad (17)$$

Finally, if to consider neuro-muscular sensing, processing and, actuating system of the human pilot following block diagram can be given [1]:

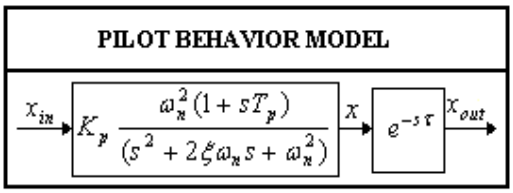

Fig. 5 Mathematical Model of the Human Pilot Behavior

Using Fig. 5 following transfer function of the human pilot can be derived [1,5]:

$$Y_p(s)=\frac{x_{out}(s)}{x_{in}(s)}=\frac{x_{out}(s)}{x(s)}\frac{x(s)}{x_{in}(s)}=K_p\frac{\omega_n^2(1+sT_p)}{(s^2+2\xi\omega_n s+\omega_n^2)}e^{-s\tau} \quad (18)$$

In eq (18) second order term of

$$\frac{\omega_n^2}{(s^2+2\xi\omega_n s+\omega_n^2)} \quad (19)$$

defines mathematical model of the neuromuscular system of the human pilot [1]. It is easy to derive that the second order proportional-differential term of eq (18)

$$Y=\frac{x(s)}{x_{in}(s)}=K_p\frac{\omega_n^2(1+sT_p)}{(s^2+2\xi\omega_n s+\omega_n^2)} \quad (20)$$

may be rewritten in the following state space model:

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -\omega_n^2 & -2\xi\omega_n\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}x_{in} \quad (21)$$

$$x=\omega_n^2K_p\begin{bmatrix}1 & T_p\end{bmatrix}\begin{bmatrix}x_1\\ x_2\end{bmatrix} \quad (22)$$

From equation (18) it easily can be derived that mathematical model of the human pilot is proportional-differential (*PD*) second order (*2O*) term having time delay (*TD*) [5,6,7,8].

For further discussions let us denote eq (18) as *PD-2O-TD*-model.

Let us introduce the following state variable

$$x_3=x_{out}+x \quad (23)$$

Time delay τ in eq (18) can de approximated using first order Padé approximants, i.e.:

$$e^{-s\tau}\cong-\frac{s-2/\tau}{s+2/\tau} \quad (24)$$

Let us substitute eq (24) into eq (18), and convert this mathematical model into the time domain.

After simple mathematical manipulations one can get following state and output equations [1,8, , 0]:

$$\dot{\mathbf{x}}=\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\\ \dot{x}_3\end{bmatrix}=\begin{bmatrix}0 & 1 & 0\\ -\omega_n^2 & -2\xi\omega_n & 0\\ \left(\frac{4}{\tau}K_p\omega_n^2\right) & \left(\frac{4}{\tau}K_pT_p\omega_n^2\right) & \left(-\frac{2}{\tau}\right)\end{bmatrix}\cdot\begin{bmatrix}x_1\\ x_2\\ x_3\end{bmatrix}+\begin{bmatrix}0\\ 1\\ 0\end{bmatrix}x_{in} \quad (25)$$

$$x_{out} = \begin{bmatrix} -\omega_n^2 K_p & -\omega_n^2 K_p T_p & 1 \end{bmatrix} \begin{bmatrix} x_1 & x_2 & x_3 \end{bmatrix}^T \quad (26)$$

4. TIME DOMAIN ANALYSIS OF THE HUMAN PILOT BEHAVIOR

One of the most important kind of the human pilot activity is the reference signal tracking. Many flight tasks (e.g. semi-automated landing, refueling, air-to-air combat, air-to-ground weapon delivery, terrain following, formation flight, aerobatic close formation flight etc.) are in close relationship with this kind of actuating.

There can be defined some typical input signals to be followed by the pilots, such as step signal, ramp signal, and much other kind of pure or transformed periodical signals (e.g. saw tooth, square signals etc.). In this paper author chose for the time domain analysis the step input function, the ramp input signal, and finally, the square signal [3,4,5].

It is well-known form the previous sections that there are several possible mathematical model of the human pilot to be used during computer simulation. In this paper we will apply dynamical mathematical model of *PD-1O-TD* defined by eq (9), which is represented in Fig. 4. For the computer-aided simulation let us use the following parameters of the mathematical model defined by eq (9):

$$K_p = 10;\ T_p = 1s;\ T_1 = 0{,}4s;\ \tau = 0{,}5s \quad (27)$$

During computer simulation from the possible set of order of approximation there were chosen the 1st, the 4th, and, the 7th order of approximations. Fig. 6 shows step responses of the human pilot having approximated mathematical model of the time delay. The input signal of the human pilot to be followed by him is $x_{in}(t) = 1(t)$ [9,10].

From Figure 6 it is obvious that increase of order of approximation result in larger amplitudes of the output signal. However, in the time delay zone, increase of the order of the approximation results in oscillations with higher frequencies. It means that error of approximation decreases as its order increases.

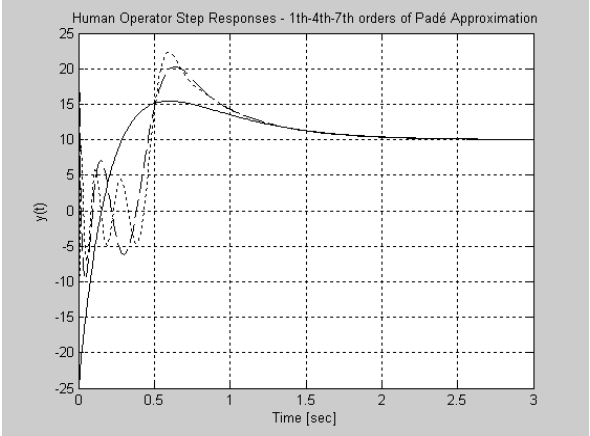

Fig. 6 Step Responses of the Human Operator '–' 1st '– –' 4th '….' 7th Order Approximation

Fig. 7 shows ramp responses of the human pilot mathematical model. The input signal of the human pilot to be followed by him now is $x_{in}(t) = t$.

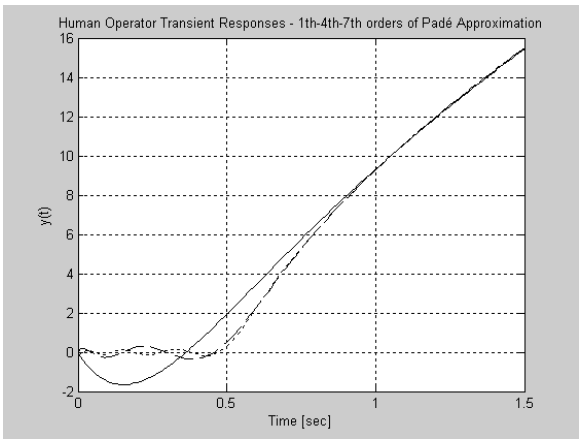

Fig. 7 Ramp Responses of the Human Operator '–' 1st '– –' 4th '….' 7th Order Approximation

From Fig. 7 it is easily can be seen and derived that increase of the order of approximation results in decrease of the error of the approximation: in the time delay zone magnitude of the output signal $x_{out}(t)$ decreases as order of the approximation is increases while output signal is going to be more and more oscillatory. Finally, let us analyze the human operator behavior when he is tracking the periodical signal. For this kind of analysis author chosen the square signal with frequency of $f = 0{,}3$ Hz, and period time of $T = 1/0{,}3\,\text{sec}$. Results of the computer simulation can be seen in Fig. 8.

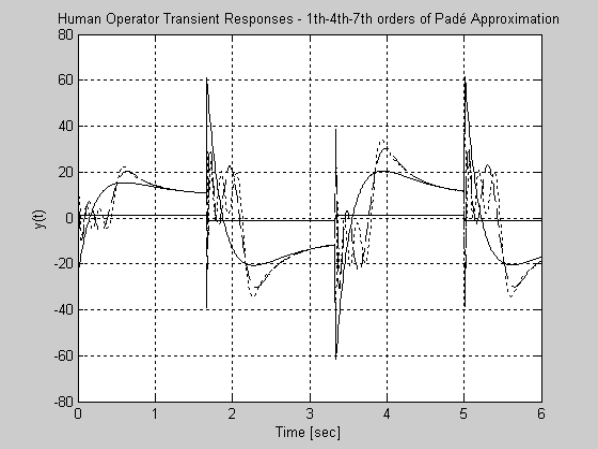

Fig. 8 Transient Responses of the Human Operator '–' 1st '– –' 4th '….' 7th Order Approximation

From Fig. 8 it is easily can be determined that increase of the order of approximation results in less amplitudes in output signal. In time domain of the delay the output signal becomes more oscillatory as order of approximations increases.

5. FREQUENCY DOMAIN ANALYSIS OF THE HUMAN PILOT BEHAVIOR

Typical input signal of the human pilot is the sinusoidal with variable frequencies. Figure 9 shows the response of the human pilot to the harmonic input signal of the sinusoidal with unity gain [9,10]. From Fig. 9 it is obvious that pilot gain for each order of approximation is very close to each other. The phase angle radically decreases as order of approximation is increases [9,10].

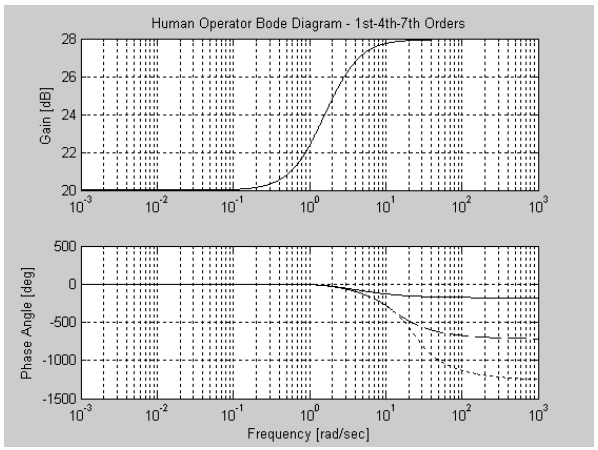

Fig. 9 Bode Diagrams of the Human Operator '–' 1st '– –' 4th '….' 7th Order Approximation

6. COMPARISON OF THE HUMAN PILOT'S BEHAVIOR IN THE TIME DOMAIN

In the practice a question *'what kind of the model of the pilot activity to use for the control system analysis and design?'* often may arise. From theory of automatic flight control systems it is evident that the *pilot-in-the-loop* problem can be characterized with the multi-loop feature, i.e. many flight parameters of such regimes as semi-automated landing of the aircraft airspeed, vertical speed, height of the flight, distance from runway threshold, glide path angle, angular deflection measured from runway centre line etc. must be controlled by the pilot.

From this argue follows that increase value of the flight parameters to be controlled results in decrease of the complexity of the pilot model to be applied during analysis and design of the automatic flight control systems [1,5,8,9,10].

Let us analyze behavior of the human pilot model for several form of its mathematical model supposing second order Padé-approximation for the given time delay. During computer simulation mathematical model defined by eqs (7), (8), (9) and (18). Results of the computer simulation can be seen in Figures 10, 11, and 12.

Fig. 12 represents step responses of the human pilot behavior, when input is step response function of $x_{in}(t) = 1(t)$.

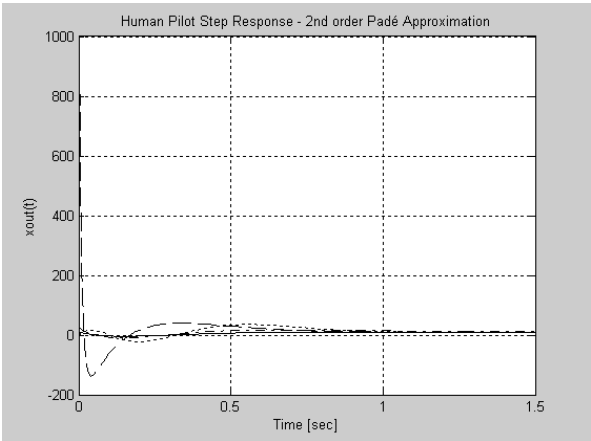

Fig. 10 Step Response of the Human Pilot '–' P-TD '– –' PD-TD '–.–.' PD-1O-TD '…' PD-2O-TD

Fig. 10 shows ramp responses of different pilot models having input of $x_{in}(t) = t$.

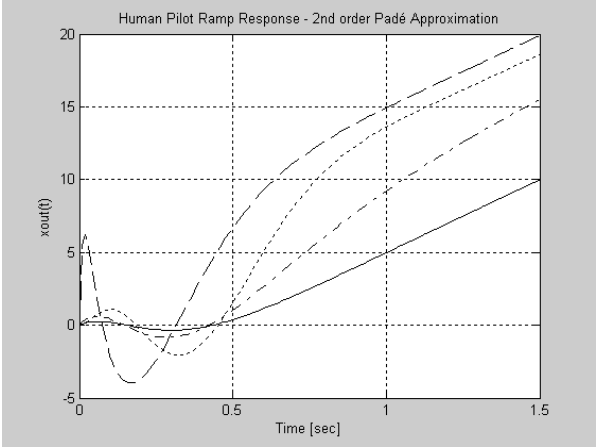

Fig. 11 Ramp Response of the Human Pilot '–' P-TD '– –' PD-TD ''–.–.' PD-1O-TD '…' PD-2O-TD

Fig. 11 shows transient responses of different human pilot mathematical models induced by square periodical signal with unity gain and frequency of 0,3 Hz.

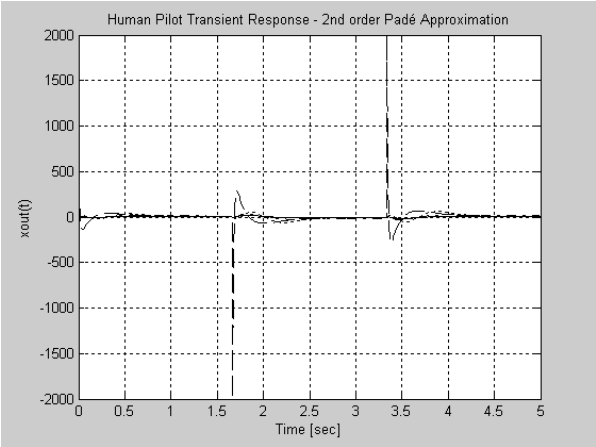

Fig. 12 Transient Response of the Human Pilot '–' P-TD '– –' PD-TD ''–.–.' PD-1O-TD '…' PD-2O-TD

Figures 10, 11, 12 clearly show that if to add *D*-term to the proportional (see eq (7)) it will result in more oscillatory system (see eq (8)) with large amplitudes (dashed line on the figures). Introducing fist order term to eq (8) will result in damped system reducing oscillatory feature (dash-dot line on the figures). Application of the second order term of eq (18) in comparison with system defined by eq (9) results in more oscillatory behavior (dotted line on the figures).

Using the method given above human pilot model behavior can be compared also for higher orders of the Padé-approximation.

7. DERIVATION OF THE CRITICAL PARAMETERS OF THE PILOT'S ACTIVITY

Knowledge of the human pilot behavior is very important from the flight safety aspects. It is difficult to model a human pilot having mathematical model considering all possible conditions. Even common mathematical models of the human pilot can be applied with great success. Purpose of the author is to show how to determine critical parameters of the human pilot? It is well known that there are many parameters of the pilot (e.g. gain, time delay, time constants, damping rations, natural frequencies etc.) which can be analyzed and also their critical value can be found.

Due to its importance author will deal only with determination of the critical time delay of the human operator yielding instability of the control loops of the automatic flight control systems. Results and proposals of this paper can be applied for extension of the analysis shown is this article. The general method recommended by the author is well known from control systems theory but the paper suggests the new field for its application.

Pilot is the most important element in the aircraft steering system. Even if aircraft has modern control system for maneuvering driven by digital computer pilot must has the right to take control over aircraft and steer it manually. Automation of the aircraft flight phases induced the need to design semi-automated automatic flight control systems, which suggest for the pilot what kind of actuation to carry out. For this purpose high level technology displays are used in the cockpit.

Semi-automated aircraft steering is very useful because pilot takes active part in actuation process and do not reduce his ability. During flight phases semi-automated steering can be applied: semi-automated landing, refueling, air-to-air combat, dog fight, air-to-

ground weapon delivery, terrain following, formation flight, aerobatic flight, close formation flight etc.

7.1. Derivation of the Critical Value of Human Pilot Time Delay

During semi-automatic, or manual control of the aircraft one of the problem to be solved by the pilot is reference signal tracking or, following commands suggested by the automatic flight control system, or other systems (e.g. navigation system, radar system, weapon system etc.). As it was said before commands are listed on the display: e.g. turn left, turn right, accelerate, decelerate, descend, climb, etc.

For example, in this paper the single loop automatic flight control system is analyzed. In this particular case pilot has to control only one flight parameter. Let us choose for analysis the roll angle control system. In this system the task of the pilot to track the reference signal of the roll angle $\gamma_R(t)$ indicated on the display.

Block diagram of the semi-automated roll angle control system can be seen in Fig. 13 [3,4,5,8,9,10].

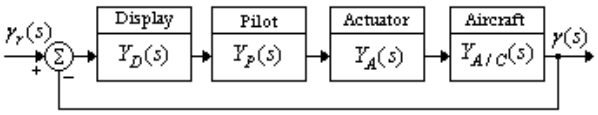

Fig. 13 Pilot-in-the Aircraft Roll Angle Control System

Flight parameters and data are indicated on the displays. It is supposed that display has no time delay and, any time constants. This condition is strongly satisfied for modern analogue and digital displays.

Transfer function of the display can be formulated as follows [3,5]:

$$Y_D(s) \cong 1. \tag{28}$$

Let us take into consideration for the modeling of pilot behavior mathematical model of the human operator. Regarding [5] transfer function, and model parameters are as follows:

$$Y_P = K_p(1+sT_p)\,e^{-\tau s} \cong K_p(1+sT_p)\frac{1-\tau/2\,s}{1+\tau/2\,s} \tag{29}$$

In eq (29) later we will consider following parameters [5,6,7,8]:

$$K_p = 10,\ T_p = 1\,\text{sec}. \tag{30}$$

From eq (29) it is evident that model of the aircraft applied in this section is proportional-differential (*PD*) one with time delay (*TD*), which is approximated with the first order Padé-approximation given in.

Ailerons of the aircraft are deflected using hydraulic actuator.

The simplified mathematical model of the actuator can be defined as it given below:

$$Y_A(s) = \frac{20}{20+s} = \frac{1}{1+0{,}05s} \cong 1 \tag{31}$$

Lateral motion dynamics of the aircraft is supposed to be the so-called single degree of freedom approximation derived by [3,5] and its transfer function is as follows:

$$Y_{A/C}(s) = \frac{\gamma(s)}{\delta_A(s)} = \frac{0{,}21}{s(s+0{,}9)} \tag{32}$$

where $\delta_A(s)$ is the angular deflection of the ailerons, or input of the aircraft, $\gamma(s)$ is roll angle, or in other words, response of the aircraft to its input signal.

From [1] it is evident that pilot model parameters depend upon complexity of the task to be solved by the pilot, and also upon physical and psychical ability of the pilot. Among these parameters time delay is the most important because its presence tends closed loop automatic flight control system to its stable working boundary [3,5,9,10]. Let us derive τ_{crit}, which leads closed loop automatic flight control system to its stable working conditions. For this purpose let find the closed loop automatic flight control system transfer function related to reference input signal of $\gamma_r(s)$.

The closed loop transfer function of the investigated system can be derived using Fig. 3, i.e.:

$$W(s)=\frac{\gamma(s)}{\gamma_R(s)}=\frac{Y_D(s)Y_P(s)Y_A(s)Y_{A/C}(s)}{1+Y_D(s)Y_P(s)Y_A(s)Y_{A/C}(s)}\cong\frac{Y_P(s)Y_{A/C}(s)}{1+Y_P(s)Y_{A/C}(s)} \quad (33)$$

Substituting data defined by eqs (28)-(32) into eq (33) yields to closed loop transfer function formula:

$$W(s)=\frac{0{,}21\cdot(10+10s)(1-\tau/2)}{(s^2+0{,}9s)(1+\tau/2)+0{,}21\cdot(10+10s)(1-\tau/2)} \quad (34)$$

In control theory there are many available methods for determination of the closed loop control system stability. Some of them are graphical, others are algebraic ones. These methods allow deriving stability conditions of the closed loop system. Other possible application of the algebraic stability criteria is finding critical parameter of the closed loop control system [3,4,5,9,10]. Using stability criteria formulated by Hurwitz closed loop control system is stable if and only if

1. all coefficients of the characteristic polynomial are positive ones, say $a_i>0$. This is the necessary stability condition;

2. algebraic minors on the main diagonal of the Hurwitz-determinant are positive, say $\Delta_i>0$. If there is a single determinant with negative value, the closed loop control system is unstable. If $\Delta_i=0$, the system in upon stable working boundary and this condition can be used for determination of the critical parameters of the control system. This is the sufficient condition of the closed loop stability.

Let us find the characteristic polynomial of the closed loop control system, which is the denominator of the transfer function of eq (6). It is supposed that the only variable parameter is the pilot time delay τ while all other parameters are supposed to be constant. One can easily write that:

$$K(s)=(s^2+9s)(1+\tau/2\,s)+0{,}21\cdot(10+10s)(1-\tau/2\,s)=0 \quad (35)$$

After some simple mathematical procedures we get the following third order characteristic polynomial, i.e.:

$$K(s)=\frac{\tau}{2}s^3+(1-0{,}6\tau)s^2+(3-1{,}05\tau)s+2{,}1=a_0s^3+a_1s^2+a_2s+a_3=0 \quad (36)$$

Applying necessary stability conditions using coefficients of eq (36) one can determine following stability inequalities:

$$a_0=\tau/2>0 \;\rightarrow\; >0\text{ s} \quad (37)$$

$$a_1=1-0{,}61\tau>0 \;\rightarrow\; \tau<1{,}6666\text{ s} \quad (38)$$

$$a_2=3-1{,}05\tau>0 \;\rightarrow\; \tau<2{,}8571\text{ s} \quad (39)$$

From eqs (37)-(39) it is obvious that for the stable working closed loop control system the human pilot time delay must lie in the following range:

$$0<\tau<1{,}6666\text{ s}. \quad (40)$$

For the next step let us find sufficient conditions of stability using Hurwitz-determinant.

The Hurwitz-determinant can be found using coefficients of the characteristic polynomial. One can write that:

$$\Delta_3=\begin{vmatrix}1-0{,}6\tau & 2{,}1 & 0\\ \tau/2 & 3-1{,}05\tau & 0\\ 0 & 1-0{,}6\tau & 2{,}1\end{vmatrix} \quad (41)$$

Using eq (41) the following algebraic minors leaning on main diagonal can be found. If we suppose that the system on the boundary of the stable working, following determinants can be derived [7]:

$$\Delta_i=0 \quad (42)$$

From eq (41) we can find the following stability conditions:

$$\Delta_1=1-0{,}6\tau=0 \;\rightarrow\; \tau_{crit}=1{,}6666\text{s} \quad (43)$$

$$\Delta_2=\begin{vmatrix}1-0{,}6\tau & 2{,}1\\ \tau/2 & 3-1{,}05\tau\end{vmatrix}=0 \quad (44)$$

$$0{,}63\tau^2-3{,}9\tau+3=0\rightarrow\begin{matrix}\tau_{1crit}=5{,}2904\text{ s}\\ \tau_{2crit}=0{,}9001\text{ s}\end{matrix} \quad (45)$$

$$\Delta_3=\begin{vmatrix}1-0{,}6\tau & 2{,}1 & 0\\ 0{,}5\tau & 3-1{,}05\tau & 0\\ 0 & 1-0{,}6\tau & 2{,}1\end{vmatrix}=2{,}1\cdot\Delta_2=0 \quad (46)$$

$$\Delta_2 = 0 \rightarrow \begin{matrix} \tau_{1crit} = 5{,}2904\,\mathrm{s} \\ \tau_{2crit} = 0{,}9001\,\mathrm{s} \end{matrix} \quad (47)$$

From eqs (42)-(47) critical parameter of the human pilot time delay destabilizing closed loop automatic flight control system can be easily derived to be:

$$\tau_{crit} = 0{,}9001\,\mathrm{sec} \quad (48)$$

Time delay domain defined from necessary stability conditions and given by eq (40) is limited with time delay defined for the sufficient stability conditions given by eq (48). Stability conditions for the closed loop automatic flight control system given in Figure 13 can be derived as follows:

$$0 < \tau < 0{,}9001 \text{ sec} \quad (49)$$

Let us calculate the step response of the closed loop automatic flight control system. In this particular case reference signal of the system to be followed by the human pilot is

$$\gamma_r(t) = 1(t) \quad (50)$$

Let the set of time delays considered during computer simulation be as follows:

$$\tau_{stab} = 0{,}3\mathrm{sec};\ \tau_{crit} = 0{,}9\,\mathrm{sec};\ \tau_{unstab} = 1\mathrm{sec} \quad (51)$$

Results of the computer simulation can be seen in Fig. 14.

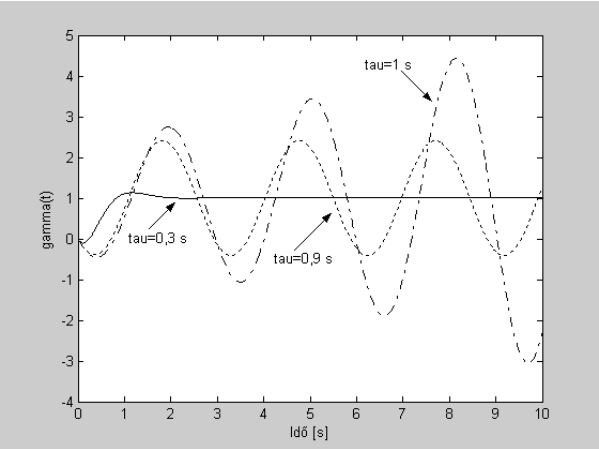

Fig. 14 Closed Loop Automatic Flight Control System Step Responses

Figure 14 shows that for small value of time delay, say $\tau_{stab} = 0{,}3\mathrm{sec}$, the closed loop step response is stable: the roll angle has bounded value. Transient response time is small. It means that pilot is able to track the reference signal with no static error and the closed loop control system is stable.

In case of critical time delay of $\tau_{crit} = 0{,}9\,\mathrm{sec}$ the closed loop system including human pilot has harmonic, periodical response with constant amplitudes. In other words, pilot unable to track the bounded reference signal.

Finally, having unstable time delay of $\tau_{unstab} = 1\,\mathrm{sec}$, closed loop automatic flight control system with the pilot inside has unstable response, which is harmonic signal with increasing amplitudes. It is evident that in this particular case pilot loosing the control over the aircraft and may generate the so called *pilot induced oscillation (PIO)* which can be dangerous for flight safety. In worst case situation *PIO* can lead to damage of the airframe and to fatal accident of the aircraft.

Dynamic performances of the closed loop automatic flight control system were found for three different values of the time delay defined by eq (51) and put into Appendix 2.

From the Appendix 2 it is evident that for $\tau_{stab} = 0{,}3\mathrm{sec}$ closed loop automatic flight control system is stable, and has eigen values of $\lambda_1 = -1{,}06$, and $\lambda_{2,3} = -2{,}2 \pm 2{,}89\mathrm{j}$ on the left side of the complex plane, which tells about stability.

For critical value of the time delay of $\tau_{crit} = 0{,}9\,\mathrm{sec}$ closed loop has a pair of complex roots of $\lambda_{2,3} = -1{,}32 \cdot 10^{-4} \pm 2{,}14\mathrm{j}$, which is practically lies on the imaginary axis of the complex plane. These roots generate harmonic response of the closed loop automatic flight control system.

In case of $\tau_{unstab} = 1\,\mathrm{sec}$ closed loop automatic flight control system has a pair of roots on the right side of the complex plane, say, $\lambda_{2,3} = 0{,}109 \pm 2{,}03\mathrm{j}$, which generates unstable response from the closed loop automatic flight control system.

8. CONCLUSIONS

Human operators are still one of the most important ‘part’ of the control systems. They may monitor the physical processes, or

actively actuate in the control systems. Since operator acts as simple term of the closed loop control system it is necessary to model his activity, and, to take into consideration. Modeling human pilots is important from many aspects of aircraft maintenance both in the air and on the ground. His mathematical model depends upon complexity of the system in which he acts, upon the level of his training, upon his physical and psychical conditions, and finally, depends on signals' characteristics to be followed.

The paper dealt with determination of the human pilot's critical parameters. Author introduced widely applied mathematical models of the human operator. Paper showed a new field of application of the classical Hurwitz stability criteria. A new example was presented how it can be used for purposes of derivation of critical parameters of the pilot.

Note and underline that for complex analysis of critical parameters of the human operator (e.g. gain K_p, and prediction time constant T_p) also must be determined. Conditions and requirements for stability of the closed loop automatic flight control system must be satisfied for all possible parameters of the human operator for all possible aircraft dynamics, i.e. for all possible flight conditions and regimes.

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STOCHASTIC NOISES AFFECTING DYNAMIC PERFORMANCES OF THE AUTOMATIC FLIGHT CONTROL SYSTEM

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***Abstract**: External and internal disturbances affect dynamic performances of the automatic flight control systems and can lead to unwanted changes in accuracy of the closed loop control system. In worst case situation, i.e. in extreme meteorological circumstances they can lead to loose stability. The purpose of the authors is to summarize the basic features and equations of atmospheric disturbances. The paper deals with generating stochastic signals with pre-defined statistical parameters regarding different weather conditions. Main equations and transfer functions of the linear filters will be derived and given in the paper. Filter parameters will be chosen with consideration of the weather conditions given in military specifications of MIL–F–8785C, and MIL-STD-1797A. Generating of the stochastic signals with given statistical parameters, and the computer-aided simulation is supported by MATLAB® supplemented with necessary toolboxes.*

***Keywords**: human pilot behavior, time delay, critical parameters.*

1. INTRODUCTION

The early mathematical models of the turbulent air were deterministic ones, and they made it possible to generate models such as step gust, '1-cos' gust etc. It is well-known that regarding altitude atmospheric turbulence models can be defined as low altitude ones, if height is less than 2000 ft, and medium/high altitude ones, if height is greater than 2000 ft. The paper will limit investigation to that of the low-altitude random atmospheric turbulences, and will show random time series representing components of the speed of the turbulent air; namely translational component of, u_g, lateral component of v_g, and finally, vertical component of w_g derived for several weather conditions. The proposed atmospheric turbulence models can be applied for design and analysis of the unmanned aerial vehicle (UAV) systems including unmanned aircraft, unmanned helicopter, or unmanned quadrotor systems flying at low altitudes and at low speed.

2. BRIEF HISTORY & LITTERATURE OVERVIEW

Basic equations, definitions, and characteristics of the random processes and random systems are given in [1]. Donald McLean in [2] propagates both deterministic and stochastic mathematical models of the atmospheric disturbances. A complex set mathematical models of the atmospheric disturbances including both deterministic and random ones are given in [2,3,4], and its implementation is shown in [2,5]. In [6] Szabolcsi and Mészáros focused attention and showed how to apply mathematical models of the low-altitude atmospheric turbulences for spreading air pollution. Pokorádi in [7] summarizes main characteristics of the stochastic signals, and applied Markov-chains for modeling aircraft ground maintenance and repair. He also used stochastic theory for solution of diagnostics problem in aircraft technical systems. Random time series are generated and filtered to that of the components of the speed of the atmospheric

turbulence using computer packages MATLAB® [8], and Control System Toolbox [9].

3. MATHEMATICAL MODELS OF THE CONTINUOUS ATMOSPHERIC DISTURBANCES

This chapter mainly based upon [1,2,3,4,5,6,7], and strictly follows methodology given in [4,6]. The power spectral density (PSD) function of the turbulent air, the so-called von Kármán spectrum, which is better fit registrations of the turbulent air records, is given as follows [2,3,4]:

$$\Phi_{\text{Kármán}}(\Omega)=\frac{\sigma^2 L}{\pi}\frac{1+\frac{8}{3}(1{,}339L\Omega)^2}{\left(1+1{,}339L^2\Omega^2\right)^{11/6}} \quad (1)$$

where L [m] is the gust wavelength, $\Omega=\omega U_0^{-1}$ [rad/m] is spatial frequency, ω [rad/s] is the observed angular frequency, and finally, σ [m/s] is the r.m.s. gust velocity.

The second one, the more favored PSD function is the Dryden PSD function, which can be programmed more easily then the von Kármán-model. If there is no structural analysis is performed the use of Dryden PSD function is permissible. The Dryden PSD function can be defined as given below [2,3,4,6]:

$$\Phi_{\text{Dryden}}(\Omega)=\frac{\sigma^2 L}{\pi}\frac{1+3L^2\Omega^2}{\left(1+L^2\Omega^2\right)^2} \quad (2)$$

Having goal to analyze hypothetical aircraft mathematical models with no interest in investigation of the structural behavior and supposing aircraft to be the rigid one, the simplest mathematical form of the PSD function defined by equation of (2) we will use in this article. Regarding basic references of [2,3,4,6] one can define PSD functions of the component speed of the turbulent air along body axis system of the aircraft, i.e.:

$$\Phi_{u_g}(\Omega)=\frac{2\sigma_u^2 L_u}{\pi}\frac{1}{1+(L_u\Omega)^2} \quad (3)$$

$$\Phi_{v_g}(\Omega)=\frac{\sigma_v^2 L_v}{\pi}\frac{(1+3(L_v\Omega)^2)}{\left[1+(L_v\Omega)^2\right]^2} \quad (4)$$

$$\Phi_{w_g}(\Omega)=\frac{\sigma_w^2 L_w}{\pi}\frac{(1+3(L_w\Omega)^2)}{\left[1+(L_w\Omega)^2\right]^2} \quad (5)$$

where $\sigma_i^2=\int_0^\infty \Phi_i(\Omega)\,\mathrm{d}\,\Omega_i\big|_{i=u,v,\text{ or }w}$. Since $\omega=U_o\Omega$ formulas of (3)–(5) may be rewritten as follows:

$$\Phi_{u_g}(\omega)=\frac{2\sigma_u^2 L_u}{U_o\pi}\frac{1}{\left\{1+(L_u/U_o)^2\omega^2\right\}} \quad (6)$$

$$\Phi_{v_g}(\omega)=\frac{\sigma_v^2 L_v}{U_o\pi}\frac{(1+3(L_v/U_o)^2\omega^2)}{\left\{(1+(L_v/U_o)^2\omega^2\right\}^2} \quad (7)$$

$$\Phi_{w_g}(\omega)=\frac{\sigma_w^2 L_w}{U_o\pi}\frac{(1+3(L_w/U_o)^2\omega^2)}{\left\{(1+(L_w/U_o)^2\omega^2\right\}^2} \quad (8)$$

For generating random signals with the required intensity, scale length, and PSD functions for given speed and height of the flight, a hypothetical wide-band noise generator with PSD function of $\Phi_N(\omega)$ must be used to provide signal with the linear filter, chosen such that it has an appropriate frequency response so that the output signal from the linear filter will have a PSD function of $\Phi_i(\omega)$ (see Figure 1) [2,4]:

$$\begin{aligned}\Phi_i(\omega)&=\left|G_i(s)\right|^2_{s=j\omega}\Phi_N(\omega)\\&=G_i(s)\,G_i(-s)\big|_{s=j\omega}\Phi_N(\omega)\end{aligned} \quad (9)$$

If the white noise source is chosen so that its power spectrum is similar to that of called 'white' noise one can write that

$$\Phi_N(\omega)=1 \quad (10)$$

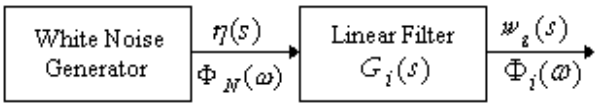

Fig. 1 Block Diagram for Generating Stochastic Signals

Substituting eq (10) into eq (9) result the following formula

$$\begin{aligned}\Phi_i(\omega)&=\left|G_i(s)\right|^2_{s=j\omega}\Phi_N(\omega)\\&=G_i(s)\,G_i(-s)\big|_{s=j\omega}\end{aligned} \quad (11)$$

The linear filter transfer functions of $G_i(s)$

are given in [2] to be:

$$G_{u_g}(s) = \frac{\sqrt{K_u}}{s+\lambda_u}$$

$$G_{v_g}(s) = \sqrt{K_v}\,\frac{s+\beta_v}{(s+\lambda_v)^2}$$

$$G_{w_g}(s) = \sqrt{K_w}\,\frac{s+\beta_w}{(s+\lambda_w)^2} \qquad (12)$$

where:

$$K_u = \frac{2U_o\sigma_u^2}{L_u\pi},\ K_v = \frac{3U_o\sigma_v^2}{L_v\pi},$$

$$K_w = \frac{3U_o\sigma_w^2}{L_w\pi} \qquad (13)$$

$$\beta_v = \frac{U_o}{\sqrt{3}L_v},\ \beta_w = \frac{U_o}{\sqrt{3}L_w} \qquad (14)$$

$$\lambda_u = \frac{U_o}{L_u},\ \lambda_v = \frac{U_o}{L_v},\ \lambda_w = \frac{U_o}{L_w} \qquad (15)$$

It is easily can be derived that substitution equations (12)-(15) into equation (9) results in the PSD functions of the Dryden-models's PSD-functions of (6)-(8). If the air turbulence model is used for analysis of its effects on flight of the small UAV aircraft let the initial parameters be as they are given below:

$$H = 100\,\text{m} \cong 328{,}084\ \textit{feet}\ ^{1}$$
$$U_0 = 25\ \text{m/s} = 90\ \text{km/h} \qquad (16)$$

From equations (13)-(15) it is evident that for derivation of transfer functions of the linear filters defined by equation (12) it is necessary to know turbulence scale of L_i, and turbulence intensity of σ_i, measured along appropriate axis of the given coordinate system.

Let us consider NASA-parameters referred to [2,3] to be as follows:

- along longitudinal (OX) axis:

$$3{,}4\,\text{m/s} \le \sigma_u \le 0{,}85\,\text{m/s} \qquad (17)$$

- along lateral (OY) axis:

$$2{,}8\,\text{m/s} \le \sigma_v \le 0{,}7\,\text{m/s} \qquad (18)$$

- along vertical (OZ) axis:

$$1{,}8\,\text{m/s} \le \sigma_w \le 0{,}45\,\text{m/s} \qquad (19)$$

For extreme weather conditions (thunderstorm) McLean [2] suggests turbulence intensities as they given below:

$$\sigma_u = \sigma_v = \sigma_w = 7\,\text{m/s} \qquad (20)$$

Turbulence integral scale lengths L_i of the low altitude turbulence models for $10\ \textit{feet} \le h \le 1000\ \textit{feet}$ can be derived using following formulas [5,8,9]:

$$L_u = 2L_v = \frac{h}{(0{,}177 + 0{,}000823\cdot h)^{1{,}2}}$$

$$L_w = 0{,}5\,h \qquad (21)$$

Regarding McLean, for extreme weather conditions (thunderstorm) one can apply following integral scale lengths given in [2]:

$$L_u = L_v = L_w = 580\,\text{m} \qquad (22)$$

Constant speed components of the turbulent air are given in military standards of [4,7] as function of theirs exceedance. For the low altitude random turbulence models intensity of the turbulence, σ_w can be measured as:

$$\sigma_w = 0{,}1\,u_{20} \qquad (23)$$

where u_{20} is constant longitudinal component speed of the turbulent air measured at the altitude of $h = 20\,\text{feet}$. Using equations of (21)-(22) integral scale lengths of the air turbulence were found and they are summarized in Table 1.

Table 1 Integral scale lengths at altitude of $H = 100\,\text{m} \cong 328{,}084\,\text{feet}$

Scale length [m]	Nominal (Nom)	Extreme (Thunderstorm)
L_u	862,185497 feet ≅ 262,7941311 m	580
$L_v = 0{,}5\,L_u$	431,0927485 feet ≅	580
L_w	50	580

Using equations of (17)-(20) turbulence intensities were found and they are summarized in Table 2.

Table 2 Turbulence intensities

Turbulence intensities	NASA-Min (Min)	NASA-Max (Max)	Extreme (Thunderstorm)
σ_u, [m/s]	0,85	3,4	7
σ_v, [m/s]	0,7	2,7	7
σ_w, [m/s]	0,45	1,8	7

[1] *1 foot ≅ 0,3048 m — 1 m ≅ 3,28084 feet*

Constant longitudinal component speed of the turbulent air, called u_{20}, were found using military standard of [3], and using equations of (21)-(22).

Constant speed of u_{20} are summarized in Table 3.

Table 3 Constant speed of u_{20}

Turbulent Air Characteristics	NASA-Min (Min)	NASA-Max (Max)	Extreme (Thunderstorm)
$\sigma_w = 0{,}1\,u_{20}$ [m/s]	0,45	1,8	7
u_{20} [m/s] - [km/h]	4,5 - 16,2	18 - 64,8	70 - 252

Linear transfer functions defined by equations (12) having parameters given by equations of (13)–(15), and satisfying conditions derived by equations (16)–(23), and considering weather conditions given by Table 1, and Table 2, can be determined, and they ca be found in the following tables given below [2,3]:

Table 4 Parameters of the linear filters providing longitudinal speed component of the air turbulence, $u_g(t)$

Filter Parameters		
Weather Conditions	$K_u = \frac{2\sigma_u^2 U_o}{L_u \pi}$ $\left[m^2/s^3\right]$	$\lambda_u = \frac{U_o}{L_u}$ $\left[s^{-1}\right]$
NASA-Min	0,043756496	0,095131547
NASA-Max	0,700103937	0,095131547
Extreme	1,344584864	0,043103448

Table 5 Parameters of the linear filters providing lateral speed component of the air turbulence, $v_g(t)$

Filter Parameters			
Weather Conditions	$K_v = \frac{3\sigma_v^2 U_o}{L_v \pi}$ $\left[m^2/s^3\right]$	$\beta_v = \frac{U_o}{\sqrt{3} L_v}$ $\left[s^{-1}\right]$	$\lambda_v = \frac{U_o}{L_v}$ $\left[s^{-1}\right]$
NASA-Min	0,089027057	0,109848449	0,190263095
NASA-Max	1,324504595	0,109848449	0,190263095
Extreme	8,902705783	0,024885787	0,043103448

Table 6 Parameters of the linear filters providing vertical speed component of the air turbulence, $w_g(t)$

Filter Parameters			
Weather Conditions	$K_w = \frac{3\sigma_w^2 U_o}{L_w \pi}$ $\left[m^2/s^3\right]$	$\beta_w = \frac{U_o}{\sqrt{3} L_w}$ $\left[s^{-1}\right]$	$\lambda_w = \frac{U_o}{L_w}$ $\left[s^{-1}\right]$
NASA-Min	0,096686627	0,288675134	0,5
NASA-Max	1,546986047	0,288675134	0,5
Extreme	2,016877296	0,024885787	0,043103448

Using parameters of Table 4, Table 5, Table 6, transfer functions of the linear filters defined by equation (12) can be derived as follows:

$$G_{u_g}^{Min}(s) = \frac{0{,}20918}{s + 0{,}09513} \tag{24-1}$$

$$G_{u_g}^{Max}(s) = \frac{0{,}83672}{s + 0{,}09513} \tag{24-2}$$

$$G_{u_g}^{Extr}(s) = \frac{1{,}15956}{s + 0{,}04310} \tag{24-3}$$

$$G_{v_g}^{Min}(s) = 0{,}29837\ \frac{s + 0{,}10984}{s^2 + 0{,}38052\,s + 0{,}03620} \tag{25-1}$$

$$G_{v_g}^{Max}(s) = 1{,}1508\ \frac{s + 0{,}10984}{s^2 + 0{,}38052\,s + 0{,}03620} \tag{25-2}$$

$$G_{v_g}^{Extr}(s) = 2{,}98374\ \frac{s + 0{,}02488}{s^2 + 0{,}08620\,s + 0{,}00186} \tag{25-3}$$

$$G_{w_g}^{Min}(s) = 0{,}31094\ \frac{s + 0{,}28867}{s^2 + s + 0{,}25} \tag{26-1}$$

$$G_{w_g}^{Max}(s) = 1{,}24377\ \frac{s + 0{,}28867}{s^2 + s + 0{,}25} \tag{26-2}$$

$$G_{w_g}^{Extr}(s) = 1{,}42016\ \frac{s + 0{,}02488}{s^2 + 0{,}08620\,s + 0{,}00185} \tag{26-3}$$

Using linear transfer function models of equations (24)-(26) it is easy to generate random time series with given statistical parameters, which can be applied both for modeling, analysis and design purposes [9,10].

4. RESULTS OF THE COMPUTER SIMULATION

Using principle derived by Fig. 1., and using transfer functions of the linear filters defined for several weather conditions one can generate computer code for solution of this problem. In our preliminary study we have used MATLAB® 6.5 computer programs [8] supplemented with Control System Toolbox [9]. Regarding mathematical models of the random air outlined in Chapter 3 all components of the speeds of the turbulent air measured along axes of the aircraft body-axis system, and they will be presented in the next sections.

4.1. Random longitudinal speed component of the turbulent air.

The longitudinal speed component is very important from the point of view of the basic flight conditions, i.e. aircraft flight is limited with its minimum longitudinal speed of, say, u_{min}.

From Chapter 3 it is known that equilibrium speed of the hypothetical UAV aircraft is $u_o = 25\,\text{m/s}$. Result of the computer simulation can be seen in Fig. 2. From Fig. 2, it is easily can be determined that in time domain of (50÷100) seconds, in other words, in the root of the turbulent zone, the mean value of the longitudinal speed is approximately, $u_{mean} \cong 4{,}2\,\text{m/s}$, which is 16,8% of that of the equilibrium one. There is a question arising from analysis of the characteristics of the longitudinal speed component direction, i.e. it can be coinciding one to that of the mean direction of the flight, or it can oppose aircraft flight. In other words, longitudinal speed component of the turbulent air can be called for head-wind, or, tail wind.

Going that way, longitudinal speed of the aircraft flying through atmospheric turbulence can be derived as follows:

- for “head-wind”:

$$u_{head} = u_o - u_{mean} = 25 - 4{,}2 = 20{,}8\,\text{m/s} \qquad (27)$$

- for “tail wind”:

$$u_{tail} = u_o + u_{mean} = 25 + 4{,}2 = 29{,}2\,\text{m/s} \qquad (28)$$

From eq. (4.1) it is evident that decrease of the longitudinal speed can lead to minimum allowed longitudinal speed of the aircraft for the given aircraft. If aircraft flight parameters, i.e. its speed and height of the flight, go out of the flight envelope, aircraft can stall, and finally, as worst case, aircraft can crash.

4.2. Random lateral speed component of the turbulent air.

Using the same manner as it was shown in previous section, computer code for random lateral speed component of the turbulent air was generated, and results of the computer simulation can be seen in Fig. 3. From Fig. 3 it is easily can be seen that in the time domain of about (50÷100) seconds, the mean values of the lateral speed are:

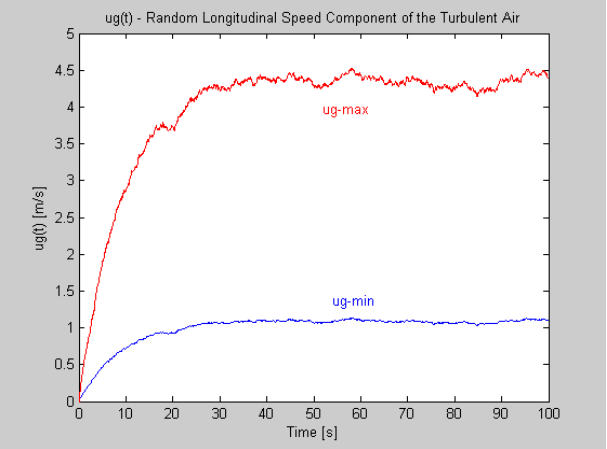

Fig. 2 Longitudinal Speed Component of the Stochastic Air

$$v_{max} \cong 1{,}7\,\text{m/s},\ v_{min} \cong 0{,}5\,\text{m/s} \qquad (29)$$

If to suppose weather conditions having statistical parameters between weather conditions of NASA-Min, and NASA-Max, it can be supposed that mean value of the lateral speed is, approximately, of 1 m/s.

It means that during flight aircraft changes it lateral coordinate for about ≅4 m in one second.

If to take into consideration the free-flight of the aircraft, or even if in normal flight aircraft “pilot” does not corrects the lateral coordinate, in 50 seconds time period, being investigated above, aircraft maintains distance of 1250 m, changing its lateral coordinate for 200 m.

It is obvious, that there is a strong need to compensate lateral deviation measured from the flight direction.

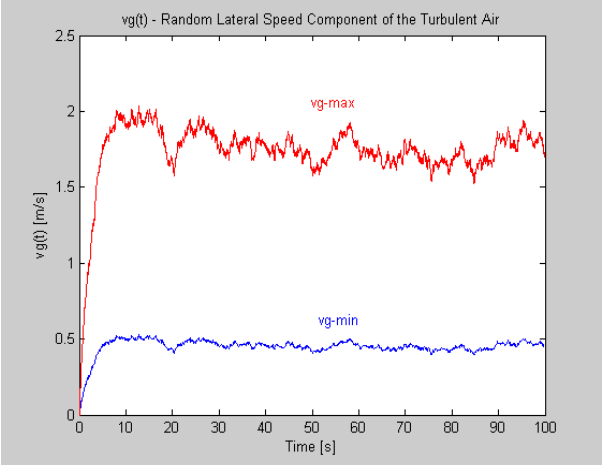

Fig. 3 Lateral Speed Component of the Stochastic Air

4.3. Random vertical speed component of the turbulent air. Random vertical speed of the turbulent air is very important from many aspects of the altitude control of the aircraft, from the point of view of the modeling of the aeroelastic structural motion of the fuselage, and wings. There are many other reasons highlighting importance of the knowledge of the stochastic vertical speed of the atmospheric turbulences. Results of the computer simulation including NASA-Min, and NASA-Max weather conditions can be seen in Fig. 4. From Fig. 4 it is easily can be seen that in the time domain of about (50÷100) seconds, the mean values of the vertical speed are as follows:

$$w_{max} \cong 0{,}7\,\mathrm{m/s}\,,\ w_{min} \cong 0{,}2\,\mathrm{m/s} \qquad (30)$$

If to take mean value of the vertical random speed of the wind to be of 0,5 m/s, during flight aircraft changes it altitude for 1,8 m per second. For the free-flight of the aircraft, or even if in normal flight aircraft "pilot" does not corrects the height of the flight, in 50 seconds time period, being investigated above, aircraft maintains distance of 1250 m, changing its height of the flight for 90 m, to that of the initial of $H_o \cong 100\,\mathrm{m}$. It means that having no control on aircraft altitude, in turbulent air aircraft nearly duplicates its height of the flight. It is obvious, that height of the flight must be controlled, and altitude must be kept at its constant value.

If to take mean value of the vertical random speed of the wind to be of 0,5 m/s, during flight aircraft changes it altitude for 1,8 m per second. For the free-flight of the aircraft, or even if in normal flight aircraft "pilot" does not corrects the height of the flight, in 50 seconds time period, being investigated above, aircraft maintains distance of 1250 m, changing its height of the flight for 90 m, to that of the initial of $H_o \cong 100\,\mathrm{m}$.

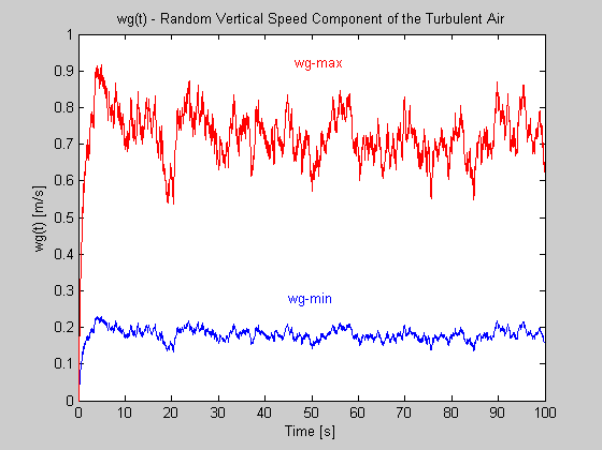

Fig. 4 Vertical Speed Component of the Stochastic Air

It means that having no control on aircraft altitude, in turbulent air aircraft nearly duplicates its height of the flight. It is obvious, that height of the flight must be controlled, and altitude must be kept at its constant value.

4.4. Results of the computer simulation on the atmospheric turbulences for the "NASA-Min" weather conditions. Using results of the previous computer simulation, for "NASA-Min" weather conditions all appropriate time series of the longitudinal, lateral, and vertical components of the random air were plot in common coordinate system, and they can be seen in Fig. 5.

From Fig. 5 it is evident that longitudinal speed component of the atmospheric turbulence has largest mean value. If the aircraft is the piloted one the vertical speed component $w_g(t)$ is important from point of view of the ride comfort.

For UAVs vertical speed is important for fatigue reduction purposes. Finally, lateral speed $v_g(t)$ can lead to worsening navigational performances, i.e. UAV can be lost during flight.

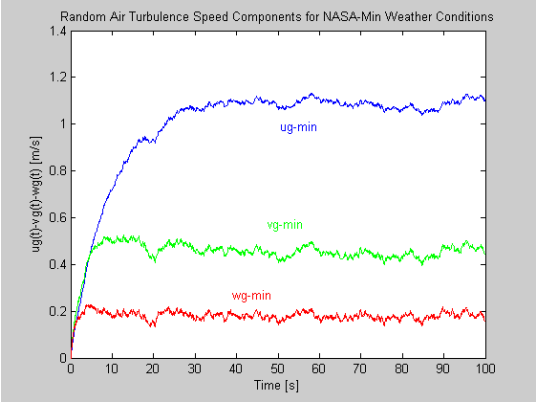

Fig. 5 Results of the Computer Simulation for "NASA-Min" Weather Conditions

4.5. Results of the computer simulation of the atmospheric turbulences for the "NASA-Max" weather conditions. Using results of the computer simulation made before, for "NASA-Max" weather conditions all appropriate time series of the longitudinal, lateral, and vertical components of the random air were plot in one, common coordinate system, and they can be seen in Fig. 6.

From Fig. 6 it is easily can be derived that longitudinal speed component, $u_g(t)$, of the atmospheric turbulence has largest mean value. It is evident that for head-wind weather conditions, there is exists a maximum value of the longitudinal random speed, $u_{g_{max}}(t)$, which is allowed to avoid stalling of the aircraft.

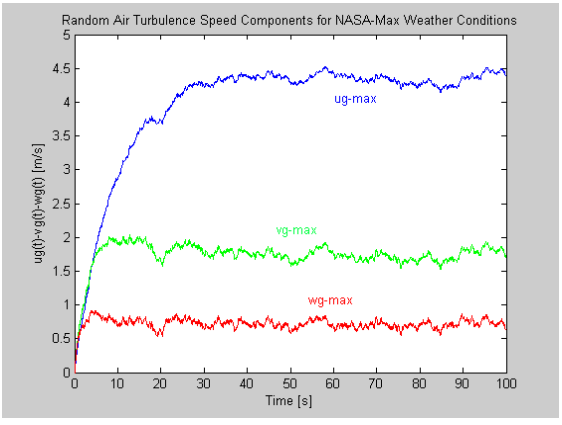

Fig. 6 Results of the Computer Simulation for "NASA-Max" Weather Conditions

4.6. Results of the computer simulation of the atmospheric turbulences for "Extreme-Thunderstorm" weather conditions. Result of these computer simulations are mainly hypothetical, however, it is necessary to know how extreme air masses are moving. These results are very important although from the point of view of the flight achieved beyond visual range for large distances, when there are big differences between weather conditions at arrival and departure airfields. Result of the computer simulation can be seen in Fig. 7.

The most important result is that atmospheric turbulence has largest value in the mean of lateral component of the turbulent air.

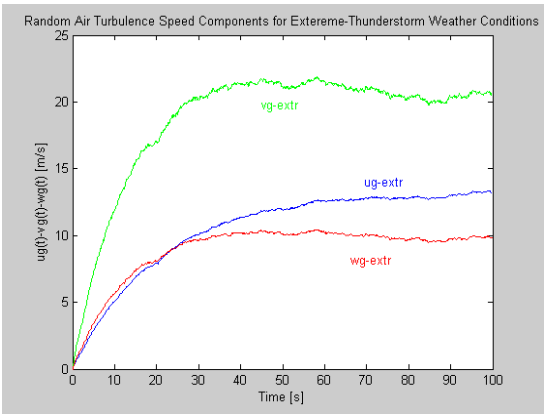

Fig. 7 Results of the Computer Simulation for "Extreme" Weather Conditions

The other important statement coming form this analysis, that if to consider maximum value of the longitudinal head-wind to be of $u_{g\_head}(t) = 5\,m/s$, this maximum value is reached at about 5 seconds of the computer-aided simulation

It means that to avoid stalling of the aircraft it is necessary to compensate decrease of the longitudinal speed of the aircraft increasing throttle, or it is necessary to maintain maneuver to keep given flight parameters in the defined flight envelope of the given type of the aircraft.

5. MODELING OF SENSOR NOISES IN AUTOMATIC FLIGHT CONTROL SYSTEMS

Most of the modern automatic flight control systems are driven by electric energy, i.e. outputs of the flight control systems are electrical signals proportional to state variables of the spatial motion of the aircraft. Additive noises of the output signals can be regarded as

random ones. It is well-known that statistical parameters of these stochastic signals are purely described, and they can be derived from analysis of the registered time histories of the random flight parameters.

The second method is the study of the computer simulation of the random time series. This particular case supposes random flight parameters to have Gaussian distribution. These signals are to be filtered from those of the output signals of the white noise generator, and in most cases are filtered using linear filters to have zero mean value. In general, typical drift of the attitude gyroscope is $0{,}1^0/\mathrm{h}$. The accuracy of the rate gyro is $0{,}1^0/\sec$, and $0{,}1^0$ for attitude gyros. Static error of the accelerometers is typically $3{,}5\cdot10^{-3}\mathrm{m/s^2}$. Barometric altimeters have r.m.s. errors of 16 m [2].

6. SUMMARY & CLOSING REMARKS

This paper deals with mathematical modeling of the atmospheric turbulences. Main references are cited to highlight importance of this scientific article. Mathematical modeling of the atmospheric turbulences are important from many aspects of the flight: these models are used for derivation of the flight envelope of the aircraft, for derivation of the limitations of the flight parameters and derivation of the meteorological minimums defined for given type of the aircraft, and finally, these models are widely applied for preliminary design of the automatic flight control systems.

In this article it was discussed that statistical parameters of the atmospheric turbulence depend not only on flight parameters but on weather conditions, too. Limiting our investigations to that of the analysis of the low-altitude turbulent air models we have considered several weather conditions, namely '*NASA-Min*', '*NASA-Max*', and finally, '*Extreme-thunderstorm*' weather conditions were analyzed.

For given initial flight parameters and weather conditions author had created a new embedded MATLAB® m-file to produce time series applicable to visualize random speed components of the turbulent air, namely longitudinal, lateral, and finally, vertical speed components of the turbulent air were investigated.

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GLOBAL STABILITY OF THE POSITIVE SOLUTIONS OF NONLINEAR DIFFERENCE EQUATIONS AND ASYMPTOTIC MEAN SQUARE STABILITY OF EQUILIBRIUM POINTS IF WITH STOCHASTIC PERTURBATIONS

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Abstract: *The main objective of this paper is to study the boundedness character, the periodic character, the convergence and the global stability of the positive solutions of the difference equation:*

$$u_{n+1} = \frac{A + \sum_{i=0}^{k} \alpha_i u_{n-i}}{B + \sum_{i=0}^{k} \beta_i u_{n-i}}, \; n \in Z=\{0,1,...,\}, \tag{1.1}$$

where A, B, α_i, β_i *and the initial conditions*

$$u_i = \varphi_i, \; i \in Z_0 = \{-k,-k+1,...,0\},$$

while k *is a positive integer number and the necessary and sufficient conditions for asymptotic mean square stability of the equilibrium point of fractional difference equation is exposed to stochastic perturbations* ξ_n *which are directly proportional to the deviation of the system state* u_n *from the equilibrium point* $\bar{u}$, *the form* $\sigma(u_n - \bar{u})\xi_{n+1}$.

Keywords and phrases: *Asymptotic mean square stability*, *global stability, nonlinear difference equations, periodic character, stochastic perturbations.*
2000 Mathematics Subject Classification**:** *Primary* 39A10, 39A11; *secondary* 93E15.

1. INTRODUCTION

Difference equations have always played an important role in the construction and analysis of mathematical models of biology, ecology, physics, economic processes, etc [9]. The case where any of A, B, α_i, β_i is allowed to be zero gives different special cases of (1.1) which are studied by many authors (see, e.g, [1], [2], [3], [4], [12]). Furthermore, the results about such equations offer prototypes for the development of the basic theory of the global behavior of nonlinear difference equations. Note that the difference equation (1.1) has been extensively studied in the special case k = 1 in the monograph [6]. So, the results presented in our paper are new.

Definition 1.1. The equilibrium point $\bar{u}$ of the equation

$$u_{n+1} = f(u_n, u_{n-1},..., u_{n-k}), \quad n = 0,1,...$$

is the point that satisfies the condition:

$$\bar{u} = f(\bar{u}, \bar{u}, \ldots, \bar{u}).$$

Definition 1.2. The equilibrium point $\bar{u}$ of equation (3) is said to be:

1. locally stable, if for every $\varepsilon > 0$ there exists $\delta > 0$ such that every solution $\{u_n\}$ with initial conditions

$$u_{-k}, u_{-k+1} \ldots, u_0 \in (\bar{u}-\delta, \bar{u}+\delta),$$

we have $|u_n - \bar{u}| < \varepsilon$, for all $n \in N$.

2. locally asymptotically stable if it is locally stable and if there exists $\gamma > 0$ such that for any initial conditions

$u_{-k}, u_{-k+1} \ldots, u_0 \in (\bar{u}-\gamma, \bar{u}+\gamma)$,

the corresponding solution $\{u_n\}$ tends to $\bar{u}$.

3. global attractor if every solution $\{u_n\}$ converges to $\bar{u}$ as $n \to \infty$.

4. globally asymptotically stable if $\bar{u}$ is locally asymptotically stable and $\bar{u}$ is also global attractor.

5. unstable if $\bar{u}$ is not locally stable.

Definition 1.3. A sequence $\{u_n\}$, $n \geq -k$ is said to be periodic with period p if $u_{n+p} = u_n$ for all $n \geq -k$. A sequence $\{u_n\}$, $n \geq -k$ is said to be periodic with prime period p if p is the smallest positive integer having this property.

Assume that

$$\begin{cases} \tilde{a}_j = \sum_{i=j}^{k} \alpha_i, \ \tilde{b}_j = \sum_{i=j}^{k} \beta_i, \ j=0,1,...,k \\ \tilde{a} = \tilde{a}_0, \ \tilde{b} = \tilde{b}_0, \\ \bar{a} = \sum_{i=0}^{k} (-1)^i \alpha_i, \ \bar{b} = \sum_{i=0}^{k} (-1)^i \beta_i \end{cases} \quad (1.2)$$

and suppose that equation (1.1) has some point of equilibrium $\bar{u}$ (not necessary a positive one).

Then by assumption

$$B+\tilde{b}\,\bar{u} \neq 0 \quad (1.3)$$

the equilibrium point $\bar{u}$ is defined by the algebraic equation:

$$\bar{u} = \left(A+\tilde{a}\bar{u}\right) \Big/ \left(B+\tilde{b}\bar{u}\right) \quad (1.4)$$

By condition (1.3) equation (1.4) can be transformed to the form:

$$\tilde{b}\,\bar{u}^2 - (\tilde{a}-B)\,\bar{u} - A = 0 \quad (1.5)$$

It is clear that if

$$(\tilde{a}-B)^2 + 4A\tilde{b} > 0 \quad (1.6)$$

equation (1.1) has two points of equilibrium:

$$\bar{u}_1 = \frac{\tilde{a}-B+\sqrt{(\tilde{a}-B)^2+4A\,\tilde{b}}}{2\tilde{b}} \quad (1.7)$$

and

$$\bar{u}_2 = \frac{\tilde{a}-B-\sqrt{(\tilde{a}-B)^2+4A\,\tilde{b}}}{2\tilde{b}} \quad (1.8)$$

If

$$(\tilde{a}-B)^2 + 4A\tilde{b} = 0 \quad (1.9)$$

then equation (1.1) has only one point of equilibrium:

$$\bar{u} = (\tilde{a}-B) \big/ 2\tilde{b} \quad (1.10)$$

And at last if

$$(\tilde{a}-B)^2 + 4A\tilde{b} < 0 \quad (1.11)$$

then equation (1.1) has not equilibrium points.

Remark 1.1. Consider the case $A=0, \tilde{b} \neq 0$. From (1.4) we obtain the following. If, $B \neq 0$ and $\tilde{a} \neq B$, then equation (1.1) has two points of equilibrium:

$$\bar{u}_1 = \frac{\tilde{a}-B}{\tilde{b}}, \quad \bar{u}_2 = 0 \quad (1.12)$$

If, $B \neq 0$ and $\tilde{a}=B$, then equation (1.1) has only one point of equilibrium: $\bar{u}=0$. If $B=0$, then equation (1.1) has only one point of equilibrium: $\bar{u} = \tilde{a} \big/ \tilde{b}$.

Remark 1.2. Consider the case $A = \tilde{b} = 0$ and $B \neq 0$. If $\tilde{a} \neq B$, then equation (1.1) has only one point of equilibrium: $\bar{u}=0$. If $\tilde{a}=B$, then each solution $\bar{u}=$ const is an equilibrium point of equation (1.1). Consequently, the positive equilibrium point $\bar{u}$ of the difference equation (1.1) is given by (1.7).

Let f: $(0, \infty)^{k+1} \to (0, \infty)$ be a continuous function defined by

$$f(u_0, u_1, \ldots, u_k) = \frac{A+\sum_{i=0}^{k} \alpha_i u_i}{B+\sum_{i=0}^{k} \beta_i u_i} \quad (1.13)$$

The linearized equation associated of equation (1.1) about the positive equilibrium point $\bar{u}$ is:

$$z_{n+1} = \sum_{i=0}^{k} \frac{\partial f}{\partial u_i}(\bar{u}, \bar{u}, \ldots, \bar{u}) z_{n-i}, \ n = 0,1,... \quad (1.14)$$

or

$$z_{n+1} + \sum_{i=0}^{k} b_i z_{n-i} = 0 \quad (1.15)$$

Where

$$b_i = -\frac{\partial f}{\partial u_i}(\bar{u}, \bar{u}, \ldots, \bar{u}) = \frac{\beta_i \bar{u} - \alpha_i}{B+\tilde{b}\bar{u}} \quad (1.16)$$

Theorem 1.1 (see [1,7,9]). Assume that $a,b \in R$ and $k \in \{0, 1, 2, \ldots\}$. Then

$$|a| + |b| < 1 \quad (1.17)$$

is a sufficient condition for the asymptotic stability of the difference equation

$$u_{n+1}+au_n+bu_{n-k}=0,\ n=0,1,2,\ldots, \quad (1.18)$$

Theorem 1.1 can be easily extended to a general linear difference equation.

Theorem 1.2. (see [1,7]). Let

$$u_{n+k}+p_1u_{n+k-1}+\ldots+p_ku_n=0 \quad (1.19)$$

$n=0,1,2,\ldots,$

where $p_1,p_2,\ldots,p_k \in R$ and $k \in \{1,2,\ldots\}$.

Then equation (1.19) is asymptotically stable provided that

$$\sum_{i=0}^{k}|p_i|<1 \quad (1.20)$$

2. MAIN RESULTS

In this section, we establish some results which show that the positive equilibrium point $\bar{u}$ of the difference equation (1.1) is globally asymptotically stable and every positive solution of the difference equation (1.1) is bounded, the periodic character and the necessary and sufficient conditions for asymptotic mean square stability of the equilibrium point of rational difference quation (1.1), if is exposed to stochastic perturbations ξ_n which are directly proportional to the deviation of the system state u_n from the equilibrium point $\bar{u}$, the form $\sigma(u_n-\bar{u})\xi_{n+1}$.

Theorem 2.1. Assume that $B>\tilde{a}$ holds. Let $\{u_n\}_{n=-k}^{\infty}$ be a solution of the difference equation (1.1) such that for some $n_0 \geq 0$, either

$$u_n \geq \bar{u} \text{ for } n \geq n_0 \quad (2.1)$$

$$u_n \leq \bar{u} \text{ for } n \geq n_0 \quad (2.2)$$

Then u_n converges to $\bar{u}$ as $n \to \infty$, that is,

$$\lim_{n\to\infty} u_n=\bar{u} \quad (2.3)$$

Proof. Assume that (2.1) holds. The case where (2.2) holds is similar and will be omitted. Then, for $n \geq n_0+k$, we deduce that

$$u_{n+1}=\frac{A+\sum_{i=0}^{k}\alpha_iu_{n-i}}{B+\sum_{i=0}^{k}\beta_iu_{n-i}}=\left[\sum_{i=0}^{k}\alpha_iu_{n-i}\right]\left[\frac{1+A\Big/\sum_{i=0}^{k}\alpha_iu_{n-i}}{B+\sum_{i=0}^{k}\beta_iu_{n-i}}\right]\leq$$

$$\leq\left[\sum_{i=0}^{k}\alpha_iu_{n-i}\right]\left[\frac{1+A/\tilde{a}\,\bar{u}}{B+\tilde{b}\,\bar{u}}\right]=$$

$$=\left[\sum_{i=0}^{k}\alpha_iu_{n-i}\right]\left[\frac{A+\tilde{a}\,\bar{u}}{\tilde{a}\,\bar{u}\,(B+\tilde{b}\,\bar{u})}\right] \quad (2.4)$$

With the aid of (1.3), the last inequality becomes:

$$u_{n+1}\leq\sum_{i=0}^{k}\alpha_iu_{n-i}\Big/\tilde{a} \quad (2.5)$$

and so

$$u_{n+1}\leq\max_{0\leq i\leq k}\{u_{n-i}\} \text{ for } n\geq n_0+k \quad (2.6)$$

Set

$$v_n=\max_{0\leq i\leq k}\{u_{n-i}\} \text{ for } n\geq n_0+k \quad (2.7)$$

Then clearly

$$v_n\geq u_{n+1}\geq\bar{u} \text{ for } n\geq n_0+k \quad (2.8)$$

Next, we claim that

$$v_{n+1}\geq v_n \text{ for } n\geq n_0+k \quad (2.9)$$

Now, we have

$$v_{n+1}=\max_{0\leq i\leq k}\{u_{n+1-i}\}=\max\{u_{n+1},\ \max_{0\leq i\leq k}\{u_{n-i}\}\}\leq$$

$$\leq\max\{u_{n+1},v_n\}=v_n \quad (2.10)$$

From (2.8) and (2.9), it follows that the sequence $\{v_n\}$ is convergent and that

$$v=\lim_{n\to\infty}v_n\geq\tilde{u} \quad (2.11)$$

Furthermore, we get

$$u_{n+1}\leq\frac{A+\sum_{i=0}^{k}\alpha_iu_{n-i}}{B+\tilde{b}\,\bar{u}}\leq\frac{A+\tilde{a}\,v_n}{B+\tilde{b}\,\bar{u}} \quad (2.12)$$

From this and by using (2.9) we obtain,

$$u_{n+1}\leq\frac{A+\tilde{a}\,v_{n+i-1}}{B+\tilde{b}\,\bar{u}}\leq\frac{A+\tilde{a}\,v_n}{B+\tilde{b}\,\bar{u}} \quad (2.13)$$

for $i=1,\ldots,k+1$.

Then

$$v_{n+k+1}=\max_{0\leq i\leq k+1}\{u_{n+i}\}\leq u_{n+1}\leq\frac{A+\tilde{a}\,v_n}{B+\tilde{b}\,\bar{u}} \quad (2.14)$$

and by letting $n\to\infty$, we obtain

$$v\leq\frac{A+\tilde{a}\,v}{B+\tilde{b}\,\bar{u}} \quad (2.15)$$

Consequently, we obtain

$$v\left(1-\frac{\tilde{a}}{B+\tilde{b}\bar{u}}\right)\leq\frac{A}{B+\tilde{b}\bar{u}} \quad (2.16)$$

From (1.3) and (2.16), we deduce that $v\leq\bar{u}$, and in view of (2.11), we obtain $v=\bar{u}$. Thus, the proof of Theorem 2.1 is completed.

Theorem 2.2. Let $\{u_n\}_{n=-k}^{\infty}$ be a positive solution of the difference equation (1.1) and $B>1$. Then there exist positive constants m and M such that

$$m \le u_n \le M, \quad n=0,1,... \tag{2.17}$$

Proof. From the difference equation (1.1), we have, when $B>1$

$$u_{n+1} \le \frac{A}{B}+\frac{1}{B}\left(\sum_{i=0}^{k}\alpha_i u_{n-i}\right), \quad n=0,1,... \tag{2.18}$$

Consider the linear difference equation

$$w_{n+1}=\frac{A}{B}+\frac{1}{B}\left(\sum_{i=0}^{k}\alpha_i w_{n-i}\right), \quad n=0,1,... \tag{2.19}$$

with the initial conditions $w_i=u_i>0$, $i=-k,\dots,-1,0$. It follows by complete induction that

$$u_n \le w_n \tag{2.20}$$

First of all, assume that $B \ge \tilde{a}$. Then we have $A/(B-\tilde{a})$ is a particular solution of (2.19) and every solution of the homogeneous equation which is associated with (2.19) tends to zero as $n\to\infty$. Hence

$$\lim_{n\to\infty} w_n = \frac{A}{B-\tilde{a}} \tag{2.21}$$

From this (19) and (2.20), it follows that the sequence $\{u_n\}$ is bounded from above by a positive constant M say. That is,

$$u_n \le M, \quad n=0,1,... \tag{2.22}$$

Set

$$m = \frac{A}{B+\tilde{b}\,M} \tag{2.23}$$

then we have

$$u_{n+1}=\frac{A+\sum_{i=0}^{k}\alpha_i u_{n-i}}{B+\sum_{i=0}^{k}\beta_i u_{n-i}} \ge \frac{A}{B+\tilde{b}M}=m \tag{2.24}$$

and consequently, we get

$$m \le u_n \le M, \quad n=0,1,... \tag{2.25}$$

which completes the proof of Theorem 2.2 when $B>\tilde{a}$.

Second, consider the case when $B \ge \tilde{a}$. It suffices to show that $\{u_n\}$ is bounded from above by some positive constant. For the sake of contradiction, assume that $\{u_n\}$ is unbounded. Then there exists a subsequence $\{u_{n_j}\}$ such that

$$\lim_{j\to\infty} n_j=\infty, \quad \lim_{j\to\infty} u_{1+n_j}=\infty, \quad u_{1+n_j}$$
$$=\max\{u_n;\ -k \le n \le 1+n_j\}, \quad j=0,1,2,... \tag{2.26}$$

From (2.18), we deduce that

$$\sum_{i=0}^{k}\alpha_i u_{-i+n_j} \ge B u_{1+n_j} - A \tag{2.27}$$

Taking the limit as $j\to\infty$ of both sides of the last inequality, we obtain

$$\lim_{j\to\infty}\sum_{i=0}^{k}\alpha_i u_{-i+n_j}=\infty \tag{2.28}$$

It is easy enough to show that $u_{-i+n_j} \le u_{1+n_j}$, $(i=0,1,2,...k)$ and then as $\tilde{a}=\sum_{i=0}^{k}\alpha_i$ we have:

$$\sum_{j=0}^{k}\alpha_j u_{-i+n_j} \le \tilde{a} u_{1+n_j} \tag{2.29}$$

From the last inequality and the difference equation (1.1), we obtain:

$$0 \le \tilde{a}u_{1+n_j} - \sum_{i=0}^{k}\alpha_i u_{-i+n_j} =$$
$$= \frac{\tilde{a}A+\sum_{i=0}^{k}\alpha_i u_{-i+n_j}\left[\tilde{a}-B-\sum_{i=0}^{k}\beta_i u_{-i+n_j}\right]}{B+\sum_{i=0}^{k}\beta_i u_{-i+n_j}} \tag{2.30}$$

Consequently, it follows that

$$\sum_{i=0}^{k}\beta_i u_{-i+n_j} \le \tilde{a}-B \tag{2.31}$$

Then for every $i=0,1,2,\dots,k$ for which β_i is positive, the subsequence $\{u_{-i+n_j}\}$ is bounded which implies that the sequence $\left\{\sum_{i=0}^{k}\alpha_i u_{-i+n_j}\right\}$ is also bounded. This contradicts (2.28) and the proof of the Theorem 2.2 is completed.

Theorem 2.3. Assume that $B>\tilde{a}$ holds. Then the positive equilibrium point $\bar{u}$ of the difference equation (1.1) is globally asymptotically stable.

Proof. The linearized equation (1.15) with (1.16) can be written in the form

$$z_{n+1}+\sum_{i=0}^{k}\frac{\beta_i\bar{u}-\alpha_i}{B+\tilde{b}\bar{u}}z_{n-i}=0 \tag{2.32}$$

As $B>\tilde{a}$, we get

$$\sum_{i=0}^{k}\left|\frac{\beta_i\bar{u}-\alpha_i}{B+\tilde{b}\bar{u}}\right| \le \frac{\tilde{a}+\tilde{b}\bar{u}}{B+\tilde{b}\bar{u}}<1 \qquad (2.33)$$

Thus, by Theorem 2.2, we deduce that the equilibrium point $\bar{u}$ of the difference equation (1.1) is locally asymptotically stable. It remains to prove that the equilibrium point $\bar{u}$ is a global attractor. To this end, set

$$I=\liminf_{n\to\infty} u_n \quad \text{and} \quad S=\limsup_{n\to\infty} u_n,$$

which by Theorem 2.4 are positive numbers.

Then, from the difference equation (1.1), we see that

$$S \le \frac{A+\tilde{a}S}{B+\tilde{b}I}, \quad I \ge \frac{A+\tilde{a}I}{B+\tilde{b}S} \qquad (2.34)$$

Hence

$$A+(\tilde{a}-B)I \le \tilde{b}IS \le A+(\tilde{a}-B)S \qquad (2.35)$$

From which it follows that I = S. Thus, the proof of Theorem 2.3 is completed.

Theorem 2.4. The necessary and sufficient condition for the difference equation (1.1) to have positive prime period two solutions is that both inequalities

$$A(\tilde{b}-\bar{b})^2-(\tilde{a}+\bar{a})(\tilde{b}-\bar{b})(B+\bar{a})<\tilde{b}(B+\bar{a})^2 \qquad (2.36)$$

$$B+\bar{a}<0 \qquad (2.37)$$

are valid.

Proof. First, suppose that there exist positive prime period two solutions

$$\ldots,P,Q,P,Q,\ldots \qquad (2.38)$$

of the difference equation (1.1). We will prove that the condition (2.36) holds. It follows from the difference equation (1.1) that

$$\begin{cases} P=\dfrac{A+\alpha_0Q+\alpha_1P+\alpha_2Q+\alpha_3P+\ldots}{B+\beta_0Q+\beta_1P+\beta_2Q+\beta_3P+\ldots} \\ Q=\dfrac{A+\alpha_0P+\alpha_1Q+\alpha_2P+\alpha_3O+\ldots}{B+\beta_0P+\beta_1Q+\beta_2P+\beta_3Q+\ldots} \end{cases} \qquad (2.39)$$

Consequently, we obtain

$$A+\alpha_0Q+\alpha_1P+\alpha_2Q+\alpha_3P+\ldots=$$

$$=BP+\beta_0PQ+\beta_1P^2+\beta_2PQ+\beta_3P^2+\ldots \qquad (2.40)$$

$$A+\alpha_0P+\alpha_1Q+\alpha_2P+\alpha_3O+\ldots=$$

$$=BQ+\beta_0PQ+\beta_1Q^2+\beta_2PQ+\beta_3Q^2+\ldots \qquad (2.41)$$

By subtracting, we deduce after some reduction that

$$P+Q=\frac{-(B+\bar{a})}{\beta_1+\beta_3+\ldots} \qquad (2.42)$$

while by adding we obtain

$$PQ=\frac{A(\beta_1+\beta_3+\ldots)-(\alpha_0+\alpha_2+\ldots)(B+\bar{a})}{\bar{b}(\beta_1+\beta_3+\ldots)} \qquad (2.43)$$

where $B+\bar{a}<0$. Now, it is clear from (2.42) and (2.43) that P and Q are two positive distinct real roots of the quadratic equation

$$t^2-(P+Q)t+PQ=0 \qquad (2.44)$$

Thus, we deduce that

$$\left(\frac{-(B+\bar{a})}{\beta_1+\beta_3+\ldots}\right)^2 >$$

$$>4\left(\frac{A(\beta_1+\beta_3+\ldots)-(\alpha_0+\alpha_2+\ldots)(B+\bar{a})}{\bar{b}(\beta_1+\beta_3+\ldots)}\right) \qquad (2.45)$$

From (2.45), we obtain

$$A(\tilde{b}-\bar{b})^2-(\tilde{a}+\bar{a})(\tilde{b}-\bar{b})(B+\bar{a})<$$

$$<\tilde{b}(B+\bar{a})^2 \qquad (2.46)$$

and hence the condition (2.36) is valid.

Conversely, suppose that the condition (2.36) is valid. Then, we deduce immediately from (2.46) that the inequality (2.45) holds. Consequently, there exist two positive distinct real numbers P and Q such that

$$\begin{cases} P=\dfrac{-(B+\bar{a})}{2(\beta_1+\beta_3+\ldots)}-\dfrac{1}{2}\sqrt{T_1} \\ Q=\dfrac{-(B+\bar{a})}{2(\beta_1+\beta_3+\ldots)}+\dfrac{1}{2}\sqrt{T_1} \end{cases} \qquad (2.47)$$

where $T_1 > 0$ which is given by the formula

$$T_1=\left(\frac{-(B+\bar{a})}{\beta_1+\beta_3+\ldots}\right)^2-$$

$$-4\left(\frac{A(\beta_1+\beta_3+\ldots)-(\alpha_0+\alpha_2+\ldots)(B+\bar{a})}{\bar{b}(\beta_1+\beta_3+\ldots)}\right) \qquad (2.48)$$

Thus, P and Q represent two positive distinct real roots of the quadratic equation (2.44).

Now, we are going to prove that P and Q are positive prime period two solutions of the difference equation (1.1). To this end, we assume that

$$u_{-k}=P,\ u_{-k+1}=Q,\ldots,u_{-1}=Q,\ u_0=P \qquad (2.49)$$

We wish to show that

$$u_1=Q,\ u_2=Q \qquad (2.50)$$

To this end, we deduce from the difference equation (1.1) that

$$u_1=\frac{A+\alpha_0u_0+\alpha_1u_{-1}+\ldots+\alpha_ku_{-k}}{B+\beta_0u_0+\beta_1u_{-1}+\ldots+\beta_ku_{-k}}=$$

$$=\frac{A+P(\alpha_0+\alpha_2+\ldots)+Q(\alpha_1+\alpha_3+\ldots)}{B+P(\beta_0+\beta_2+\ldots)+Q(\beta_1+\beta_3+\ldots)} \quad (2.51)$$

Dividing the denominator and numerator of (2.51) by

$$-(B+\bar{a})(\beta_1+\beta_3+\ldots)$$

and using (2.47)-(2.48), we obtain

$$u_1=\frac{\frac{-2A(\beta_1+\beta_3+\ldots)}{B+\bar{a}}+(1+\sqrt{K_1})(\alpha_0+\alpha_2+\ldots)+(1-\sqrt{K_1})(\alpha_1+\alpha_3+\ldots)}{\frac{-2B(\beta_1+\beta_3+\ldots)}{B+\bar{a}}+(1+\sqrt{K_1})(\beta_0+\beta_2+\ldots)+(1-\sqrt{K_1})(\beta_1+\beta_3+\ldots)}=$$

$$=\frac{\tilde{a}-2A(\beta_1+\beta_3+\ldots)/(B+\bar{a})+\bar{a}\sqrt{K_1}}{\tilde{b}-2B(\beta_1+\beta_3+\ldots)/(B+\bar{a})+\bar{b}\sqrt{K_1}} \quad (2.52)$$

where

$$K_1=1-\frac{A(\tilde{b}-\bar{b})^2-(\tilde{a}+\bar{a})(\tilde{b}-\bar{b})(B+\bar{a})}{\bar{b}(B+\bar{a})^2} \quad (2.53)$$

and from the condition (2.36), we deduce that $K_1 > 0$. Multiplying the denominator and numerator of (2.52) by

$$\left(\tilde{b}-2B(\beta_1+\beta_3+\ldots)/(B+\bar{a})\right]-\bar{b}\sqrt{K_1} \quad (2.54)$$

we have:

$$u_1=[\tilde{a}-2A(\beta_1+\beta_3+\ldots)/(B+\bar{a})]\times$$

$$\times\frac{[\tilde{b}-2B(\beta_1+\beta_3+\ldots)/(B+\bar{a})]-\bar{b}\,\bar{a}\sqrt{K_1}}{[\tilde{b}-2B(\beta_1+\beta_3+\ldots)/(B+\bar{a})]^2-\bar{b}^2K_1}+$$

$$+\frac{[\tilde{b}\,\bar{a}-\bar{a}\,\bar{b}-\bar{a}\frac{2B(\beta_1+\beta_3+\ldots)}{B+\bar{a}}+\bar{b}\frac{2A(\beta_1+\beta_3+\ldots)}{B+\bar{a}}\sqrt{K_1}}{[\tilde{b}-2B(\beta_1+\beta_3+\ldots)/(B+\bar{a})]^2-\bar{b}^2K_1} \quad (2.55)$$

After some reduction, we deduce that

$$u_1=\frac{-(B+\bar{a})(1+\sqrt{K_1})}{2(\beta_1+\beta_3+\ldots)}\times$$

$$\times\frac{\left[2(\alpha_1+\ldots)(\beta_0+\ldots)-2(\alpha_0+\ldots)(\beta_1+\ldots)-\frac{2(\beta_1+\ldots)}{(B+\bar{a})(A\bar{b}-B\bar{a})}\right]}{\left[2(\alpha_1+\ldots)(\beta_0+\ldots)-2(\alpha_0+\ldots)(\beta_1+\ldots)-\frac{2(\beta_1+\ldots)}{(B+\bar{a})(A\bar{b}-B\bar{a})}\right]}=$$

$$=\frac{-(B+\bar{a})(1+\sqrt{K_1})}{2(\beta_1+\beta_3+\ldots)}=\frac{-(B+\bar{a})}{2(\beta_1+\beta_3+\ldots)}+\frac{1}{2}\sqrt{T_1}=Q \quad (2.56)$$

Similarly, we can show that

$$u_2=\frac{A+\alpha_0u_1+\alpha_1u_0+\ldots+\alpha_ku_{-(k-1)}}{B+\beta_0u_1+\beta_1u_0+\ldots+\beta_ku_{-(k-1)}}=$$

$$=\frac{A+Q(\alpha_0+\alpha_2+\ldots)+P(\alpha_1+\alpha_3+\ldots)}{B+Q(\beta_0+\beta_2+\ldots)+P(\beta_1+\beta_3+\ldots)}=P \quad (2.57)$$

By using the mathematical induction, we have

$$u_n=P,\ \ u_{n+1}=Q,\ (\forall)\ n\geq -k \quad (2.58)$$

Thus, the difference equation (1.1) has positive prime period two solutions

$$\ldots,P,Q,P,Q,\ldots \quad (2.59)$$

Hence the proof of Theorem 2.4 is completed.

Let now $\{\Omega,\sigma,P\}$ be a probability space and $\{F_i\in\sigma, i\in Z\}$ be a nondecreasing family of σ-algebras of σ, i.e. $F_{n_1}\subset F_{n_2}$ for $n_1 < n_2$, E be the expectation, ξ_n, $n\in Z$, be a sequence of F_n-adapted mutually independent random variables such that $E\xi_n=0$, $E\xi_n^2=1$. It is supposed that the rational difference equation (1.1) has an equilibrium point $\bar{u}$ and is exposed to additive stochastic perturbations type of $\sigma(u_n-\bar{u})\xi_{n+1}$ that are directly proportional to the deviation of the state u_n of system (1.1) from the equilibrium point $\bar{u}$. So, equation (1.1) takes the form

$$u_{n+1}=\frac{A+\sum_{i=0}^{k}\alpha_iu_{n-i}}{B+\sum_{i=0}^{k}\beta_iu_{n-i}}++\sigma(u_n-\bar{u})\xi_{n+1} \quad (2.60)$$

Note that the equilibrium point $\bar{u}$ of equation
(1.1) is also the equilibrium point of equation (2.60). Putting $v_n=u_n-\bar{u}$ we will center equation (2.60) in the neighborhood of the point of equilibrium $\bar{u}$. From (2.60) it follows that:

$$v_{n+1}=\frac{A+\sum_{i=0}^{k}(\tilde{a}_i-\tilde{b}_i\bar{u})v_{n-i}}{B+\tilde{b}\bar{u}+\sum_{i=0}^{k}\tilde{b}_iv_{n-i}}+\sigma v_n\xi_{n+1} \quad (2.61)$$

It is clear that stability of the trivial solution of equation (2.61) is equivalent to stability of the equilibrium point of equation (2.60).

Together with nonlinear equation (2.61) we will consider and its linear part

$$z_{n+1}=\sum_{i=0}^{k}\gamma_i z_{n-i}+\sigma z_n\xi_{n+1},\ \gamma_i=\frac{\tilde{a}_i-\tilde{b}_i\bar{u}}{B+\tilde{b}\bar{u}} \qquad (2.62)$$

Two following definitions for stability are used below.

Definition 2.1. The trivial solution of equation (2.61) is called stable in probability if for any $\varepsilon_1>0$ and $\varepsilon_2>0$ there exists $\delta>0$ such that the solution $v_n=v_n(\varphi)$ satisfies the condition

$$P\{\sup_{n\in Z}|v_n(\varphi)|>\varepsilon_1\}<\varepsilon_2$$

for any initial function φ such that

$$P\{\sup_{i\in Z_0}|v_n(\varphi_i)|\le\delta\}=1.$$

Definition 2.2. Zero solution of equation (2.62) is called mean square stable if for any $\varepsilon>0$ there exists $\delta>0$ such that the solution

$$z_n=z_n(\varphi)$$

satisfies the condition

$$E|z_n(\varphi)|^2<\varepsilon$$

for any initial function φ such that

$$\|\varphi\|^2=\sup_{i\in Z_0}|\varphi_i|^2<\delta.$$

If besides

$$\lim_{n\to\infty}E|z_n(\varphi)|^2=0$$

for any initial function φ then the trivial solution of equation (2.62) is called asymptotically mean square stable.

Since the order of nonlinearity of equation (2.61) is more than 1, then obtained stability conditions at the same time are ([9], [10]) conditions for stability in probability of the trivial solution of nonlinear equation (2.61) and therefore for stability in probability of the equilibrium point of equation (2.61).

Lemma 2.1. [4] If

$$\sum_{i=0}^{k}|\gamma_i|<\sqrt{1-\sigma^2} \qquad (2.63)$$

then the trivial solution of equation (2.62) is asymptotically mean square stable.

Put

$$\tilde{\beta}=\sum_{i=0}^{k}|\gamma_i|,\ \tilde{\alpha}=\sum_{i=1}^{k}|G_i|,\ G_i=\sum_{j=i}^{k}|\gamma_j| \qquad (2.64)$$

Lemma 2.2. [4] If

$$\tilde{\beta}^2+2\tilde{\alpha}\left|1-\tilde{\beta}\right|+\sigma^2<1 \qquad (2.65)$$

then the trivial solution of equation (2.62) is asymptotically mean square stable.

Lemma 2.3. [4] Let there exist the nonnegative functional

$$V_i=V(i,u_{-k},\ldots,u_i),\ i\in Z$$

for which the conditions

$$EV(0,u_{-k},\ldots,u_0)\le c_1\|\varphi\|^2,\ E\Delta V_i\le -c_2\,Eu_i^2,\ i\in Z$$

where

$$\Delta V_i=V_{i+1}-V_i,\ c_1>0,\ c_2>0$$

hold. Then equation (2.62) zero solution is asymptotic mean square stable.

Consider the vectors

$$\tilde{z}_n=(z_{n-k},\ldots,z_{n-1},z_n)^t$$

and

$$b=(0,\ldots,\sigma)^t$$

of dimension *k*+1 and the square matrix

$$A=\begin{pmatrix}0&1&0&\cdots&0&0\\0&0&1&\cdots&0&0\\\cdots&\cdots&\cdots&\cdots&\cdots&\cdots\\0&0&0&\cdots&0&1\\\gamma_k&\gamma_{k-1}&\gamma_{k-2}&\cdots&\gamma_1&\gamma_0\end{pmatrix}$$

Then equation (2.62) can be described in the form

$$\tilde{z}_{n+1}=A\tilde{z}_n+bz_n\xi_{n+1} \qquad (2.66)$$

Let the square matrix $U=\|u_{i,j}\|$ of dimension k+1 has all zero elements except for

$$u_{k+1,k+1}=1$$

and consider the matrix equation

$$A'DA-D=-U \qquad (2.67)$$

Theorem 2.5. Let equation (2.67) have a positive semidefinite solution D with $d_{k+1,k+1}>0$. Then, for asymptotic mean square stability of equation (2.62) zero solution, it is necessary and sufficient that the inequality:

$$\sigma^2 d_{k+1,k+1}<1 \qquad (2.68)$$

hold.

Proof. Consider the functional

$$V_n = \tilde{z}'_n D \tilde{z}_n + \sigma^2 d_{k+1,k+1} \sum_{i=1}^{k} z^2_{n-i} \qquad (2.69)$$

Calculating $E\Delta V_i$ by virtue of (2.69), (2.66), we obtain:

$$E\Delta V_n =$$

$$= E\left[\tilde{z}'_{n+1} D \tilde{z}_{n+1} + \sigma^2 d_{k+1,k+1} \sum_{i=1}^{k} z^2_{n+1-i} - \tilde{z}'_n D \tilde{z}_n - \sigma^2 d_{k+1,k+1} \sum_{i=1}^{k} z^2_{n-i} \right] =$$

$$= E[(A\tilde{z}_n + b z_n \xi_{n+1})' D (A\tilde{z}_n + b z_n \xi_{n+1}) - \tilde{z}'_n D \tilde{z}_n] +$$

$$+ \sigma^2 d_{k+1,k+1} E(z^2_n - z^2_{n-k}) =$$

$$= E[\tilde{z}'_n (A'DA) - D)\tilde{z}_n + b'Db z^2_{n-k}] +$$

$$+ \sigma^2 d_{k+1,k+1} E(z^2_n - z^2_{n-k}) = (\sigma^2 d_{k+1,k+1} - 1) E z^2_n$$

Let conditions (2.68) hold. Then the functional (2.69) satisfies the conditions of Lemma 2.3. It means that equation (2.66) zero solution is asymptotic mean square stable. It follows that condition (2.68) is sufficient for asymptotic mean square stability of equation (2.66) zero solution. Let condition (2.68) not hold, i.e.,

$d_{k+1,k+1} \geq 1$.

Then, $E\Delta V_i \geq 0$. From here it follows that

$$\sum_{i=0}^{k-1} E\Delta V_i = EV_k - EV_0 \geq 0$$

i.e., $EV_i \geq EV_0 > 0$.

It means that equation (2.62) zero solution cannot be mean square stable. Therefore, condition (2.68) is necessary for asymptotic mean square stability of equation (2.62) zero solution. Theorem is proved. Remark that for every *k*, equation (2.66) is the system of

$$(k+1)(k+2)/2$$

equations. Consider the different particular cases of equation (2.66).

Corollary 2.1. For k = 1 condition (2.68) takes the form

$$|\gamma_i| < 1, \quad |\gamma_0| < 1 - \gamma_1 \qquad (2.70)$$

$$\sigma^2 < d_{22}^{-1} = \frac{(1-\gamma_1)((1-\gamma_1)^2 - \gamma_0^2)}{1-\gamma_1} \qquad (2.71)$$

If, in particular, $\sigma = 0$ then condition (2.68) is the necessary and sufficient condition for asymptotic mean square stability of the trivial solution of equation (2.62) for k = 1.

Remark 2.1. Put $\sigma = 0$. If $\tilde{\beta}=1$ then the trivial solution of equation (2.62) can be stable (for example, $z_{n+1} = z_n$ or $z_{n+1} = 0{,}5(z_n + z_{n-1})$), unstable (for example, $z_{n+1} = 2z_n - z_{n-1}$) but cannot be asymptotically stable. Really, it is easy to see that if $\tilde{\beta} \geq 1$ (in particular, $\tilde{\beta}=1$) then sufficient conditions (2.63) and (2.65) do not hold. Moreover, necessary and sufficient (for k = 1) condition (2.68) does not hold too since if (2.68) holds then we obtain a contradiction

$$1 \leq \tilde{\beta} = \gamma_0 + \gamma_1 \leq |\gamma_0| + \gamma_1 < 1$$

Remark 2.2. As it follows from the Lemmas 2.1, 2.2, 2.3 and Theorem 2.5 at the same time are conditions for stability in probability of the equilibrium point of equation (2.60). From conditions (2.63), (2.65) it follows that $|\tilde{\beta}| < 1$.

Let us check if this condition can be true for each equilibrium point. Suppose at first that condition (1.6) holds. Then equation (2.60) has two points of equilibrium $\bar{u}_1$ and $\bar{u}_2 = 0$ defined by (1.7) and (1.8) accordingly.

Putting

$$S = \sqrt{(\tilde{a}-B)^2 + 4A\tilde{b}}$$

via (2.64), (2.62), (1.4) we obtain that responding $\tilde{\beta}_1$ and $\tilde{\beta}_2$ are:

$$\begin{cases} \tilde{\beta}_1 = \dfrac{\tilde{a}-\tilde{b}\bar{u}_1}{B+\tilde{b}\bar{u}_1} = \dfrac{\tilde{a}-\frac{1}{2}(\tilde{a}-B+S)}{\tilde{a}+\frac{1}{2}(\tilde{a}-B+S)} = \dfrac{\tilde{a}+B-S)}{\tilde{a}+B+S)} \\ \tilde{\beta}_2 = \dfrac{\tilde{a}-\tilde{b}\bar{u}_2}{\lambda+\tilde{b}\bar{u}_2} = \dfrac{\tilde{a}-\frac{1}{2}(\tilde{a}-B-S)}{\tilde{a}+\frac{1}{2}(\tilde{a}-B-S)} = \dfrac{\tilde{a}+B+S)}{\tilde{a}+B-S)} \end{cases} \qquad (2.72)$$

So, $\tilde{\beta}_1 \tilde{\beta}_2 = 1$. It means that the condition $|\tilde{\beta}| < 1$ holds only for one from the equilibrium points $\bar{u}_1$ and $\bar{u}_2$.

Namely,

if $\tilde{a}+B>0$ then $|\tilde{\beta}_1| < 1$,

if $\tilde{a}+B<0$ then $|\tilde{\beta}_2| < 1$,

if $\tilde{a}+B=0$ then $\tilde{\beta}_1 = \tilde{\beta}_2 = -1$.

In particular, if A=0 then via Remark 1.1 and (2.62) we have:

$$\tilde{\beta}_1 = B\,\tilde{a}^{-1},\ \tilde{\beta}_2 = B^{-1}\tilde{a}$$

Therefore,

$$\left|\tilde{\beta}_1\right|<1 \quad \text{if } |B|<|\tilde{a}|$$

$$\left|\tilde{\beta}_2\right|<1 \quad \text{if } |B|>|\tilde{a}|,$$

$$\left|\tilde{\beta}_1\right|=\left|\tilde{\beta}_2\right|=1 \quad \text{if } |B|=|\tilde{a}|.$$

so, via Remark 2.1 we obtain: equilibrium points $\bar{u}_1$ and $\bar{u}_2$ can be stable concurrently only if corresponding $\tilde{\beta}_1$ and $\tilde{\beta}_2$ are negative concurrently. Suppose now that condition (1.9) holds. Then equation (2.60) has only one point of equilibrium (1.10). From (2.64), (2.62), (1.4), (1.10) it follows that corresponding $\tilde{\beta}$ equals

$$\tilde{\beta}=\frac{\tilde{a}-\tilde{b}\bar{u}}{B+\tilde{b}\bar{u}}=\frac{\tilde{a}-\frac{1}{2}(\tilde{a}-B)}{B+\frac{1}{2}(\tilde{a}-B)}=\frac{\tilde{a}+B)}{B+\tilde{a}}=1$$

As it follows from Remark 2.1 this point of equilibrium cannot be asymptotically stable.

Corollary 2.2. Let $\bar{u}$ be an equilibrium point of equation (2.60) such that

$$\sum_{i=0}^{k}\left|\alpha_i-\beta_i\bar{u}\right|<\left|B+\tilde{b}\bar{u}\right|\sqrt{1-\sigma^2},\ \sigma^2<1 \quad (2.73)$$

Then the equilibrium point $\bar{u}$ is stable in probability.

The proof follows from (2.62), Lemma 2.1 and Remark 2.2.

Theorem 2.6. Let $\bar{u}$ be an equilibrium point of equation (2.60) such that

$$\left|\tilde{a}-\tilde{b}\bar{u}\right|<\left|B+\tilde{b}\bar{u}\right| \quad (2.74)$$

$$2\sum_{i=0}^{k}\left|\tilde{a}_i-\tilde{b}_i\bar{u}\right|<\left|B+\tilde{a}\right|-\sigma^2\frac{(B+\tilde{b}\bar{u})^2}{\left|B-\tilde{a}+2\tilde{b}\bar{u}\right|} \quad (2.75)$$

Then the equilibrium point $\bar{u}$ is stable in probability.

Proof. Via (1.4), (2.62), (2.64) we have:

$$\tilde{\alpha}=\left|B+\tilde{b}\bar{u}\right|^{-1}\sum_{i=0}^{k}\left|\tilde{a}_i-\tilde{b}_i\bar{u}\right|$$

$$\tilde{\beta}=\left(\tilde{a}-\tilde{b}\bar{u}\right)\Big/\left(B+\tilde{b}\bar{u}\right)$$

Rewrite (2.2.65) in the form

$$2\tilde{\alpha}<1+\tilde{\beta}-\frac{\sigma^2}{1-\tilde{\beta}},\ \left|\tilde{\beta}\right|<1$$

and show that it holds. From (2.74) it follows that $\left|\tilde{\beta}\right|<1$. Via $\left|\tilde{\beta}\right|<1$ we have:

$$1+\tilde{\beta}=1+\frac{\tilde{a}-\tilde{b}\bar{u}}{B+\tilde{b}\bar{u}}=\frac{B+\tilde{a}}{B+\tilde{b}\bar{u}}>0$$

$$1-\tilde{\beta}=1-\frac{\tilde{a}-\tilde{b}\bar{u}}{B+\tilde{b}\bar{u}}=\frac{B-\tilde{a}+2\tilde{b}\bar{u}}{B+\tilde{b}\bar{u}}>0$$

so,

$$2\sum_{i=0}^{k}\left|\tilde{a}_i-\tilde{b}_i\bar{u}\right|<\left|B+\tilde{b}\bar{u}\right|\left(\frac{B+\tilde{a}}{B+\tilde{b}\bar{u}}-\sigma^2\frac{(B+\tilde{b}\bar{u})^2}{\left|B-\tilde{a}+2\tilde{b}\bar{u}\right|}\right)=$$

$$=\left|B+\tilde{a}\right|-\sigma^2\frac{(B+\tilde{b}\bar{u})^2}{\left|B-\tilde{a}+2\tilde{b}\bar{u}\right|}$$

It means that the condition of Lemma 2.2 holds. Via Remark 2.2 the proof is completed.

Corollary 2.3. An equilibrium point $\bar{u}$ of the equation

$$u_{n+1}=\frac{\mu+\alpha_0u_n+\alpha_1u_{n-1}}{\lambda+\beta_0u_n+\beta_1u_{n-1}}+\sigma(u_n-\bar{u})\xi_{n+1} \quad (2.76)$$

is stable in probability if and only if

$$\left|\alpha_1-\beta_1\bar{u}\right|<\left|B+\tilde{b}\bar{u}\right|\left|\alpha_0-\beta_0\bar{u}\right|<$$

$$<(B-\alpha_1+(\beta_0+2\beta_1)\bar{u}\,\mathrm{sign}(B+\tilde{b}\bar{u}) \quad (2.77)$$

$$\sigma^2<(B+\alpha_0-\alpha_1+2\beta_1\bar{u})\times$$

$$\times\frac{(B+\alpha_1+\beta_0\bar{u})(B-\tilde{a}+2\tilde{b}\bar{u})}{(B-\alpha_1+(\alpha_0+2\beta_1)\bar{u}(B+\tilde{b}\bar{u})^2} \quad (2.78)$$

The proof follows from (2.62), (2.68), (2.69).

3. CONCLUSIONS

This study of the establish some results which show that the positive equilibrium point $\bar{u}$ of the difference equation (1.1) is globally asymptotically stable and every positive solution of the difference equation (1.1) is bounded, the periodic character and the necessary and sufficient conditions for asymptotic mean square stability of the equilibrium point of rational difference equation (1.1), if is exposed to stochastic

perturbations ξ_n which are directly proportional to the deviation of the system state u_n from the equilibrium point $\bar{u}$, the form $\sigma(u_n - \bar{u})\xi_{n+1}$.

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RESEARCHES REGARDING SOME SINTERED SAMPLES MADE UP OF DIFFERENT POWDERS

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***Abstract**: In this paper there are presented the results of a study about some physico-mechanical characteristics (time of sinterisation, density, hardness, stretching resistance, contraction) of sintered samples made of different powders. There were used: powders resulting from ball-bearings machining (RUL) and powders made by famous international companies (Mannesmann, Höganäs). All the results of the study are presented comparatively for the different samples.*

***Keywords**: powder, sintering, bearings, properties, samples.*

1. INTRODUCTION

With the grinding of components of ball-bearings, it is resulting an important quantity of sludge. With a rather easy technology, we can separate the powder from ball-bearings steel [1, 5].

By pressing and sintering, we can obtain parts what's characteristics and properties are presented as following.

2. CHEMICAL COMPOSITION OF SINTERED SAMPLES

The chemical composition of sintered samples, usually, different a little from the powder's chemical composition.

During sintering samples with iron base, the carbon level may be not in the normal limits, if the protecting atmosphere within the sintering furnace has not the prescribed composition.

In the case of sintered samples made of powder resulted from ball-bearings, chemical composition (%) is presented in Table 1.

Table 1 Chemical composition of sintered samples

C	**Mn**	**Cr**	**Ni**	**Cu**	**Al**	**Si**
0.2	0.31	1.74	0.2	0.4	1.61	1.4
Mo	**V**	**W**	**Ti**	**Mg**	**Zn**	**Fe**
0.2	0.007	0.1	0.1	0.01	0.03	<92

Chemical composition was determined with a spectrograph. As it can be observed from this table, the carbon's percentage is decreasing, reaching the value of 0.2%, and the other elements maintain there primary values [2,3].

Researches regarding chemical composition of sintered samples resulted from ball-bearings processing, show, that, these samples can be thermochemically treated as example - carburization or carbonitruration.

3. TIME OF SINTERISATION, DENSITY AND HARDNESS

The sintering time is an important parameter for the sintering of the pressed objects made of powders.

The research studies carried out have shown that the sintering time for the resulted powder in the case of bearings processing is of 90 minutes. If this value is higher, the variation of the mechanical properties is not significant.

In Figure 1, the hardness variation according to the sintering time is presented. The objects have been pressed with a pressure of 700 MPa and sintered at a temperature of 1150 °C.

Density and hardness are important parameters for the physico-mechanical

characteristics of any kind of material, and also for sintered samples. Sintered samples density is influenced in the first place by compressure pression (strength of pressure) of the powder. An important influence over density has the sintering temperature, but also the sintering time of the pressed material [2,4]. The hardness of sintered materials depends, in the first place, on density, and the nature of the powder.

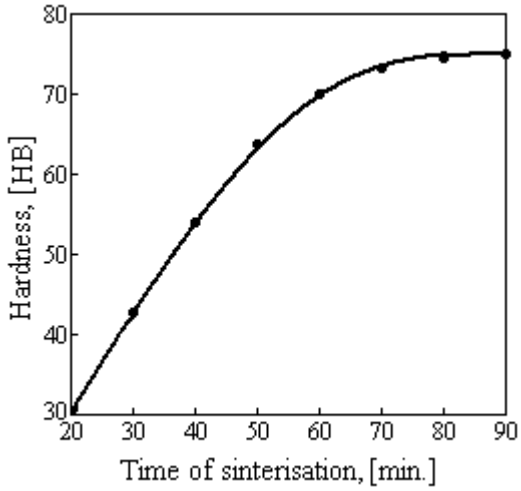


Fig. 1 Hardness Variation according to the Sintering Time

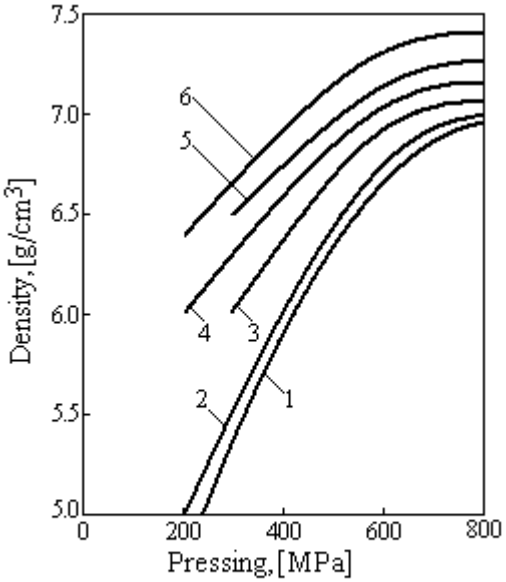


Fig. 2 Variation of density during sintering different powders

The study of these parameters, for the sintered samples made from ball-bearings processing, was made by compeering different sintered materials from different kinds of powders.

The results can be observed in Fig. 2.

Comparing the obtained values with the characteristics of some pieces made of powders produced especially for sintering, we can observe similarities.

At a pressure of 500-700 MPa, the density of pieces of RUL powder is approaching the hardness of pieces of high pressability, like Atomet 4601, Sumiron 4100 S.

As in the case of density, variation of hardness for the same types of powders is presented in Fig. 3.

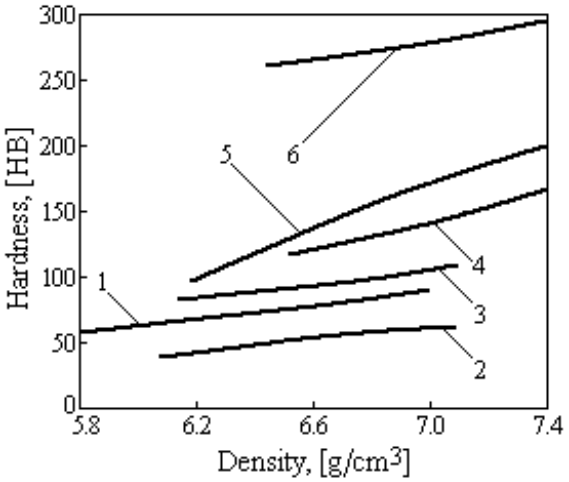


Fig. 3 Variation of sinterisation hardness for different powders

As it was expected, in the case of hardness, in a certain way there are maintained the relations as in variation of density. But, in some cases, sintered samples of powder resulted from ball-bearings processing, have a better hardness as other pieces (example: RZ 400).

4. STRETCHING RESISTANCE

There have been carried out several tests in order to determine the stretching resistance.

The results of these tests are presented in Table 2.

Table 2 Stretching Tests Results

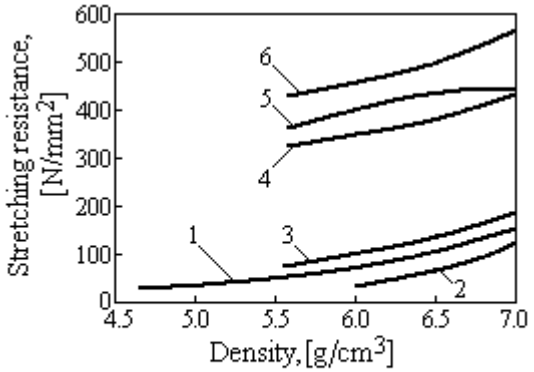
No.	Density, [g/cm^3]	Stretching resistance, [N/mm^2]
1	4.8	28
2	5.6	42
3	6.2	76
4	6.6	105
5	6.9	141

The samples for the stretching test have been pressed with pressures in between 300 and 700 MPa and sintered for 60 minutes at the temperature of 1150°C.

Stretching resistance is the main characteristic for determination of mechanical resistance of materials, and mainly of sintered samples too. Stretching resistance of sintered materials depends on factors like:

- physico - chemical characteristics of the powder;
- pressing parameters (strength, pressure), sintering parameters (time, temperature, atmosphere);
- porosity;
- the type of heat-treating after sintering.

Comparatively to the studied powders, stretching resistance of RUL powder is presented in Fig. 4



1-RUL, 2-Sumiron 4100S, 3-RZ 400,
4-Atomet 4601, 5-Ultrapac, 6-NC 100-24

Fig. 4 Stretching resistance

We can observe that stretching resistance of sintered pieces made of powders from ball-bearings processing, is approaching the stretching resistance of sintered pieces made from Höganäs powder (NC 100-24) and Mannesmann (RZ 400).

5. DIMENSIONAL VARIATIONS

Sintered materials can be successfully used rather then those obtained in a classical way, if dimensions and its variations are maintained beside the best tolerance.

Dimensionality is a very important parameter for the fabrication of sintered samples made from powders.

The exact determination of the variation of dimension and the right designing of pressing matrix, are permitting to make sintered samples without a later calibration.

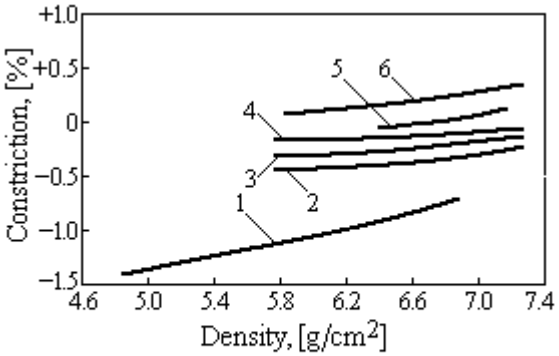
Variation of dimensions of sintered samples is influenced by:

- the type of the powder;
- the size of grain;
- density (table 3);
- compaction pressure;
- sintering parameters (temperature, time, atmosphere).

Table 3 Constriction Variation According to the Density

No.	Density, [g/cm^3]	Constriction, [%]
1	4.8	- 1.5
2	5.6	- 1.3
3	6.2	- 1.0
4	6.9	- 0.5

The values of constriction of sintered samples, made of the powders studied in this paper, are presented in Fig. 5.



1-RUL, 2-RZ 400, 3-Sumiron 4100S,
4-NC 100-24, 5-Atomet 4601, 6-Ultrapac

Fig. 5 Constriction of sintered samples

Sintered samples of RUL powder are containing a lot of iron, what is generating

constriction. Theoretically, because of the copper it should appear a growth of volume (copper is diffusing in iron at the sintering temperature; this will lead to acceleration of sinterisation, and the Fe particles have no time to get together), but because of the low percentage (0.40% Cu) contraction will take place [3,4].

6. CONCLUSIONS

The values of some physico - mechanical parameters for sintered samples made of powders obtained from ball-bearings processing (RUL) are in a lot of cases close to the values of sintered pieces made from other powders, especially produced.

It can be said that, from RUL powder it can be obtained parts with high density and hardness, and also with a good stretching resistance.

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MICROWAVES ELECTROMAGNETIC FIELD INFLUENCE ON PH. THEORETICAL AND EXPERIMENTAL RESULTS

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***Abstract**: Microwave radiation determines the pH modification of the watery solutions. The paper presents the influence of microwaves on watery solutions with both types of pH - acid and alkaline, using thermographic analyses.*

***Keywords**: pH, deionization, microwave.*

1. INTRODUCTION

The low intensity electromagnetic radiant fields of microwaves are often manifested in areas such as: fixed and mobile communications, satellite and terrestrial television systems, wireless computer networks, control systems in automation, measurement techniques and systems.

All of these radiant fields can be either guided or unguided, but regardless of the manner of propagation between emission and reception they enter into the contact with the substances from radiated zone.

If in radiated zone exists substances that contain watery solutions they are submissive to the specific effects of the microwave, most pithiness of this are:

- The heating effect in volume if in the watery solution exist free ions;
- The effect of deionization of the solution below radiant field influence.

The both mentioned effects determine the pH modification of the respective solution.

At the cessation of the radiant field, the temperature of the solution fall-back on the anterior state of exposure (to ambient medium temperature).

When the solution is submissive to the effect of deionization, in most of cases the return to the initial do not achieves and the modification of ions concentration remaining definitively.

Some quantitative and qualitative aspects of this process are related in this paper. The experiments were accomplished on watery solutions with both types of pH: acid and alkaline.

2. FUNDAMENTAL CONCEPTS

pH**,** named "potential of hydrogen", is defined as the cologarithm of the activity of dissolved hydrogen ions (H^+).

$$pH = \log_{10} C_{H^+} \quad (1)$$

C_H is the (dimensionless) activity of hydrogen ions, defined by

$$C_{H^+} = H^+ \cdot f_H \quad (2)$$

where: H^+ is hydrogen ions concentration [mol/liter]; f_H is activity coefficient of hydrogen ion.

Hydrogen ion activity coefficients cannot be measured experimentally, so they are based on theoretical calculations.

The pH scale is not an absolute scale; it is relative to a set of standard solutions whose pH is established by international agreement.

Usually, measured pH values will mostly lie in the range 0 to 14 (pH scale), with neutral value pH = 7.

Pure water is said to be neutral. The pH for pure water at 25 °C (77 °F) is close to 7.0. Solutions with a pH less than 7 are said to be acidic and solutions with a pH greater than 7 are said to be basic or alkaline.

pH determination is based on electrometrical method and is commonly measured by means of a combined glass electrode, which measures the potential difference, or electromotive force, E, between an electrode sensitive to the hydrogen ion activity and a reference electrode, such as a calomel electrode or a silver chloride electrode.

The potential difference depends on ions concentration of unknown pH solution and its temperature.

Hydrogen ions concentration of unknown pH solution (the combined glass electrode) ideally follows the *Nernst* equation:

$$E = E_0 + [(R \cdot T)/2{,}303 \cdot F] \cdot \ln a, \quad (3)$$

where: E is a measured potential; E_0 is the standard electrode potential (the electrode potential for the standard state in which the activity is one); R is the perfect gas constant (8310 J/grad·mol); T is the temperature in Kelvin; F is the Faraday constant (96.500°C/mol); a is ions concentration of solution.

(3) equation is equivalent by (4):

$$E = E_0 + [(60mV)(T/300] \cdot \lg a \quad (4)$$

3. RESEARCH METHOD

From (4) equation results:

1. Variation of measured potential E is linear dependent on solution temperature.

2. E potential depends on the logarithm of hydrogen ions concentration of tested solution.

3. E potential depends simultaneous on the multiplication T·lna.

The exposure of a solution in a microwave electromagnetic field determines two effects:

- Thermal effect (the solution heating);
- Deionization effect.

According to the (4) equation, the mentioned effects lead to pH potential modification.

It is known that pH unit has a linear variation depending on temperature.

$$1pH(T) = \frac{54{,}2}{273} \cdot T \quad (5)$$

where: 1pH is the pH unit mV equivalent; T is the temperature in Kelvin.

pH = 7 is invariable and his electric mV equivalent is zero. Hereby, we can consider that pH = 6 is the first unity of electric pH equivalent with negative polarity and pH = 8 is the first unity of pH electric equivalent with positive polarity.

Due to microwave radiation exposure, a pH known solution is warming up; its rise in temperature from T_a to T_b ($T_a < T_b$) determine the rise of pH electric equivalent (absolute value).

- In case of acidic solutions:

$$[7 - pH(T_a)] \rightarrow [7 - pH(T_b)] = \frac{[7 - pH(T_a)]}{273} \cdot 54{,}2 \cdot T_b \quad (6)$$

- In case of alkaline solutions:

$$[pH(T_a) - 7] \rightarrow [pH(T_b) - 7] = \frac{[pH(T_a) - 7]}{273} \cdot 54{,}2 \cdot T_b \quad (7)$$

where: $pH(T_a)$ is pH numerical indication at temperature T_a; $pH(T_b)$ is pH numerical indication at temperature T_b.

The equations (6) and (7) show the dependence between pH potential and temperature not considering the deionization effect. The mentioned equations are valid only for theoretical quantitative verification, because the measurement results denote different values.

The difference between results of theoretical calculus (equations (6) and (7)) and practical measurements emphasizes the simultaneity of the phenomenon manifested in microwave electromagnetic field.

The calculus of thermo effect influence and deionization effect influence about solutions fulfills separately (due to the superposition of the phenomenon) by equations (4), (6), (7).

4. EXPERIMENTAL RESULTS

The experiments have been accomplished using a thermographic camera and a pH-meter. The effects of microwaves (900MHz) were

investigated for 10 mg distilled water, pH = 2 solution and pH = 13 solution in two cases - on dielectric support and in absorbent medium.

In the next we present only a part of experimental results - the representative once.

Figures 1 to 6 show thermographic results in the beginning of the experiments (0 sec exposure - Fig. a) and after 60 sec exposure to radiation (Fig. b).

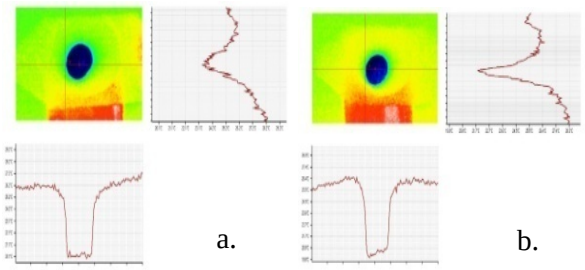

Fig. 1 Thermographic result - distilled water

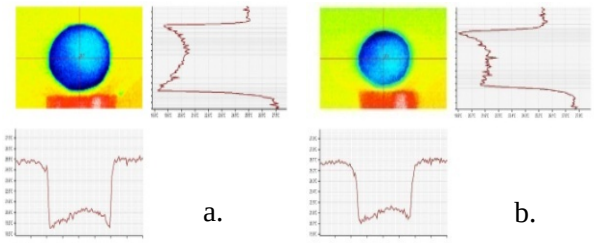

Fig. 2 Thermographic result - distilled water in absorbent medium

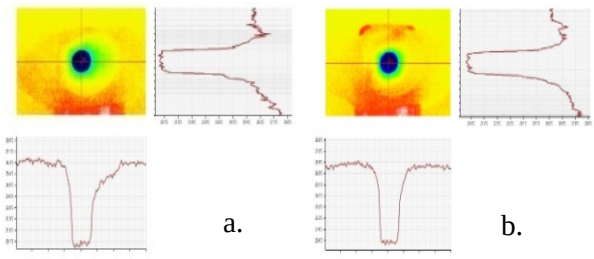

Fig. 3 Thermographic result - pH = 2 solution

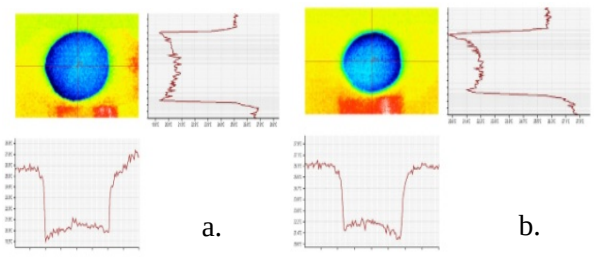

Fig. 4 Thermographic result - pH = 2 solution in absorbent medium

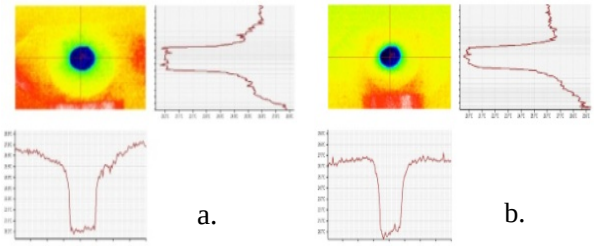

Fig. 5 Thermographic result - pH = 13 solution

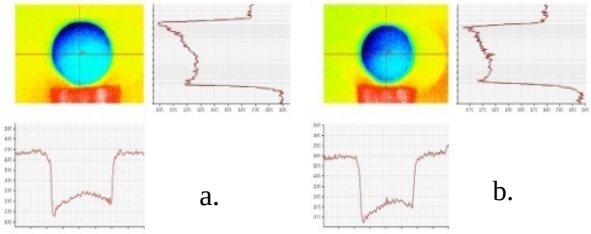

Fig. 6 Thermographic result - pH = 13 solution in absorbent medium

The thermal evolutions of solutions are presented in figures 7 to 12.

We observed that in case of distilled water on dielectric support, microwave radiation determines deionization - the thermal effect is cancelled (Fig. 7). The temperature evolution of the distilled water in absorbent medium (Fig. 8) denotes that the striking effect is the thermal once, followed by the deionization process. The same consideration is true for the pH = 2 solution exposure to microwave radiation.

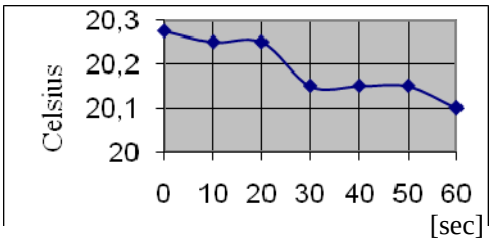

Fig. 7 Temperature evolution - distilled water

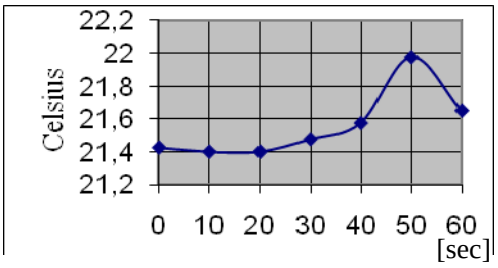

Fig. 8 Temperature evolution - distilled water in absorbent medium

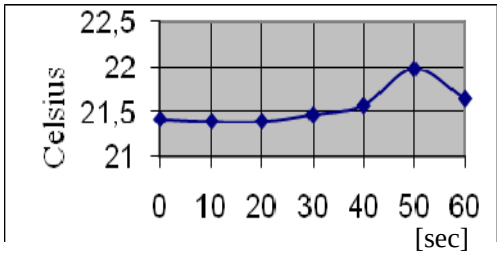

Fig. 9 Temperature evolution - pH = 2 solution

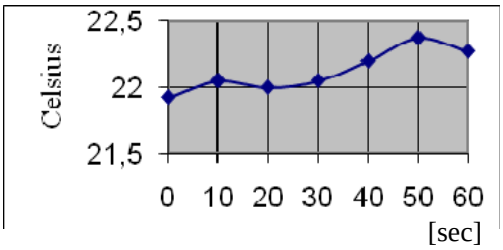

Fig. 10 Temperature evolution - pH = 2 solution in absorbent medium

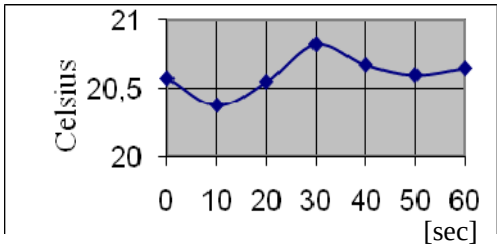

Fig. 11 Temperature evolution - pH = 13 solution

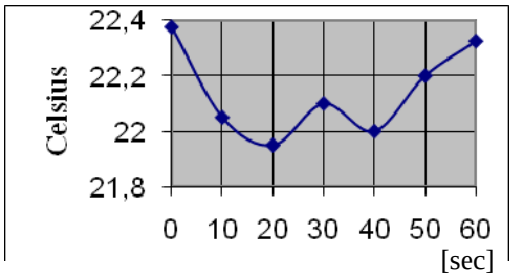

Fig. 12 Temperature evolution - pH = 13 solution in absorbent medium

In case of solution with pH = 13 the effects of microwave irradiation are succeeded: deionization and thermal. The peak at around 30 sec of exposure can be a result of the errors associated with the determination.

5. CONCLUSIONS

Microwave radiation affects pH of watery solutions as was theoretically demonstrated. Through the thermo graphic analyses we observed that the effects of microwave exposure are manifested in a different way for the two solutions: acid and alkaline.

The experimental results emphasize the complexity of phenomenon manifested due to microwave irradiation.

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CONSIDERATIONS ABOUT THE MICRO PROPELLER DESIGN AND IT'S INTERACTION WITH THE AERODYNAMIC SURFACES

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***Abstract**: This paper aims to present specific methods for optimizing the design of micro propellers. In order to better understand the goal of the paper, the effects of a micro propeller on the aerodynamic surfaces of a micro air vehicle are presented briefly, and then the analyzing tools of the micro propeller design. The final part aims to renew the interest in predicting the influence of the propeller-wing flow interaction on the aerodynamic characteristics of deflected slipstream and small wing aircraft.*

***Keywords**: MAV, micro propeller effect; aerodynamics, optimization.*

1. INTRODUCTION

Propellers are available in wood, nylon and reinforced plastics. The reinforced plastic propellers present the advantages of their ruggedness and efficiency, even though they weigh roughly twice the weight of their wooden equivalents.

Propeller effects

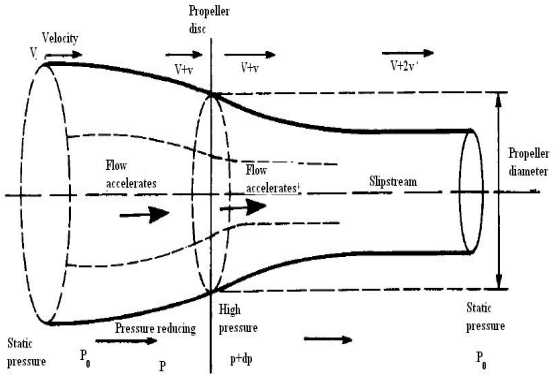

Fig. 1 Slipstream

- **Slipstream.** The slipstream moves (see Fig. 1 above) as a helix rotating around the airplane in the same direction as the propeller's rotation, but at higher than flight speed. It strikes body, wing and tail surfaces at angles and increases the drag of any obstacle in its path. Its most unfavorable impact is on the vertical tail surface – it causes yawing that calls for rudder-trim correction.

The increase in the velocity of the oncoming relative wind reduces the propellers effective pitch, as does one blade's downwash on the next. Such downwash further reduces the propeller's efficiency. The situation is made worse with three or more blades.

For model airplanes, such multi-blade propellers aren't recommended, except for scale models of aircraft so equipped.

In full scale aircraft, multi-blade propellers are used to absorb the high power of modern piston and turbo-prop engines.

They also reduce the propeller's diameter so as to avoid compressibility effects from tip speeds close to the speed of sound.

The loss of efficiency in this reduction must be accepted.

- **Asymmetric blade effect.** When the plane of the propeller is inclined to the direction of flight, the advancing blade operates at a higher AoA than the retreating blade. Thrust on the advancing side is higher than on the retreating side. This causes a pitching or yawing couple.
- **Pitching moment.** When the thrust line is tilted, a vector is introduced that

introduced that causes a pitching moment. It may combine with the asymmetric blade effect.

o **Torque.** The resistance to rotation caused by the propeller's drag tries to rotate the whole airplane in the opposite direction. This is particularly true in a steep climbing attitude at low forward speed and maximum rpm where the propeller is operating at high AoAs, such as just after liftoff.

A touch of opposite aileron input may be needed to off set the torque.

o **Gyroscopic precession.** Like a gyroscope, a rotating propeller resists any effort to change the direction of its axis.

The heavier the propeller and the higher the rpm, the greater this resistance. If a force is applied to tilt the plane of the propeller's rotation, it is "precessed" 90 degrees onward, in the direction of the propeller's rotation.

This effect shows up markedly on tail-dragger takeoffs if the tail is lifted too soon and too high. Precession causes a yaw to the left (for propellers rotating clockwise, viewed from behind) that could result in a ground loop unless corrected by rudder action.

One of the most important systems that determine the performance of the MAVs is its propulsion system (electric engine, batteries, and propeller).

The interaction between the propeller and aerodynamic surfaces is an important task in MAV design strategy because of the influence on stability, performance, energy consumption and noise.

In MAV design there are a lot of constraints given by the equipments and their loading restrictions, the significant differences given by the aerodynamics at very low Re numbers. In addition in the practical design it is possible to sacrifice the level of stability to achieve a better maneuverability or to reduce further the size of the vehicle.

The effects of propeller size and placement (with respect to the airframe) on performance and stability need some additional considerations.

The MAV design must be stable and controllable while minimizing electric power consumption. But these are *conflicting requirements*.

For example, the movement of the MAV's central of gravity to a forward position to improve the natural stability requires a forward movement of the central of lift, to maintain a proper pitch moment; this fact reduces the distance between the wing and the propeller, and this might influence the propeller efficiency and the overall torque budget.

In the literature there are different experimental approaches, with different advantages and limitations:

a) One approach is based on a physical separation of the power plant.
b) A strategy to measure/computation-nally predict characteristics of the resulting pattern of velocities within the flow field.

Force and moment measurements provide a single useful value, whereas more intensive velocity measurements can yield inside into a closer relation between the particular result and the given geometry. Our focus is to use both types of tools to develop a better framework for understanding the propeller airframe interference (PAI) effects for a flying wing MAV and to develop a better knowledge of the wing position.

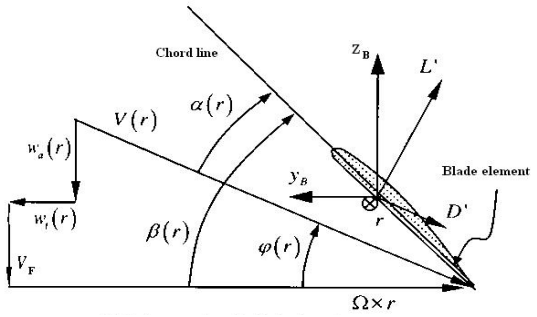

Fig. 2 Cross section of a blade element

2. A REVIEW OF ANALYZING TOOLS OF MICRO PROPELLER DESIGN

The basic tools in the literature include: an aerodynamic model, an acoustic model and a structural model.

The optimization framework involves a very high number of iterations and the models should be accurate and efficient.

a) The aerodynamic model

In this analysis the focus is on the distribution of the aerodynamic loads along the

blades, necessary to obtain the propeller thrust and required power.

Blade element models are based on the segmentation of each blade into small elements, which is equivalent with 2D analysis (Fig. 2).

The cross section is defined by it's radial coordinate, r, with y_B and z_B the cross sectional coordinates.

The resultant cross sectional velocity V is the sum of the vehicle air speed V_f, the circumferential velocity $\Omega \times r$ and the induced velocity components w_a and w_t.

The angle of attack, α, is obtained by subtracting the inflow angle, φ, from the pitch angle, β.

The 2D performance coefficients C_x, C_z are obtained by using aerodynamic database.

The lift and drag per unit length, are:

$$P = \frac{1}{2}\rho V^2(r)\cdot c(r)\cdot C_Z \qquad (1)$$

$$R = \frac{1}{2}\rho V^2(r)\cdot c(r)\cdot C_x \qquad (2)$$

The induced velocity components are calculated with the moment theory in an actuator disk model.

The equations that express the conservation of axial and rotational momentum are:

$$dT(r) = 4\cdot\pi\cdot\rho\cdot w_d(r)\cdot\left[V_F + w_a(r)\right]\cdot r\cdot dr \qquad (3)$$

$$dQ(r) = 4\cdot\pi\cdot\rho\cdot w_t(r)\cdot r\cdot\left[V_F + w_a(r)\right]\cdot r\cdot dr \qquad (4)$$

Equations 1-4 are solved for each blade element.

b) **The acoustic model**

Is used to compute the noise generated by the propeller and is based on the Flowes Williams/Hawkings equation:

$$\frac{1}{a^2}\cdot\frac{\partial^2(\Delta p)}{\partial t^2} - \frac{\partial^2(\Delta p)}{\partial \tilde{x}_i^2} = \frac{\partial^2 T_{ij}}{\partial \tilde{x}_i \partial \tilde{x}_j} + \frac{\partial}{\partial t}\left\{\rho_a\cdot V_i\cdot\delta(f)\cdot\frac{\partial f}{\partial \tilde{x}_i}\right\} - \nabla\left\{\Delta p_{ij}\cdot\delta(f)\cdot\frac{\partial f}{\partial \tilde{x}_j}\right\} \qquad (5)$$

where a is the speed of sound, Δp is the static pressure, t is the time and $\tilde{x}$ is the location vector of the noise source relative to a stationary system of coordinates. T_{ij} is the Lighthill stress tensor, Δp_{ij} is the generalized stress tensor, v is the source velocity vector and δ is the Kronecker's delta function, f is a function that defines the surface of the body that produces the pressure wave.

The expression for the loading and thickness noise expressions are 6-7.

$$\Delta p_{load}(\tilde{x}, t) = \frac{1}{4\pi}\sum_k \left\{ \begin{array}{l} \dfrac{\dot{F}\cdot\hat{r}_{rel} + F\cdot\hat{r}_{rel}\cdot\dfrac{\dot{M}\cdot\hat{r}_{rel}}{1-M_r}}{r_{rel}\cdot a\cdot(1-M_r)^2} \\ + \dfrac{F\cdot\hat{r}_{rel}\cdot\dfrac{1-M\cdot M}{1-M_r} - F\cdot M}{r^2{}_{rel}\cdot(1-M_r)^2} \end{array} \right\} \qquad (6)$$

$$\Delta p_{thick}(\tilde{x}, t) = \frac{\rho}{4\cdot\pi}\sum_k \left\{ \frac{\psi_0}{r_{rel}\cdot(1-M_r)^3}\cdot\left[\begin{array}{l} \dfrac{\ddot{M}_r}{1-M_r} + 3\cdot\left(\dfrac{\dot{M}_r}{1-M_r}\right)^2 \\ + \dfrac{\dot{M}_r\cdot a\cdot(1+2M_r)}{r_{rel}\cdot(1-M_r)} + 2\left(\dfrac{M_r\cdot a}{r_{rel}}\right)^2 \end{array} \right] \right\}_k \qquad (7)$$

c) **The finite element structural model**

It is important to ensure that the blades will be able to withstand the aerodynamic and directional loads.

The main assumptions are:

- Bending analysis is based on the fact that sections perpendicular to the elastic axis before deformation remain perpendicular to that axis.
- The torsion equation is based on the Saint Venant assumption.

The axial stress is given by (Timosenko, Gaudier):

$$\sigma_{xx-(i)}(x_{(i)}, y_{(i)}, z_{(i)}) = E\cdot\left[\begin{array}{l} \dfrac{P_{(i)}(x_{(i)})}{(EA)_{(i)}} + \dfrac{d^2 V_{(i)}(x_{(i)})}{dx_{(i)}^2} \\ \left[y_{C-(i)} - y_{(i)}\right] + \dfrac{d^2 w_{(i)}(x_{(i)})}{dx_{(i)}^2}\cdot\left[z_{C-(i)} - z_{(i)}\right] \end{array} \right] \qquad (8)$$

where E is the material tension modulus of elasticity, EA is the cross sectional stiffness in tension, $y_{C-(i)}$ and $z_{C-(i)}$ are the coordinates

of the cross sectional tension center.

The cross sectional shear stress components are computed based on the components of the cross sectional resultant shear force.

The maximum Von Misess is given by:

$$\bar{\sigma}_{(i)}\left(x_{(i)}, y_{(i)}, z_{(i)}\right) = \sqrt{\left[\sigma_{xx-(i)}\left(x_{(i)}, y_{(i)}, z_{(i)}\right)\right]^2 + 3\left(\tau^2_{xy-(i)} + \tau^2_{xz-(i)} + \tau^2_{yz-(i)}\right)} \quad (9)$$

3. OPTIMIZATION ASPECTS OF THE MICRO PROPELLER DESIGN

The method for optimization uses the three design tools already presented, that include the three major disciplines: aerodynamics, acoustics and structural analysis.

Giving the disciplines equal importance in the task of optimization and considering them all enables the designer to approach a variety of design problems.

Most of the researches concentrate on the design of the blades first and after that they search for an optimization of the propeller hub and spinner, as the latter two exert smaller influence on the propeller's performance.

In a traditional design process the variables are given by: the pitch angle distribution, the chord distribution and the thickness ratio distribution.

By dividing the design variables we ca deal with any design requirement easier.

The main categories are:

- general design variables, affect the global configuration: number of propellers, engine gear ratio, number of propeller blades, propeller radius, rotational speed, airspeed.
- blade design variables, define the geometry and structure of the blade: pitch angle, chord, sweep angle, mass, dihedral angle, structural properties cross-sectional variables, define the cross-sectional airfoil geometry: thickness ratio, lift coefficient. Any optimization problem can be defined as a search for the minimum of a particular function f(x), called a cost function.

The cost function is a measure of the quality of the design. So a general optimization problem can be described like this:

$$\min_{x\in\Re}\left[f(x)\right] \text{ subject to } g(x)=0,\ h(x)\le 0$$

With this design method more practical cost functions can be dealt with.

For example, if there is the need for high endurance, the cost function becomes the required power of the batteries. Using a cost function like this takes into consideration not only the propeller characteristics but the entire propulsion system. But the cost function is not limited to one goal. It can represent a combination of, let's say, fuel flow and maximum airspeed.

There are also constraints to the optimization problem regarding mainly four categories: aerodynamic, structural, acoustic and side constraints. The focus is on three optimization schemes: a simple genetic algorithm, an enumerative scheme and a scheme that uses the steepest-descent method.

The first method, as the name states is similar to an evolution process and starting from an initial random set of designs by using a genetic scheme leads to an improved population. Any cost function has more than one minimum, but only one of those is the global one, the advantage brought by this method being that it is capable of better predicting the region in which this global minimum is.

The next scheme used is the enumerative simplex scheme that is capable of dealing efficiently with a large number of design variables.

The final stage of the search for the better design uses a derivative-based method that is very effective in the cases in which the cost function has only one minimum.

The focus was set on the application of the steepest descent model that uses the gradient vector, involving the calculation of the N first derivatives of the cost function (where N is the number of design variables).

By using all these schemes at various stages of the design process we can optimize the final design.

The designer's role in the optimization procedure is a very important one and is shown when the need arises for defining the various optimization elements (design variables, cost function and constraints).

4. AN ANALYSIS OF THE INTERACTION BETWEEN THE PROPELLER AND THE WING FOR A FLYING WING MAV

This part aims to renew the interest in predicting the influence of the propeller-wing flow interaction on the aerodynamic characteristics of deflected slipstream and tilt wing aircraft; in the case of a wing in a slipstream generated by one or more propellers with an external flow due to forward motion of the wing the following assumptions are made:

1. The fluid is inviscid and incompressible.
2. Rotation in the slipstream is ignored and it is treated as a uniform jet.
3. The jet boundary is assumed to extend back in parallel direction.

Under these assumptions the perturbation velocity due to the wing can be represented as the gradient of a velocity potential which satisfies Laplace's equation.

At the boundary it is necessary to maintain continuity of both pressure and the traverse flow angle. Let V_j and V_i be the undisturbed velocities in the slipstream and the external flow.

Then if Bernoulli's equation is linearized, the boundary conditions can be expressed as:

$$\varphi_j = \mu\varphi_0$$

$$\mu\frac{\partial\varphi_j}{\partial n} = \frac{\partial\varphi_0}{\partial n} \qquad (10)$$

where $\Phi_j = \mu\Phi_0$ is the interior potential, Φ_0 is the exterior potential, and μ is the velocity ratio $\mu = \frac{V_0}{V_j}$.

In order to estimate the lift of a propeller-wing combination at an angle of attach it is necessary to allow for the direct contribution of the propeller thrust, the propeller normal force due to the inclined inflow, and change in the wing lift due to the propeller.

The propeller slipstream has three principal effects on the wing: it increases the dynamic pressure, it alters the angle of attack, and it decreases the lift slope.

All three effects must be estimated.

Assuming that the effect of the jet is small on the part of the wing outside the jet, it is possible to make an estimate by using superposition.

The increase in lift of the blown part of the wing, treated as if it were an independent plan form, is added to the lift of the whole wing in a free stream.

Provided that the wing completely spans the jet, the increase in angle of attack on one side of the jet should be compensated by the decrease on the other side, so the total lift should be about the same, although its distribution is altered.

5. CONCLUSIONS

We have presented the basics of the interaction between the propeller and the different aerodynamic surfaces. We have also analyzed the tools used for micro propeller design.

We have presented a method for designing propellers that includes three analysis capabilities: aerodynamics, structural and acoustics. By combining all these analysis into one tool for designing propellers we can better account for the characteristics of the entire air vehicle in the design process.

The new design method integrates vehicle aerodynamics and engine characteristics into the design process and we can safely say that the method for combining three different optimization schemes is beneficial when the design problem includes a high number of variables and constraints.

Another advantage of the new design method is that it allows for the definition of any practical cost function, leading to an optimal compromise between different goals. It is also important to mention that the new design method is capable of designing propellers under various constraints, such as acoustic or structural.

The part about the analysis of the interaction between the propeller and the wing for a flying wing MAV aims to renew the interest in predicting the influence of the propeller-wing flow interaction on the aerodynamic characteristics of deflected slipstream and tilt wing aircraft.

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THE INCREASING OF TECHNOLOGICAL PERFORMANCES FOR ALUMINUM CASTINGS BY APPLYING HOT ISOSTATIC PROCESSING

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***Abstract**: Hot isostatic processing (HIP), involves the simultaneous application of pressure and elevated temperature to materials. Under these conditions of heat and pressure, internal pores or defects within a solid body or a powder compact collapse and weld up. HIP is today used for a lot of applications, like upgrading castings (removing shrinkage pores in interdendritic space), densifying pre-sintered components, consolidation of powders and interfacial bonding. The paper presents some theoretical data for Densal applications and also, some experimental data about CastCon process applied to ATSi5Cu1 alloy.*

***Keywords**: HIP processing, diffusion bonding, Densal.*

1. INTRODUCTION

HIP is able to remove internal voids from all types of material and promotes diffusion bonding across the surfaces of the void.

The replacement of the void by continuous material is the basis for the improvements in mechanical properties that HIP provides.

HIP is normally the first thermal process after casting and results in homogenization of the cast microstructure.

HIP is not effective when the porosity breaks out at the surface of the casting.

In this situation the pressurizing gas enters the pore and there is no pressure differential to drive pore closure.

For this reason large steel sand castings and cast copper alloys do not normally respond well to HIP.

It is possible to enclose the casting in a welded capsule with ceramic grain surrounding the casting to act as a pressure transmitting medium.

An alternative is to identify and weld over the surface breaking porosity.

However, these procedures are usually cost-effective only with the highest-value products

2. INDUSTRIAL APPLICATIONS

2.1. Aluminum Alloys

Aluminum alloys respond particularly well to HIP. Typical improvements in mechanical properties are a doubling of elongation and an order of magnitude increase in fatigue life.

HIP is widely used on sand, low pressure die and investment castings for aerospace, automotive and general engineering applications.

Turbocharger compressor rotors are increasingly being HIPped as in order to meet demands for higher duties that require improves fatigue performance.

HIP can also improve the pressure tightness of pump housings by eliminating porosity that would otherwise be exposed during machining.

Aerospace aluminum castings are HIPped to achieve better X-radiographic standards as well as improved mechanical properties.

The HIP process parameters used by TTI Group ~ 500 ºC and (50 – 100) MPa (argon gas) for 1 hour - are suitable for the majority of commonly used alloy specifications. Heat treatment of aluminum alloys is also carried

out at Letchworth, offering the possibility of a "one-stop shop" for HIP and heat treatment of aluminum castings.

2.2. New Prospectives with Densal

Densal = DENSe ALuminum and was developed by Bodycote HIP Ltd.

Aluminum alloys are a very important material group in modern automobiles. The alloys' low density ~2.8 g/cm^3 combined with their proven mechanical properties offers automobile manufacturers new possibilities in lightweight construction.

Aluminum casting offers an attractive possibility of economically producing complicated net-shape components. However, regardless of the casting techniques or the alloy composition used, gas- and shrinkage-porosity can exist in the castings that negatively influence the mechanical properties of the component.

Densal is an innovative, post-casting, hot isostatic pressing, or HIP, densification process that remedies porosity problems. Using Densal in combination with proper foundry techniques results in a significant improvement in the mechanical properties of cast parts over parts without Densal.

The use of Densal ensures the economical and resource friendly production of high quality, defect-free cast aluminum components with mechanical properties that approach those of forged aluminum parts.

A prerequisite for successful Densal processing is that the porosity should not be surface connected, or contain high internal gas pressure.

The best results are attained with unmachined, sand- or permanent mould castings with undamaged casting surface (Fig. 1).

Densal improves aluminum castings which are subjected to high dynamic loads, such as are seen in safety-critical applications.

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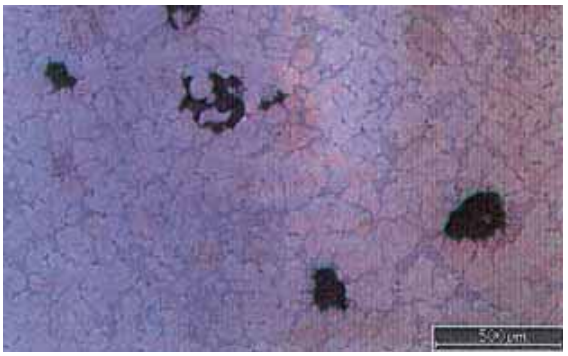
Densal delivers:

- higher mechanical strength;
- higher fracture toughness;
- up to an order of magnitude longer fatigue life;
- uniform mechanical properties;
- pore-free surface after machining;
- uniform properties throughout a production run;
- full x-ray inspection acceptance;
- better property adherence to attainable values.



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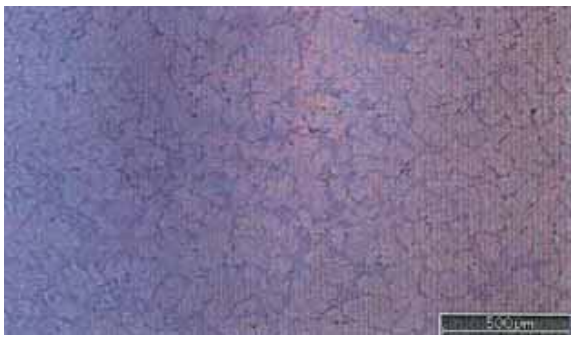

b)

Fig. 1 Aluminum component without Densal (a) and with Densal (b) for ATSi5Cu1 casting alloy

The best densification results from Densal are seen with unmachined, sand- or permanent mould castings with an intact casting skin. Porosity should not be surface connected and should not contain high pressure gas.

The Densal process allows for the economical production of high quality defect-free aluminium casting - which are comparable with forged components.

Applications for Densal use, are:

- highly dynamically loaded aluminum castings;
- safety critical parts made from aluminum alloys;
- defect-free sealing components and cosmetic parts.

Examples of Densal Usage

Aluminum casting are used significantly in modern,high-performance engines. Constantly increasing performance requirements for these engines increasingly bring these components, for example crankcases and cylinder heads, to their stress limits.Densal also offers further cosmetic advantages in manufacturing: after the process, when all sub-surface pores has been closed, and during machining, no unwanted porosity in the machined surface will appear. Without Densal porosity exposed through machining usually results in scrapped parts.

Fatigue Life Improvement with Densal

Rotating beam fatigue test of samples taken from the bearing support area of the crankcases mentioned previously prove that Densal increases fatigue life by the factor 10 for material: ATSi5Cu1.

3. THE CastCon PROCESS

The European automotive industry is known worldwide as the technically most advanced and innovative. Based on economical and political pressure to reduce fuel consumption and CO_2 emission the efforts for light weighting in automobile design and constructions have increased significantly and specific solutions based on the intensive use of aluminum as modified or new alloys have been developed in the last decades [6].

The European automotive industry has more than doubled the average amount of aluminum used in passenger cars during the last decade and will do even more so in the coming years. In the year 2000 an average of 102 kg aluminum was used in automotive parts in Western Europe, with 59 kg in engine parts, 11 kg in structural parts, 6 kg chassis applications and 5 kg for body-in-white (21 kg others). Based on current developments in new model generations with innovative aluminum concepts it can be estimated that the use of this material in European passenger cars will more than double in the next decade.

One of the main advances of aluminum is its availability in a large variety of semi-finished forms, such as shape castings, extrusions and sheet. Such semis are very suitable for mass production and innovative solutions in the form of compact and highly integrated parts that meet the high demands for performance, quality and cost efficient manufacturability.

As part of these advantages are given by CastCon technology. Table 1 outlines its general capabilities.

Table 1 CastCon Prototyping Capabilities

Parameters	Capabilities
Shape	Simple to very complex;
Size	From less than one ounce to over a hundred pounds;
Dimension Accuracy	1% or greater without post-machining (would depend on material, size and shape);
Materials	Various Steels, Cu, Co, Ni, Ti alloys as well as metal matrix composites;
Structure	Most any geometric shapes including holes, internal channels and bonding;
Mechanical Properties	Equivalent to forged parts;
Surface Roughness	N11 or better without post-machining;
Quantity	From prototype up to production runs;
Cost	From less than 1 USD for large quantities - to a few thousand USD for large complicated parts

CastCon begins with a sand mold formed with a pattern and made from a selected sand and binder mixture. A powdered material is fed into the cavity of the sand mold either dry or wet. The powdered material is then heated and isostatically pressed with a high pressure source. The sand mold acts as a pressure transmitting medium, uniformly consolidating the powdered material within the mold [5].

The major advantages of the CastCon process include:

- excellent shape forming capability inherited from the vast usage of sand molding techniques in the metal casting industry;
- good mechanical properties equivalent to forged parts. The CastCon process is rapidly approaching commercialization. Opportunities currently exist to implement this advanced manufacturing process in a production

application. Product flexibility, superior properties, and a reduced total cost makes the CastCon process enticing to members of the rapidly advancing manufacturing community, as given advantages:

- due to zero porosity and fine microstructure;
- great flexibility of producing a wide variety of metallic, intermetallic, ceramic and composite components facilitated by using various powdered materials and their mixtures;
- capability of producing macro composites by bonding different powders, or a powder to a solid, or a solid to a solid;
- an unique powder coating method for improving abrasive and corrosion resistances.

3.1. Experimental data

Experimetal tests were applied to casted samples from ATSi5Cu1 alloy [5]. Isostatically, the samples were tested CIP at 100 MPa for 120 min. The pressed structure was obtained after rapid cooling in water from 510 ^{O}C in so called "incubation period".

Table 2 Mechanical properties of ATSi5Cu1 alloy

Lot Samble No.	Tensile strength [N/mm2]		Compression strenght [N/mm2]		Elongation [%]	
	Classic test	Cast Contest	Classic test	Cast Contest	Classic test	Cast Contest
1	129.2	136.0	291.9	335.2	6.92	10.45
2	118.2	136.2	290.4	329.7	6.74	10.70
3	109.5	129.2	280.1	327.9	6.23	11.40
4	115.4	125.0	267.6	328.3	6.19	9.90
5	123.8	125.3	271.7	321.6	6.72	11.12

Mechanical properties are given in Table 2 and are obtained after natural ageing for a period of 7 days. The CastCon process is rapidly approaching commercialization. Opportunities currently exist to implement this advanced manufacturing process in a production application.

Product flexibility, superior properties, and a reduced total cost make the CastCon process enticing to members of the rapidly advancing manufacturing community.

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BILINGUALISM IN THE UNITED STATES OF AMERICA. THE *GLOSSOLALIA* ISSUE

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***Abstract**: The present paper analyses the bilingualism issue within the framework of the United States of America laying emphasis upon the concept of 'glossolalia', 'the speaking in tongues', a way of elevating language, a means of creating a foreign language, acquiring a language, which is a socially determined phenomenon. ilingualism must be perceived as both a societal and individual concern, due to the fact that languages bilinguals speak affect each other in various ways so much that there is a regular study of what happens when two languages come into contact. he focus is laid on the main ethnic minorities, their past and present place in the society as well as the degree to which they have been integrated in the American culture and civilization.*

***Key words:** bilingualism, glossolalia, speaking in tongues, language, society, culture, America.*

1. INTRODUCTION

Glossolalia is another way of elevating language, a way of creating a foreign language, so to speak. It is interesting that this phenomenon does not occur in Judaism, which uses archaic Hebrew for worship.

An unusual religious discourse activity is *speaking in tongues* known scientifically as *glossolalia*. This is unusual because the utterances are not in a recognizable language.

Acquiring a language is very much a socially determined phenomenon. No child can learn an oral language without hearing one speaking.

2. INDIVIDUAL AND SOCIAL BILINGUALISM

Many people speak more than one language. They may have different levels of proficiency in each of their languages and use them for very different social situations. The languages that bilinguals speak affect each other in various ways, so much that there is a regular study of what happens when one language comes into contact with another.

In some countries, one or more languages are being abandoned and many have disappeared.

In the United States, many assume that every person usually speaks a language, the language of his or her country, being usual to speak two or more languages in the same country.

Bilingualism is both a societal and an individual concern. Although the United States is usually considered a monolingual nation, it has never been actually.

The United States plays the role of the home to Spanish, Italian, German, French, Polish, Yiddish, Swedish, Norwegian, Danish, Russian, Greek, Chinese, Filipino languages, Portuguese, Japanese, Korean, Navajo, and Vietnamese.

Grosjean [3] took this list from a 1976 United States government survey. That survey did not pick up other languages that were spoken in this country in 1976, and are still spoken such as Ukrainian, Armenian, Finnish, different languages from India and Africa, Native American (NA) languages other than the Navajo, and several varieties of Arabic. There are also a small number of speakers who

have retained the languages of their native Yugoslavia, Hungary, and Czechoslovakia.

Since the 1976 survey, several other Southeast Asian languages have been adopted to the pot, especially Hmong, Loatian, Mien, and Cambodian.

Not only are the languages different from each other, but also the cultures of the people who speak them.

As a result of the great cultural differences, often Southeast Asians have not been assimilated as well as other non-English speaking groups, including Hispanics.

There are many questions regarding the impact of bilingualism on different societies, as well as the impact of a certain society on its speakers of these languages and on the languages themselves.

How many will survive alongside English, and what problems might they pose for the educational system?

During the greatest waves of immigration, foreign-speaking children have been expected to learn English on their own. Anyway, children were usually English-speaking, in order to be assimilated into the American culture.

Nowadays, there is bilingual education for children who are immigrants, but language retention is not an insignificant issue.

When people loose the language of their culture, their families' ties can be weakened as well as their religious ties and their sense of ethnic identity and community.

When two languages come into contact, they inevitably affect each other. In the most extreme cases, languages known as Creoles are formed from the languages in contact, resulting in a new language which is a combination or blending of two or more parent languages.

Many scholars believe that the many varieties of Black speech in the United States and the Caribbean resulted from the marriage between various African languages and English, Spanish, or French. This is an example of *societal change*.

Creoles are developed, learned and spoken by entire segments of a society.

During former President Carter's visit to Poland, a United States government translator embarrassed the president by mistranslating the verb '*desire'*, the Polish word for *sexual desire, lust*, choosing an inappropriate word translatable by one meaning of English *desire.*

The Polish have a completely separate word for English *desire* in the sense of '*would like to'* as in '*we desire (would like to) be friends'* and English happens to attach both meanings to one word and Polish does not.

In some American cities there are Jewish bakeries that sell corn bread. Americans, even those who are Jewish, often think that such bread is made entirely of corn meal. But it is made from rye, one of the grains called '*korn'* in Yiddish.

In older English, corn also meant *rye* as well as other grains.

'Often general words, words without very specific semantic features are translated from one language to another. For instance, the Pennsylvania Dutch say, "It gives rain" under the influence of "es gebt rejje". If a bilingual's original language has a word that sounds like one in their second language but has a different meaning, frequently that word will adopt the meaning of the new language. This has been the fate of the Italian "fattoria", which in America means factory but in Italian meant "farm". Greek "karry", now "car" originally meant "wagon". American Portuguese "pinchar" now means "pinch" as well as its original "jump"' [2].

Thus, '*English words have crept into virtually all the immigrant languages. Florida Spanish developed "pelota de fly" for "fly ball". American German has "fleysch pie" for "meat pie". Mexican- American boys can be very "tufo" (tough) as they race cars with tires that are "eslika" silk. A car has a "breca" brake, "bomper" "bumper", and "guipa" wiper. To be out of control is "esta de control'*" [2].

Transferring a word from one language to another is not difficult.

3. MAINTAINING BILINGUALISM

There is a question that often arises in the mind of many linguists and sociologists regarding the impact and the importance of bilingualism, if it changes the words of the

mind, or if it makes one more intelligent, better to think in one way.

Some claim that knowing two languages allows one to think in two separate systems and there is another belief that one's language influences the thinking.

Recent studies indicate that there are benefits of bilingualism and also different degrees of bilingualism.

There are perhaps few bilinguals capable to speak very fluently two languages, and even if they are equally proficient, they may speak each of their languages only in different social situations or even switch languages in one social situation.

In order to decide if bilingualism confers mental flexibility or any other benefit, one has to test speakers who are equally good in both languages and who are of the same social class and age group.

But for an adult, it is difficult to learn another language, based on the first language, typically resulting a foreign accent and errors in discourse, syntax and vocabulary.

There is a clear evidence that such foreign accents have left permanent marks in American English pronunciation, although words from many immigrant groups have been adopted.

Immigrants who came to America in their 20s may still speak with an extremely thick accent when they are in their seventies, foreign accents being caused by the misperception of sounds.

Speakers seem to hear the sounds in a new language through a filter of their own language, converting new sound to one already in their linguistic repertoire that shares some features.

Many Germans who resettled in America during the 1930s and '40s still say '*zis sing'* for '*this thing'*.

Uriel Weinreich pointed this out in his study entitled *Languages in Contact* [8]. For instance, his grandmother always spoke of '*washing her hairs',* she always put her hand '*in the pocket'* and not '*in her pocket'* and she often complained '*I'm waiting since four hours'*. All of these were transferred from her native language.

Another factor may also interfere. Speakers remember semantic content or lexical choices, not the syntactic form.

People do not always notice the syntax that another person is using to encode an idea and much of the so-called bilingual interference perhaps proceeds from the same cause.

To a certain degree, one reason for the loss of many languages of different groups is that the variety they spoke was associated with poverty, persecutions and even ignorance and when the language was taught in schools, it was the standard dialect, not the one the immigrants themselves brought with them.

The larger the community of speakers of a given language, the longer the language is likely to be retained. In earlier decades, in regions with large populations of non- English speakers, business, social and church matters were often not conducted in English. Over time, except for Spanish, there has been a steady erosion of non-English languages in the United States.

It has already been noticed that foreign languages survive best where there are large enough populations so that daily social activities can be carried on in that language.

The population of the German neighborhoods of Chicago, for instance, decreased from about 161,000 to around 99,000 in the ten years from 1960 to 1970. Despite the existence of German shops, churches, radio programs, children's singing groups, soccer teams, clubs, the language is less and less spoken, but language retention in the United States is not only a matter of loosing immigrant languages, but also the Native American Languages. Southwest Hispanics were there when the English came.

Southwest Spanish speakers avoided using Spanish terms whenever they could, even terms that Anglo-Americans typically use like '*corral', 'lariat', 'frijoles',* and '*chaps'*. If they had to pronounce a Spanish word, even their own names, they would anglicize it, a behavior present in other cultures as well.

Yiddish speakers anglicized their names of their foods, so in New York City, '*kishke',* a kind of sausage, became '*stuffed derma'*.

People with Yiddish names americanized them so that '*Bayla'* became '*Bella'* and '*Tible'* became '*Toby'*.

The very large number of Spanish speakers in the United States is one of the reasons for which language is not dying out: Southwest Spanish speakers in Arizona, Texas, and California, and the Puerto Ricans and Cubans in the East, but there are now Spanish speakers from South America, such as those from Columbia, and others from Central America.

The need for Spanish bilingual professionals is very great: Spanish-speaking physicians, nurses, lawyers, teachers, and social workers. In these days, international business and financial institutions also need Spanish-English bilinguals. Moreover, Spanish is the second most widely spoken language in the world.

Except for Native American languages, no other language has as much legitimacy as Spanish has in the Southwest, a legitimacy conferred because the Spanish speakers were there before the English and in many states Spanish is not truly an immigrant language.

The Louisiana and French-Canadian speakers also have as much historical justification as do the English speakers. Nowadays, in the United States those who speak French usually also speak English.

The non-dominant language leaves traces in the dominant one in names for food, geographical features, and other common words.

Many Spanish words have entered American English like '*mesa'*, '*canyon'*, '*tostada'*, '*nada'* and even '*amigo'*. This can happen with non-native languages as well.

4. NATIVE AMERICAN LANGUAGES

Ironically, the original inhabitants of America, the Native Americans (NAs), commonly called Indians, were never able to claim their languages after the Europeans colonized their territories.

Many people think of NAs as being a monolithic group. Actually, different tribes with very different cultures and languages extended from Maine to Florida, Alaska to California, and all points between these regions.

It is estimated that there were between 500 to 1000 separate languages spoken in America north of Mexico. Each family has or had several separate languages and dialects.

A language family is a group of languages that can be shown to have been separate from one common language.

For instance, the Algonquin family included several languages spoken throughout central Canada, the Great Lakes, parts of the Southwest, and the Eastern seaboard with two distant relatives in California.

When Europeans came, saw and conquered the New World, they were not interested in the NA languages. Besides this, the conquered people were far more primitive both in social organization and technology than were the conquerors. Consequently, many NA languages disappeared with their tribes.

According to the 1970 census, there were estimated 764,000 NAs in the United States, belonging to about 150 distinct cultures. Most of these were English-speaking and only 34 percent reported an NA or Eskimo language as their first language. The Aleuts, Eskimos, and NAs in Alaska have maintained their language. About 82 percent of the Crows in Montana speak their language as a mother tongue.

5. OFFICIAL LANGUAGES

Despite the extensive bilingualism in the United States, for official purposes, so to speak, it is essentially a monolingual country.

English is the official language of the land for all purposes. A unified country requires that one language be understood and used by everyone.

While traveling in Florida, one sees stickers like '*one language, one country'*. All over the country, English speakers resent laws requiring bilingual education, bilingual notices and bilingual directions.

Americans certainly feel that if immigrants are going to come there, their national identity, and civil rights shall be affected and shall undergo many changes.

In California, Arizona, Texas and New Mexico, Anglos forget that they are the immigrants.

And Spanish speakers settled those states first and obviously everyone forgets about the Native Americans.

Even a country like the United States has no law proclaiming that English must be its official language. Laws are written in English, the courts are conducted in English, as well as classrooms.

Official languages are needed both for government and education. But language is a very personal and emotional issue.

Because of the problems caused by multilingualism in new nations, some linguists and sociolinguists have become involved in language planning.

Before a language is made official, it requires a very careful study, in order to determine the attitudes toward it. Planners must decide what languages will be employed in elementary schools.

It must be one that will not repulse natives, one that is easily spoken in different social situations, including school and business.

Choosing official languages must take potential problems into account. How can be these languages preserved as means of communication even if another must be made official for other reasons, and what is its role?

6. CONCLUSIONS

Multiculturalism as a process represented, it represents and will remain the most important element, and complex *'engine'* of a society and of the world itself.

In the United States of America, multiculturalism is not an official policy at the federal level, but according to William Haviland [5], at the state level, it is sometimes associated with English-Spanish bilingualism.

Many different nations, cultures, ideologies, aspirations, educational levels, skin colors, language heritages, all these elements have always created differences and racial conflicts.

In a country that is multiethnic and multicultural, a bilingual and multilingual country, racial inequality and intolerance are likely to exist.

Multiculturalism represents a positive and essential element of today's American society.

Multiculturalism is the term which recognizes values and celebrates cultural diversity.

It accepts and respects the right of all people to express and promote their individual cultural heritage, within a shared commitment to that country, and the basic structures and values of democracy.

The term *multiculturalism* describes the cultural and ethnic diversity of the contemporary world.

The United States of America is and will remain a culturally diverse country trying to promote this diversity which is a positive aspect of society. Such a cultural diverse society also means a linguistically rich society.

The *melting pot* attitude did not require a detailed knowledge of American history, acquisition of a complex cultural heritage.

It allowed interest in the culture of a country of origin, and family ties with that particular country [6].

All human behavior originates in the use of symbols, an opinion that all anthropologists share. Art, religion, and money involve symbols. The Christian cross, the Jewish Star of David, or many objects of worship may bring to mind centuries of struggle, they may stand for a whole philosophy or creed.

But the most important symbolic aspect of culture is language, the use of words for objects. Through language, humans are able to transmit culture from one generation to another.

In particular, language makes it possible to learn from shared experiences.

Bilingualism in the United States of America must be perceived as both a societal and individual concern.

It is worth to mention that every single individual must accept and understand the ethnic minorities, their past and present place in society as well as the degree to which they have been integrated in the American culture and civilization, thus understanding the transformations of any kind, especially

linguistic and demographic ones, which inevitably lead to a social and linguistic development.

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THE IMPACT OF THE RISK IN AUDITING FINANCIAL STATEMENTS

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Abstract*: Any investor who has to use a financial audit report expects from the auditor an endorsement, a guarantee of the business continuity and, why not, the fact that the business entity s/he has invested his/her financial capital in is not subject to any risks. Many users put the sign of equality between economic failure and the audit risk. Economic failure occurs when the business entity is unable to repay its debts to its creditors because of general or specific economic causes: economic crisis, bad management or inadequate accounting or fiscal policies. The audit risk belongs exclusively to the auditor and appears when the financial statements contain significant errors, but the auditor concludes that the financial statements present a true and fair view of the financial position, of the performance and the change of capital. Because the auditor uses some evidence based on tests, there is a certain risk that s/he will not find a significant fraud.*

Key words*: audit, audit risk, control risk, inherent risk, undetectable risk, financial situations*

1. RODUCTION

The dynamics of the financial and economic development has transformed the nature of the financial management and has also forced the investors and the managers to understand risk in a very different way from the way it was perceived before.

In this context, the activity of audit and certification of financial statements has improved, i.e. it adapted to the new requirements of the business entities and the investors. All these have led to an upgrade of the requirements of the risk assessment. Today, each and every transaction is subject to country, management, evasion, and even bankruptcy risks.

The complexity of the economic and financial transactions, the internationalization of business, the disputes between countries and the level of training of those who prepare financial statements often lead to errors and even fraud. That is why, between those who prepare financial statements and their users a new type of professionals, called *financial auditors* appeared. They express their opinion related to the quality of the financial statements. That is why many investors put the sign of equality between the economic failure and the audit risk.

2. WAYS OF APPROACHING THE AUDIT

Any business entity that contracts an audit mission expects that the financial auditor should offer it a guarantee of the continuity of its business and should tell that it is not subject to any kinds of risks. As the auditors collect the information based on tests or samples, to discover a well hidden fraud may be difficult, and there is always a risk not to discover a significant error, although the audit is conducted in accordance with the international auditing standards.

The expression "to obtain reasonable assurance" is intended to inform users that the auditors can not provide absolute assurance just looking at the fair picture of the financial statements.

The auditors make a critical assessment of the financial statements, and the methods and techniques for obtaining audit evidence in achieving the objectives improve the quality of

the financial information and minimize the risks to which the business entity is subject to.

As regards the way of approaching an audit, there generally are the following types of approaches [3]:

a. the analytical procedures approach;

b. the financial - accounting balance sheet approach;

c. the approach based on management systems;

d. the risk-based approach.

The analytical procedures approach – the audit resources aim to testing the large volumes of the transactions and the financial-accounting balances, without relying, in particular, on the areas specified in the financial situations.

The financial-accounting balance sheet approach consists in applying the analytical procedures to the financial-accounting balance, only a few limited procedures being performed on the income statement/ the profit and loss account. This type of approach is justified by the fact that if the management's statements of all accounts of the financial - accounting balance (financial position) are tested and verified, then, the performance for the audited financial year will not be significantly erroneous.

The approach based on systems – the auditor assesses the effectiveness of the internal controls of a business entity and then directs the analytical procedures to those areas which are deemed not covered by the internal controls or areas where the internal controls have not worked as planned.

The risk-based approach – the auditor materializes and redirects resources to those areas of the statements that may contain errors, as a result of the risks facing the audited business entity.

3. DEVELOPING A RISK-BASED AUDIT

Since there is no approach to the audit process to ensure the performance of achieving a perfect audit, it is accepted that, for a large part of the larger entities, the *risk-based approach* will minimize the possibility that the audit objectives are not met. The International Auditing Standard 315, *"Understanding the business entity and its environment and assessing the risks of significant errors"* [1], requires auditors to adopt a risk-based approach. ISA 315 also requires auditors to perform the risk assessment of the significant false statements at the level of statements and financial statements, evaluations based on a proper understanding of the business entity and the environment, including the internal controls.

In short, this approach requires the auditors to identify the daily key risks facing the business entity and to consider the impact that these risks can produce on the financial statements and then plan their audit procedures accordingly. Therefore, this approach is also known as "*the business risk approach*".

When using the audit approach based on risk and assessing its effects on the financial statements, the risks can be classified as follows:

a) the financial risks, such as the cash flow risk;

b) the compliance risk - the risk of the violation of the laws and regulations;

c) the operational risks - such as the risk of losing the mission and the risk of losing the data.

Within the risk-based approach the most important objective is to reduce the risk audit – the risk that the auditor has an inadequate opinion about the financial statements.

In conclusion, when planning the audit, the auditor should ascertain how the business risk is related to the business entity's risk and then determine how the business risk approach is essential in using the audit model.

3.1.THE RISK OF THE FINANCIAL STATEMENTS

The audit risk is a function of the risks of the financial statements (the risk that the financial statements to be significantly inaccurate) and of the risk linked to detection (the risk that the auditor does not identify such mistakes).

The risk of the financial statements has two components: *the inherent risk* and *the control risk.*

The inherent risk is the susceptibility of the sold of an account or a class of transactions containing incorrect information that may be individually significant or when they are cumulated with inaccurate information from other sold or other transactions, assuming that there aren't adequate internal controls.

The inherent risk is inversely proportional to the risk of planned detection and directly proportional to the quantity of verified information. A high inherent risk to a particular audited area will increase the quantity of the audit evidence. The inherent risk is limited either to the nature of the element of the financial accounting balance that is analyzed, such as a provision that is expected, or to the nature of the business entity or the industry in which it operates.

The control risk is the risk as an error that could occur in a statement, which could be significant either individually or when combined with other errors, or can not be prevented or identified and corrected in time by the internal controls.

The auditors take into account the control of a business entity together with the detailed control activities and the objectives of the control risk assessment systems of a specific area of the financial statements. The auditor has no control over the size of the control risk or the inherent risk; these are risks of the audited business entity.

The undetectable risk is the risk that the auditor's procedures do not identify an existing error in a statement, error that can be significant either individually or when combined with other errors. As the auditors use their professional judgment in determining the applicable levels of the inherent and control risk, the auditor's contribution has an impact on the allowed risk of the detection. The auditors manage the overall level of the audit risk that they are prepared to accept in a given audit mission, not only by determining the nature and the dimensions of the performed procedures and tests, but also by allocating an appropriate level of the audit resources.

The audit risk model

The audit risk is:

- the risk that the auditor expresses an inappropriate audit opinion when the financial statements contain significant errors;
- the risk that an auditor believes that the financial statements present a true and fair view and expresses an opinion without reservation, when in reality such situations are significantly erroneous.

Audit risk = inherent risk x control risk x x undetectable risk

The overall acceptable level of the audit risk must be established to use this model to combine sources of obtaining audit evidence. This model is based on the policy which states that the trust in audit should exceed 95%. Given that *the inherent risk* and *the control risk* are assessed 100%, then the risk of the undetectable risk is 0.05%, which means that *the audit risk* is less than 5%.

In conclusion, if the values of the percentages of the risk may be assessed for both the inherent risk and the control risk, then for an acceptable level of the audit risk, a level of the risk detection can be provided and thus the size of the required analytical procedures.

3.2.THE AUDITOR'S RESPONSE TO THE ASSESSED RISKS

The risk assessment by the auditor is characterized by subjectivism, which could not be sufficiently precise to identify all the risks of the significant distortion.

The International Auditing Standard 330, *"The auditor's procedures in response to the assessed risks"* [1] presents the auditor's responsibility in identifying the global response and in establishing the audit procedures regarding their nature, time and area extent at the level of the financial statements and the statements.

ISA 330 requires:

A) – the auditor to establish general procedures for approaching *the significant distortion risks* and recommend the nature of the responses to the general procedures;

B) – the auditor to determine and implement the audit procedures in response to

the significant distortion risks at the statement level, regarding:

a) the operational effectiveness of the internal controls;

b) the detailed audit tests whose nature, time and area of coverage meet the assessed significant distortion risks at the statement level (substantive procedures).

These procedures are done taking into account the following aspects:

- the risk significance;
- the probability of the occurrence of a significant distortion;
- the characteristics of the classes of the transactions, the balances of accounts or the presentation of information;
- the nature of the specific controls used by the business entity;
- the level of the auditor's pending in order to obtain the adequate audit evidence to determine whether the business entity's control systems are effective in preventing or detecting and correcting the significant distortions.

Operational effectiveness of internal controls

The auditor should apply those procedures which enable the best possible understanding of the internal controls. To *assess the control risk* the auditor should cover the following steps:

a) ***– to use the information gained during the procedures to understand the internal control***

To this end, the auditor makes inquiries, checks the way the procedures are observed, and inspects the documents. As the auditor reaches an understanding of the internal controls, s/he will see the fulfillment of the obligations and will inspect the areas. Thus, the auditor will obtain the evidence related to how the controls actually operate, which allows him/her to assess the risks of the internal controls.

b) ***– to identify the possible significant distortions that can occur at the level of statements***

The auditor takes into account and, implicitly, examines the situations where errors or even fraud can occur for the statements related to important transactions, sold accounts and presentations related to these in the financial statements, in order to identify the possible distortions.

c) – ***to identify the necessary controls***

The auditor may identify the necessary controls that could prevent or detect and correct certain distortions of a potential statement.

Each transaction has four basic functions:

1. *transaction initiation;*
2. *delivery or receipt of goods or services;*
3. *transaction recording;*
4. *considerations.*

The auditor should obtain assurance about the operation of the internal controls for each of the four specified functions.

d) – ***to test the controls***

In determining what tests should be performed, the auditor takes into account the type of the audit evidence to be obtained and the cost of the test.

Once the tests to be conducted were selected, the auditor uses to prepare an *audit program* for testing the controls that s/he planned.

e) – ***to assess the evidence and appreciate the control risk***

The final assessment of the control risks for a statement on the financial statements is based on the analysis of the samples obtained from:

- ✓ the procedures for understand the internal controls,

and

- ✓ the tests of the controls related to these.

Determining the level of the assessed control risk is an issue related to professional reasoning.

The risk assessment by the auditor provides a basis for the appropriate audit approach for designing and applying other audit procedures.

Thus, the auditor's professional reasoning leads, for example, to the decision of taking into consideration that one can obtain an effective response to the assessed risk of the significant distortion at the level of a statement:

a) only by testing the controls;

b) only by performing the substantive procedures, without testing the controls.

The auditor's option of not using mixed procedures, i.e. testing the controls and the substantive procedures appears in one of the following situations:

- when testing the internal controls would not be relevant to the respective statement;
- when the auditors carried out the procedures of risk assessment but they could not identify effective controls, relevant to the respective statement.

Regardless of the assessed risk of the significant distortion, the auditor should design and perform substantive procedures for each class of the transactions, account balance and presentation of relevant information.

Other audit procedures, their nature, timing and scope

The *nature* of the audit procedures concerns:

✓ their purpose (tests of controls) or substantive procedures

✓ their type:
- inspection;
- observation;
- interview;
- confirmation;
- recalculation;
- re-effectuation or analytical procedures.

For each class of the transactions, account sold and presentation of information, the auditor should select the most appropriate audit procedures to obtain the audit evidence about the accuracy and completeness of the information produced by the information system of the business entity, when the information is used to implement the audit procedures.

Time - refers to the period in which the audit procedures are applied, or the date on which the audit evidence is obtained. The audit procedures can be applied every term or at the end of the financial year.

The time of implementing the procedures depends primarily on the risk of significant distortion rated by the auditor and the elements unknown at the time of the initial assessment of the risk, which causes the auditor to modify the audit program.

If the auditor obtains audit evidence about the effectiveness of the operational controls during an interim period, *s/he will have to establish the audit procedures applicable for the remaining period*.

When auditing small entities, there aren't many control activities that could be identified by the auditor, and s/he will have to take into consideration whether it is possible to obtain sufficient appropriate audit evidence without controls.

In order to establish the time when the auditor decides to apply the audit procedures, s/he will take into consideration:

✓ the control environment;
✓ the date on which relevant information is available;
✓ the nature of the risk;
✓ the period or the date referred to by the audit evidence.

Certain procedures, such as: *examining the adjustments made when closing* or *comparing the financial statements with the accounting records* may be made only after the end of the period.

There may be situations when the inadequate controls or the transactions unfinished by the end of the period could lead to significant distortions, when the auditor is required to implement the procedures in order to meet that specific risk.

The *scope* of the audit procedures refers to the quantity of a specific audit procedure to be applied, such as:

- a sample size;
- the number of observations of a control activity.

The scope shall be based on the auditor's professional reasoning after taking into consideration:

- the significant threshold,
- the assessed risk, and
- the planned level of assurance.

4. CONCLUSIONS

Based on the above presentation and arguments, we can clearly draw the conclusion

that the financial audit, as the field of checking the financial statements, has the main role of assessing critically the financial statements in their entirety, of detecting errors and fraud, of supporting with evidence the management's objectives, and the fact that the financial statements offer an accurate picture of the financial position, performance and modification of own capital.

Any competent and independent auditor gives advice and recommendations to the entities' management in order to minimize the risk of inflation or deflation, to estimate the foreign exchange risks, the risk of not cashing in the debentures and the risk of insolvency.

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ABOUT SELECTION PROCESS FOR MILITARY PROFESSIONALS IN THE ROMANIAN ARMY

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***Abstract**: Promoting the military profession is the main tool to ensure a solid basis for selection. Within the system of human resources activities recruitment and selection, two phases of the same process, are highly interconnected, as the quality of selection greatly depends on recruitment. Promoting the military offer as well as a more flexible system, based on non-discrimination, equal chances, transparency and free access to information policies, are conferring the possibility of choosing this profession according to principles and criteria established by the military organization .*

***Keywords**: personnel recruitment process, selection of personnel, military career, candidates for military profession, evaluation, interview*.

1. CONSIDERATIONS ON PERSONNEL SELECTION

Supplying an organization with personnel, also called employment, comprises several activities: *human resources planning, recruitment* and *selection of personnel*.

The process of outsourcing organizations with personnel comprises: recruitment, selection and orientation or integration of personnel, while supplying personnel from within the organization implies transfers, promotions, requalifying, rehiring, development, as well as eventual retirements, resignations, firing or deaths.

In essence, *the personnel insurance process is one of filtering applicants* by means of successive specific human resources activities.

The human resources selection is the process of choosing, according to principles and criteria established by the organization and applied by the human resources department. Military professional personnel recruitment implies an exchange of the entire recruitment and selection "philosophy", as the entire process is now based on principles that provide it with flexibility and coherence. Fundamentals basic principles at recruitment and selection process's organization and functioning are as follows: *the continuity principle* - the military profession's promotion activities must be permanent; *the national coverage principle* - all promotion and candidate recruitment activities must be performed all over the country; *the pro-activity principle* - military personnel recruitment is based on scouting for candidates, establishing direct contact, so that the most focus be placed on the more difficult objectives; *the unity in action principle* - the recruitment process implies the same type of activities, documents and information, in accordance with regulations, no matter where it takes place; *the non discrimination and equal chances principle* - all Romanian citizens that comply with all general and specific standards can chose the military profession (regardless of their sex, nationality, religion etc.); *the transparency principle* - all recruitment and selection standards, criteria, procedures, military life and work, reasons for dismissal or admission must be familiar to all candidates, without restrictions; *the adaptability principle* - promotion methods for the military profession must be a flexible system, adjusted

to socio-demographic features of the target group, taking into account the area of responsibility and recruitment tasks, as well as feedback from recruitment environments.

The selection is subsequent to personnel recruitment and this is the phase where the most suitable candidates are selected for the available positions. Recruitment and selection, two phases of the same process, are highly interconnected, as the quality of selection greatly depends on recruitment. Within the system of human resources activities, personnel selection logically follows position analysis and personnel planning, phases that produce a report on occupied positions, as well as the personnel recruitment phase, that should attract a large enough number of candidates to chose from, in order to have the most capable and competitive fill in the vacancies.

Human resources department assignments in the selection process, usually are as follows: welcoming candidates, preliminary check of documents presented by candidates, informing candidates on the organization's objectives, performance and structure, informing candidates on selection procedures, preselecting candidates, medical/ psychological testing, checking references and information submitted by candidates in their documentations, candidate evaluation based on specific means, charge sheet checking, decision making on intermediary and final selection, managing selection documents and procedures. Potential candidates may be recruited from *the inside*: soldiers, military high school seniors, warrant officers, non-commissioned officers, public workers, as well as civilian employees of the Ministry of National Defense, or form *the outside*: high-school graduates, college, university graduates, with or without prior military training, military high-school graduates that work outside the Ministry of National Defense.

Recruiting military professionals depend on a series of factors, the most important being: the emergence of new education institutions, a decrease in the degree of attractiveness to the military profession, as compared to civilians ones, as a consequence of economic development, the decrease in personnel numbers and the fact that contracts are signed for a limited amount of time thus working in the military no longer provides the job security feeling, military conflict burning points as well as terrorism escalading facts that bring into attention the military profession, as young people become more pragmatic, well-informed and eager to chose.

2. SELECTION OF MILITARY PROFESSIONAL PERSONNEL

Under the circumstances of a market economy, where traditional values (patriotism, pride etc) fade away, moving on to an active, even incisive strategy to make the military profession more attractive to target groups, stood for a step forward to a modern and efficient recruitment and selection concept, that provided the necessary candidates for a profession that requires motivation and aptitudes. Within this system, *military professional personnel selection process* stands for the process of selecting recruited candidates based on specific criteria that determine their cognitive, aptitude and motivational potential.

The process of selecting candidates for the military profession is organized, according to selection strategies and policies established by the ministry, into two phases: the first one in a selection and orientation centre, and the second in the military education institutions.

The selection system for the military profession ensures: an increase in candidate quality and quantity, the selection of candidates as well as building awareness on the place and role of the military profession in the society. This selection system comprises territorial specialized structures, i.e. three regional selection and orientation centers, in Alba Iulia, Breaza and Câmpulung Moldovenesc garrisons.

Regional selection and orientation centers have the mission of evaluating candidates from the point of view of their motivation and skills, to professionally orient them, according to their potential, military requirements as well as what is expected of them on their first assignment in the military. These structures' attributes are: to organize and perform the

selection process while ensuring logistics as well, to evaluate the recruited candidates' potential in terms of motivation, skills and intelligence while complying with standards of non-discrimination and transparency, to advise and orient suitable candidates, to experiment new selection tools and to improve existing selection methods.

The selection is performed based on the following *issues*: complying with regulation standards, physical abilities, military abilities and comprises the following elimination trials: *psychological* (I.Q. tests, personality tests), *physical*, *final evaluation interview*. Selection is open only for those candidates that are "medically cleared" and that sign a release form stating that they are psychologically and physically able to take the selection tests.

The selection process takes one or two days (24 or 48 hours, depending on the type of candidates), a period that the candidate must spend completely integrated in a strict routine. Each trial is either passed, or marked *ACCEPTED (ABLE-BODIED)*, or failed, and marked *REJECTED (UNSERVICEABLE)*.

2.1. THE PSYCHOLOGICAL EVALUATION

The psychological evaluation has the role of identifying and selecting candidates with optimum potential for military life and activities, in terms of aptitudes and personality. The examination area includes general skill potential, as well as the ability to adjust to military specifics (personality and motivational structure) so that he/she is able to comply with the requirements of the military profession. This stands for one of the trials in candidate admission processes and it is mandatory and eliminatory. Psychological evaluations are based on standard methods and techniques and include *intelligence tests* (for intellectual potential evaluation), *personality tests* (for ability to adjust to military life evaluation), *and situational tests* (for leadership abilities evaluation). Psychological evaluation is relevant and result interpretation is performed by professionals in the field. The information obtained is discussed and explored during the final evaluation interview.

2.2. PHYSICAL APTITUDES EVALUATION

The testing of physical aptitudes stands for another phase of the selection process and deals with evaluating the development degree of basic movement skills and how they are put into practice under utilitarian-applicative circumstances by means of two trials: covering a utilitarian-applicative track and an endurance trial. The objectives of this testing process are: identifying candidates with the necessary abilities for adequate evolution during the formative process within military education institutions, evaluation of speed development abilities in terms of: movement, reaction, execution and repetition, evaluation of the level of dexterity in terms of space-time orientation, coordination of body segments, precision and mobility, evaluating overall body endurance in terms of physical stress over a period of time.

The principles that guide the candidates' movement abilities evaluation are: *the relevance principle* - trials deal with the four basic movement qualities: speed, dexterity, endurance, force, as well as with their degree of maturity, *the accessibility principle* - training candidates for the tests can be performed without acquiring complicated techniques, *the transparency principle* - all procedures ensure objectivity and transparency.

2.3. THE FINAL EVALUATION INTERVIEW

The interview can be defined as "*a purposeful conversation or normal verbal interaction between two persons"*. The purpose of the interview is to explore areas such as: family environment, education, work experience, other interests, as well as an evaluation of candidates from the point of view of: manners, emotional stability, maturity, attitude, motivation, interests etc. there are some obvious advantages: easy to organize, candidates can be seen and talked to, feed-back ensured. It also stands as a decisive stage in the selection process, as it facilitates the evaluation of candidate compatibility with

the military profession, the analysis of previously obtained information and the analysis of candidate reaction under specific circumstances.

The final evaluation interview represents a formal exchange of ideas and points of view, between candidates and interviewers, with the purpose of information gathering. The interview clarifies aspects arose from personality tests, candidates' communication skills and motivation for the military profession. Successful interviews must ensure an environment that is suitable for communication and cooperation. Instead of imprecise, general questions (that will have similar answers) or instead of general discussions, it is preferable to state question and points of view accurately and get information on who, what, where, when, how, why, what purpose or circumstances, what effects etc.

Those who develop a pattern in doing so will obtain great results in terms of clarifying issues and building interlocutor awareness on the issues covered.

3. CONCLUSIONS

Recruitment and selection process approach three conceptual highly enchained and interconnected delimitations must be made. They incorporate all the activities that exist within the system:

- *promotion of military profession* has to be made by means of systematically diffusing purposeful information within target groups, with the goal of increasing the attractively of military profession;
- *military professional personnel recruitment* is a complex process of informing, drawing and orienting civilian education institutions' graduates towards military institutions or the profession of soldier and, later on, of promoting according to each person's competency and aspirations;
- *military professional personnel selection* stands for the process of selecting candidates for the military profession based on specific criteria and standards dealing with cognitive potential, aptitudes and motivation.

Drawing young people towards the military career must be approached taking into account the need for rapid reaction to the labor market signals as well as for adjusting the offers to the evolution of demands. This implies diversification of forms and means of promoting the military offer as well as a more flexible system, based on non-discrimination, equal chances, transparency and free access to information policies.

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THE RELATION EGO-ALTER IN INTERCULTURAL COMMUNICATION

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Abstract*: In the current paper the relation ego-alter is analyzed, based on the impositions of social and cultural norms. The contemporary society, characterized both by an unstructured mixture of values and elements pertaining to diverse cultural media, and by melting the references, offers ideal circumstances for manifestation mainly to success-oriented actions, and to the detriment of understanding-oriented actions, as Habermas perceives it. This relation type favors the enclosing of the ego, related to the alter, and the double alienation: from the self and from the other. In order to pass beyond the estrangement generated by success-oriented actions, the individual is obliged to resort to understanding-oriented actions, which engage communication through accepting diversity and differentiation.*

Keywords*: liquid society, ego-alter, estrangement, cultural pluralism, success-oriented actions, understanding-oriented actions.*

1. THE SOCIAL NORM IMPOSITIONS

Zygmunt Bauman described the contemporary society as liquid, meaning that it changes recurrently, in accordance with the cultural crucible [1]. Liquids, which cannot hold a tangential or interaction force while still, characterize a society of liberalization, flexibility, reference melting, mixture of values and representatives of dissimilar cultures. Liquefaction is characteristic to transition periods and the horizons of an informational society have begun to melt old references. Currently a new rigidifying period shapes up and the appearance of force lines will constitute the future society's references.

A cultural mixture, within a liquefied society, doubles the unstructured mixture of values. Confronted face to face, either as a result of modeling economic forces (multinational organizations, labor migration), or as a result of some political pressure, we meet, in most unusual venues, representatives of diverse cultural media, because, should we consider Dilthey, social problems and phenomena need to be studied carefully from the cultural perspective.

In addition, the profound mutations perspective, meaning the liquefaction of the social system, may not have a different answer, but at the interaction level. This means that, individuals belonging to diverse cultures – modeled into different value systems - are confronted face to face and face to living norms dictated by society/civilization. These individuals, whose cultural patterns have been deeply imprinted within the beliefs and convictions system, have their own "brand", their own manner of relating to the social scale. The beliefs and convictions substratum, deeply structured and constricted by the "society's thinking", imposed through opinions when related to the civilization's norms, is not the object of sociology.

When meeting the *other,* beyond values, norms and symbols, the interaction is also achieved by "confronting" the rigid systems, of cultural origin. Still, the path toward communication is represented, according to parsons and Shils [2], by the imposition of the social system upon the frame of cultural pattern, so as to regulate a system of values, beliefs or meaningful symbols. Nevertheless, should the relation ego-alter rely on plain

behavior and on the other one's expectations, at the social system level, at the cultural system level, both the ego and the alter relate to the same norms system. Thus, on the one side, the cultural system presupposes relating to the norms system, as well as the regulating reverse flux. Consequently, the individual's thoughts transmitted via language, directly influence the cultural matrix, modifying/fluidizing the relating to the others as long as the cultural patterns become norms.

On the other hand, the relation ego-alter may not be adequate for either of them, even though reciprocity / complementarity is intended. Each of the two will relate to a closure, each will be the beneficiary of a normative transfer that will enclose it in the self, assimilating the "regulating symbols" and becoming the estranged of the crowded society, the stranger near the other, isolated from the malleability of relating to the cultural system and dependent on "others' thinking", imposed though opinions.

In contact with the other, a stable equilibrium is only achieved within the cultural norm but not within the social one, where the instable equilibrium is the actors' characteristic: the *ego* and the *alter,* close to internal collapse*,* fighting the "stranger nearby" and the stranger inside themselves. Adherence to the social norm, as an apparently immutable reference point, is possible via mass media and it regards strictly the opinions subsystem. To the postmodern individual, the beliefs-convictions-opinions system functions as a tire that becomes flat easily while inside it pressure is automatically regulated by connecting to the informational pump (via television, internet etc.).

Confronted face to face, individuals who relate themselves only to the social norm do not judge the other's values. An external force crushes both their values by the very social system, through informational transfer. A different system of values and norms imposes, estranging the representatives of the multicultural society, who, on the one side, become the prisoners of the net-connected habitat (while being themselves individuals connected to a net), on the other side, fight for the information "dose", once dependence has been created. Nonetheless, within a medium formed through cultural patterns, "the plurality of actions of individuals that hold common values constitutes, in a way, a sort of defense against attacks to those values" [3].

2. THE CULTURAL NORM IMPOSITIONS

Should the social norm represent the path to closure, the language, as manifestation of the langue, is considered a path to an opening toward the other. And should the language, with Saussure, constitute the added sum between *langue* and *parole,* with Beneviste, it constitutes the expression of what "we intend to say", the social convention over what represents the expressing manner of the thinking contents: „*il reçoît forme de la langue et dans la langue, qui est le moule de toute expession possible; il ne peut s'en dissocier et il ne peut la transcender*" [4].

Yet, Beneviste draws attention upon the fact that language develops within a langue, the langue being a culture's product. Moreover, language consolidates culture by building a mutual inter-determination structure, such as:

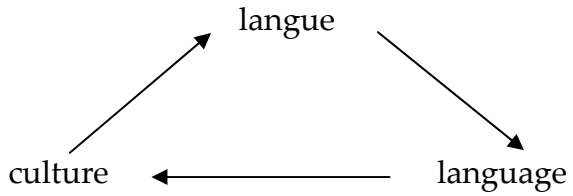

Fig. 1 The Beneviste's model

There is no viable possibility for isolating a term: language, or for constructing it while coagulating some extra-cultural social norms. And this is due to the fact that language is merely the expression of: what we intend to say", and thinking (the flux that regulates the langue relations with the system of representations, namely, the relation language-langue) is the genuine bearer of an individual's identity.

The incapacity of approaching certain codifying rules, certain agreement with regard to language, without relating to specific structures – langue and thinking, determined

by the cultural frame, constitutes the failure of a *lingua franca* imposition, once the internal cultural regulating norms are not shared through it. This happens because there is no similar symmetry relation between langue and language, as well as there is no similar relation between the contents of thinking and language. On the one side, the linguistic convention is static as long as there are no interventions upon it, the denoted meanings are static, while thinking and langue relate to the context. There is no accurate translation of a message analogically expressed through a digitally expressed equivalent (despite the "resolution" degree of the latter), nor can we start from imagining the thinking as lacking contents or the contents of thinking as being independent from the mechanism that brings it to life. This explains, once more, that the relation thinking-language is, in fact, a relation between dynamic and static, the language achieving only the digital "reproduction" of a dense, expanding area, more specifically the image of that area, a simplified temporal decoupage.

In face-to-face circumstances, members of diverse cultures interact through language and by activating their individual experience and own culture. Meanings may vary and any moving away from the denoted meaning may be interpreted fallaciously, such as Umberto Eco predicted.

In such a context, decoding the message implies either applying a mental scheme, acquired as an experience within the cultural medium to which language belongs, or simply "guessing" the intended meanings.

Likewise, the road to the universal is achieved through the national. Lack of experience within the cultural medium, conditioned by language and equally conditioning the language (through the langue), makes communication among individuals impossible. Not only the linguistic opacity of cultures toward one another is activated, but also the individual opacity of those coming into contact, as a result of their own experiences within their original cultural medium, respectively, within a common reference cultural medium.

"Untranslatability", distinguished either as a phenomenon studied from the literary perspective (Benedetto Croce), or as a phenomenon perceived from the logic perspective (W. von Orman Quine) determines the impossibility of communication between two linguistic communities, not because of a real untranslatability of the message, but because of the lack of correspondence between the conceptual gaps of the langue.

The only manner of expressing common experience is the acceptance of diversity and differentiation (tolerance also) as modalities of enriching the cultural context. The social norm has to derive from the cultural norm, and the *concordia discors* political system has to exist whenever there is contact between representatives of dissimilar cultures. Giovanni Sartori limits the aberrant decoding of pluralism through social norms imposed by the intended cultural pluralism: *"Pluralism does not equal the plural existence. Mixing the two concepts is similar to placing together, on a Hegellian night, when all cows are black, an African tribe, a system of Indian castes and why not, the lifestyle of the Middle Ages. This is a typical process, which I name the concepts evaporation, in other words, the destruction of clear and distinct ideas"* [5]. The path of communicative consensus is not yet beaten; it has to be instituted through pluralist culture principles, able to create the premises for multiculturalism and not through social or political pluralism that may lead to the individual's enclosing within his own habitat, such as within a hard shell of hyper-reality, where he interacts with the external world by means of nets.

3. CONCLUSIONS

The liquid society offers ideal conditions mainly for success-oriented actions manifestation, for rational actions related to finalities (*zweckrational*), to the detriment of understanding-oriented actions, in accordance with Habermas's classification.

Accordingly, the communicative action, under the dialogue logic and within the already mentioned context of teleological dimension prevalence, makes room for an approach to the instrumental action, following the monologue logic.

The social norm guides the action of the individual belonging to a multicultural society toward success-oriented actions, while the cultural norm creates the premises for interaction through the assuming, by the ego and the alter, of identities and roles and through their promotion.

The outcome of this interaction is genuine, non-dissimulated communication, which presupposes aiming at understanding confirmed by real consensus and does not represent a real and complete understanding. *"Competent speakers are aware that each of the consensuses met can be deceiving, however, they suppose, through the deceiving consensus concept, that this consensus may be replaced by a real consensus (which means, in fact, that it needs to be replaced), if understanding must be achieved"* [6].

In order to pass beyond the estrangement toward which individuals torn from their social context are pushed, there is need for a face-to-face confrontation between an individual and the other by appealing to the communicative action and the social norm that derives from the cultural norm.

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THE PROFESSIONAL OPTION BETWEEN VOCATION AND SOCIAL DEMANDS

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Abstract*: The activity of school and vocational guidance (SVG) or, the school and vocational counseling or, in its new terminology – career counseling – is tightly connected to the knowledge of the socio-professional area, of its exigencies and tendencies, aspects that influence significantly the individuals' options, and implicitly, the quality of individual and collective existence. School is the anticipating factor and it prepares people for employment, therefore it implies the correlation of multiple features: the organization of schooling styles and curricula, in accordance with the professions dynamics and the labor market, yet, at the same time providing individual progress.*

Keywords*: professional dynamics, school and vocational counseling, career option, individual progress.*

1. THE CONTEMPORARY WORLD'S CONFIGURATION AND DYNAMICS OF PROFESSIONS

The methods by which human beings have gathered their commodities throughout time have known major mutations, with a huge impact over the evolution of the human beings' society and over the human condition. The social divisions of labor, the industrial and informational revolutions, are but a few of the decisive moments of the change in the professions configuration. These distinctions develop not only from one epoch to another, but also within the same epoch, depending on the development stage of each country. For example, in case of developed countries, the communication and information technology sector occupies a central position in economy. The Organization for Economic Co-operation and Development (OECD) uses data provided by this sector as key elements for comparing the levels of economic development of various countries.

In the contemporary world, the development, diversification and dynamics of professions reach unprecedented standards. During the previous century, the number of professions increased to an annual average of 370 new titles and specializations, while their mobility was increasing as well. In the year of 2000, eight out of ten professions were new, the occupational classified list being continually outdated by reality. Thus, we witness an avalanche of new specializations, in some instances, limited as necessity and application terms.

The technological and informational explosion, the diversity and multitude of new data provided by development in all sectors of activity represent the cause of this extreme dynamism. In this context, the phenomenon of adjustment a re-adjustment becomes extremely actual, and it is joined by alterations of contents and strategy in the school and vocational counseling activities and in professional guidance.

The time for a unique specialization has long declined. Our society, apparently, will need more and more "polyvalent" individuals, capable of multiple adjustments, with a vast coverage range, and capable of successive accommodations and re-accommodations, in accordance with social demands. The accomplishment of such polyvalence cannot be sustained unless the stage of narrow paths and diplomas idolatry is surpassed, in favor of pluri- and inter-disciplinary studies.

The professions' evolution, the very human existence and the man's role in the labor field - all have been caused by the spectacular improvement in technology. We witness a gradual increase in the human factor role. If, following the first industrial revolution, the adjustment of man to machine was pursued, after the second industrial revolution (post-machinist, of automation) a new type of adjustment appears. This time, it equals the machine's adjustment to human actions. Automation represents *"a new integration phase, in which cerebral activities connect within the management and production control process, where the individual is no longer imitable by machine or interchangeable with the machine's functions"* [1].

In the informational era, a new re-orientation of labor occurs, which *"does not mean that the individual will stop working physically only, but he will be helped by information and informational or informative tools"* [2].

The Organization for Economic Co-operation and Development (OECD) foresees that the structural change, produced in economy by the communication and information technology, will lead, by 2010, to the situation in which, 55% of the labor force has been included in this sector. This may be called "labor informationalization". The structural changes on the labor market are the effect of economic, technological and social amendments and these are the cause for economic tendencies on the labor market. Knowing and understanding this interdependence become vital for designing and sustaining educational and vocational training projects.

2. ROLE OF SCHOOL AND VOCATIONAL COUNSELLING (AN APPROACH TO THE HUMAN POTENTIAL EXPLOITATION)

The activity of school and vocational guidance (SVG) or, the school and vocational counseling or, in its new terminology – career counseling – is tightly connected to the knowledge of the socio-professional area, of its exigencies and tendencies, aspects that influence significantly the individuals' options, and implicitly, the quality of individual and collective existence. Invested with a high social responsibility SVG represents *"an activity of stage planning and decision making, which may persuade a person to attend a certain type of educational institution and to have him engaged in practicing a profession"* [3]. The major purpose of this activity is to develop self-evaluation and self-awareness capabilities, at the individual level, and this constitutes the premise for an adequate school and vocational option. School is the anticipating factor and it prepares people for employment, therefore it implies the correlation of multiple features: the organization of schooling styles and curricula, in accordance with the professions dynamics and the labor market, yet, at the same time providing individual progress. The focus must be on the personal integral development, by granting a proper environment for studying and working, without disregarding the socio-professional background and its exigencies. That is, each adolescent has to correlate the answer to three fundamental questions: What can I do?, What do I have to do?, and What do I want to do?

From a psychological perspective, the vocational option is a complex process involving the entire personality. A central position is occupied by individual convictions and aspirations, the life ideal and the personal system of values. Within the psychological structure of vocational option, there are three distinguishable dimensions: the intellectual dimension (I know), the affective dimension (I like), and the volitional dimension (I want). The motivation for a career selection lies at the confluence of these three dimensions. These internal (subjective) factors are, in their turn, influenced by external (objective) factors, by the socio-economic and cultural environment, or the individual's life experience.

The human existence represents a sequence of choices that make up the individual destiny. Two of such options (career selection and partner selection) hold a decisive role in the self-fulfillment and access to happiness. In the contemporary world, both choices have been perturbed and vitiated by the lack of stable

value references, the extreme life dynamism and the multitude of requirements. Wrong selections, following axiologically inconsistent criteria, irrelevant for the person's capabilities, have negative effects both upon the individual (at the level of his harmonious development and self-fulfillment) and upon society, which will be unable to capitalize its most precious wealth- the human potential.

The extreme dynamics of the social and professional life cause an uncertainty and instability feeling in the individual. Statistics show that a person may change his profession three times and his employment at least seven times in a lifetime [4]. Thus, the issue of professional insertion of young people comes to stage, a process aiming at two interdependent stages: the professional formation (qualification) and the employment (insertion). In order to prevent and diminish the dysfunctions that appear in the professional insertion process, it is important for the educational offer to correspond to the present social demands, moreover, to consider possible future changes.

Peter Grootings, the coordinator of a study on young people from the European Coordination Centre for Research and Documentation in Social Sciences in Vienna, realized that there is not a correspondence between qualifications, expectations and aspirations of young people and the labor realities of the contemporary world, which is a discrepancy between the education products and the labor market requirements. Among the most serious outcomes of this discrepancy are unemployment and under-employment (employment of young people in positions inferior to their education). Under-employment also highlights another phenomenon: the over-education of new generations, which represent *"the education stock incorporated into young people's training, which cannot find a proper and complete use on the labor market"* [5].

This is the major problem of young people in Romania: the selection of a career that may provide employment and decent living. To what extent does the pressure of this demand leave room for development and capitalization of individual potential in and for the selected profession? If society lets the socio-professional insertion process get out of control, this means that it assumes devastating effect on a long term, while these effects may jeopardize the entire social scaffold. The studies carried out by the Center for Study and Research in Youth Problems from Romania have shown that the greatest difficulties encountered in finding employment are related to the level of education and area of expertise, added to which is the jobs offer. Therefore, young people are highly preoccupied with their professional qualification/ requalification and are perfectly aware that *"only a flexible training and an adaptive behavior to the labor market demands may increase their chance of success"* [6].

3. STUDY

The study carried out within the Air Force Academy aimed at identifying professions that interested the high-school students and establishing factors that influenced this orientation and the military career's degree of attractiveness to adolescents, in the current context of configuration and dynamics on the labor market. In addition, the social perception of military institutions and the motivational support for career option in this field of activity were pursued.

The investigation, based on questionnaires, was performed on a sample of 105 respondents, high-school students in their 12^{th} grade at a National college from Brasov. The structure of the sample was as follows: age segment – 18 to 20 years old; gender - 70 female students, 35 male students; origins – 90 students from urban area, 15 students from rural area. The applied questionnaire consisted of 10 items. The manner in which questions were formulated presumed that twelfth graders had already made a clear career option, supported both from the aptitudinal, motivational and affective perspectives. Out of the ten questions, six were closed questions and four were open questions. Despite the difficulty in quantifying the open questions, these offered the respondents the opportunity for free and personal stances. Data analysis showed that:

1) The questionnaire was administered in a vocational high school and one of the questions aimed at the students' motivation of their selection of the school. It resulted that for most of the students (54.3%) the school selection was determined by the final scores obtained at the end of the eighth grade (national tests) and their computer-distribution to this particular high school. Only 24.8% of the respondents declared their interest in the high school's specialization, while 9.5% were influenced by their families.

2) The students' options for various professional fields, although covering a large array, were in tight connection with the specialization provided by their high-school studies (Fig. 1).

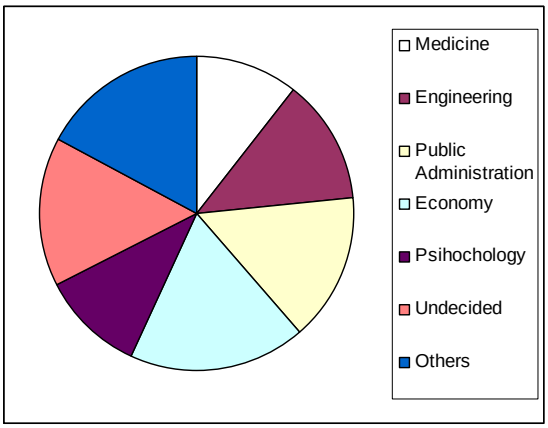

Fig. 1 The students' options for various professional fields

3) J.L. Bodden and L.E. James, appreciated, based on experimental data, that the cognitive task of making a realistic and individualized vocational selection surpasses the level of cognitive development of adolescents. Accordingly, the vocational option is strongly influenced by the family's expectations and by the data obtained from interaction with others (friends, relatives etc.). Nevertheless, the adolescents of the informational era, well anchored in the pragmatic and competitive spirit of the time and eager for self-discovery and assertion, estimated (53.3%) that aptitudes and competences played an important role in selecting and practicing a profession (Fig. 2).

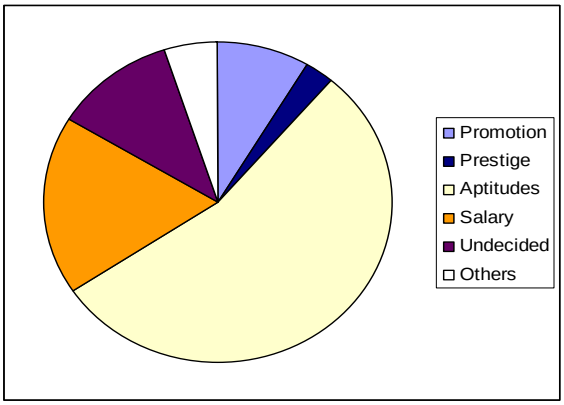

Fig. 2 Motivational support of career selection

This attitude and confidence were strengthen and confirmed by the answers to item 7: *Do you consider that in selecting a career aptitudes/competences are important?* 99% of the students answered affirmative.

The presence of indecision states and the lack of firm plans are quite normal at this age and they prefigure the opening toward new assimilations, which will gradually eliminate ambiguities, accelerating the vocational development.

4) The young people's level of information with regard to the military system, to career, in general, and to the military career, in particular, was very low (Fig. 3).

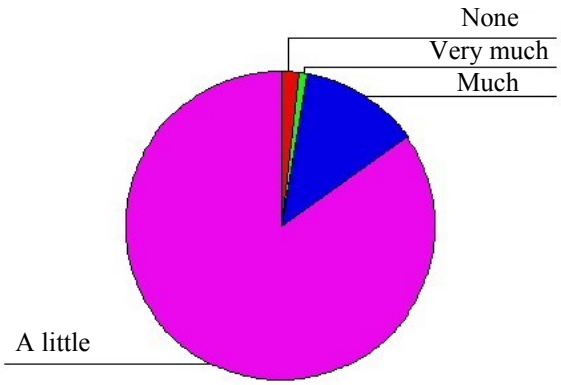

Fig. 3 Young people's level of information with regard to the military system

84.8% of the investigated respondents declared their limited knowledge regarding the military system, and the main information sources were the mass media (60%), followed by colleagues and friends (15.2%) and family (14.3%). In the actual context of the labor market configuration and dynamics, the

military career was attractive for 62.9% of the respondents, while 11.4% considered it was not interesting or "did not know" (22.9%). Even under the circumstances of this "knowledge vacuum" of the military organization by the civilian society, three elements that maintain the interest in the military career materialized in the collective mind (Fig. 4).

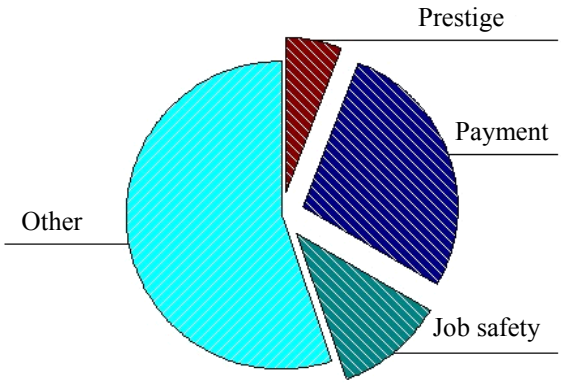

Fig. 4 Elements of attractiveness to the military career

For 44.7% of the students, payment, security of the workplace and social prestige were as many arguments favoring the option for the military career. To these added the promotion possibility, able to satisfy the assertion need of adolescents. The social perception of the army configured by establishing three distinctive features of it (Fig. 5).

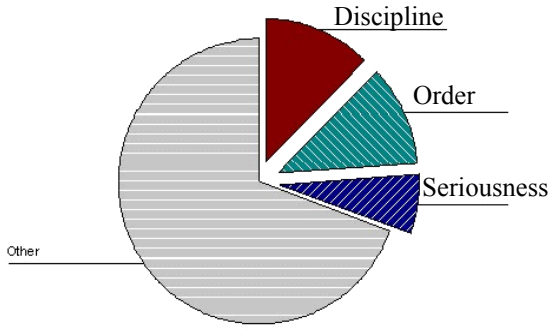

Fig. 5 Distinctive features of the military organization

Discipline, order and seriousness were characteristics that coagulated in the collective psychology as specific to the military organization, although within the modern society this model had expanded upon all types of organizations.

4. CONCLUSIONS

To sum up, we can assert that adolescents show maturity and pragmatism in selecting their careers. Even though the extrinsic motivation in making this decision is prevalent (salary, prestige etc.), the necessity of personal qualities, aptitudes or competences in practicing a job is not ignored. The military educational offer is generous, yet, it is not sufficiently known to civilians. At the same time, it is obvious that a sustained and permanent activity of school and vocational counseling is required and it is meant to fill up the informational vacuum and to diminish the young people's hesitations and indetermination. Moreover, it is intended to offer a better comprehension of the socio-professional area and its tendencies, but also a better self-awareness. This activity, performed with seriousness and responsibility will contribute significantly to the professional integration of young people and to the synchronization of the educational offer and professional formation with the jobs offer on the labor market.

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EMOTIONAL INTELLIGENCE AND NEGATIVE EMOTIONS CONVERSION

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***Abstract**: This paper contemplates explaining successful managers policy, which is based on the faith that the nevrotic energy generated by emotions can be transmuted into wisdom, only when the individual admits and accepts his true nature freeing him/herself of the attraction of his/her mental habits.*

***Key words**: management, emotional intelligence, negative emotions.*

1. THE POTENTIAL EVIL IN THE HUMAN SOUL

The imperative of the present is the fact that no science, and the management science makes no exception, can and must ignore the issue of the values. Why so? The reason is the **any science free from the moral values no longer serves the values of the humankind. Among these, the most urgent, imminent and vital to solve is the issue of the evil, whether at an individual level or the group level, or even at the level of the organization.**

More clearly than any time, nowadays we understand the fact the major threats posed to our survival no longer come from the outside nature, but from the human inner nature. The question to which an answer must be given without delay is:

"How can we temper the potential evil in the human soul, with the same kind of detachment, discernment and rigour with which we, humans, look at the outer world?"

Whether we are or are not yet willing to admit, this is not about mere theoretical difficulties in the study of the phenomena specific of the management science, which might appear in the context of the scientific managerial practise when we approach such issues as:

1. **The issue related to the construction of the moral judgements** (the imperative need to apply, construct, update and re-apply the ethical codes in organizations);
2. **The frequent and sometimes intentional confusions between opinion and scientific fact** (the need to replace autocracy by authoritarianism);
3. **The mistaken use of the scientific information by Machiavellian or uninformed bosses** (the painful need to use the job specification and the individual performance assessment report in tandem as dynamic instruments);
4. **The issue of the risk of a too great closeness to the organizational evil** (individual/group) **when the bosses get too close to look into the organizational evil**. There is no doubt that by avoiding or, on the contrary, tackling directly such issues as those mentioned hereinabove, these difficulties might make the bosses in an organization become the victims of the present.

Much less is the risk of developing the psychology of the organizational evil as science than that of failing to turn the human evil into a rigorous scientific subject matter.

How about those destined to lead nowadays? Are they endangered by their own activity? I believe so.

Any leader must remember the purpose of his/her own decisions, **that of curing.** When the purpose of the individual is only that of strengthening or enhancing self-respect and personal pride, his/her decision is, doubtlessly, mistaken. **Any judgment of the someone's evil must be justifiable by the expression, considered fatalist by some, "Only for the gift of God walk I!"**

The question is:

"Is fatalism fatality only?"

Is the purpose of life for us to prepare to die? Even though we will never discern the entire significance of human life, nor the reason why one is good or evil, what we are left with is the freedom, or more exactly the responsibility to live as correctly as possibly. **This involves making moral judgments necessary to support life, choosing to live in a state of ignorance of a higher or lesser degree.**

Therefore the question is not whether we must or mustn't judge. **We definitely need to do so.** The issue is how and when to judge wisely. Our great spiritual leaders have provided the fundamental teachings. And because we are those who must make moral judgments, it is absolutely necessary for us to refine our wisdom by applying methods, concepts and knowledge, by remembering the fundamental teachings.

Few of us understand the limits of the science of management, and much less those of science in general.

The reason thereof might be the fact that we, humans, are much too dependant on the authority, in general. We are used to regarding science as the supreme TRUTH and we are wrong, because what we don't understand in fact is that the TRUTH CANNOT BELONG TO SOMEONE IN PARTICULAR AND CANNOT BE POSSESSED. What is the truth then?

The truth is a purpose that we strive to attain full of hope. To put it otherwise, **we must try to judge over the good and the evil ourselves,** being made responsible by the free will, which is too important to leave aside for the scientists alone.

2. THE UNIQUE PERSONAL STYLE

Every individual possesses a unique personal style expressed in his way of persevering things and acting under the influence of negative emotions: anger, pride, envy, listlessness, lust. The nevrotic energy generated by emotions can be transmuted into wisdom, only when the individual admits and accepts his true nature freeing him/herself of the attraction of his/her mental habits.

In that moment the person not only that he completely understands the meaning of wisdom but he also becomes he himself part of the wisdom achieving this way a greater of making himself useful to others as a result of the fact that the unselfishness nature of wisdom is compassion.

2.1. THE ANGER

This way the nevrotic energy specific to anger (fury/sadness), set aggressively on a single manner of seeing things, hostility or defensive attitude beyond normal, scattered by these individuals for the only purpose of shutting down themselves to other point of views expressing violent reactions, could be analyzed and canalized into a superior form of energy.

This changed energy is clear-headedness as flexible and sharp as a blade so that the individual could see things from multiple points of view assessing them precisely to grasp their meaning with a crystal clear lucidity.

The wisdom consists in the individual capacity of converting one's anger in intellectual clearness.

2.2. THE PRIDE

The nevrotic energy specific to pride (narcissist attention focused on him/herself) can materialize in the fact that the person doesn't restrain him/herself, cannot submit to any system of self-discipline and sees him/herself above anyone else, completely special, living in the comfort of being admired of those in his/her vicinity, purchasing

frivolous purposes, but in the same time hiding carefully the fear of shame or defeat.

When person aware of pride he/her can transform this nevrotic energy into a more useful type, an energy serving wisely to metamorphose shame or defeat connected fears into serendipity, generosity (understood on an emotional, spiritual or physical level) to the ones in close vicinity, feelings of plenitude and opening to the world.

2.3. THE PASSION

The nevrotic energy specific to passion (in the sense of lust desire gluttony) is often exercised in a historic false appearance of seduction or in the form of hypnotic charisma serving the final purpose of a tempting/seductive/pleasant pursuing of the desired objects.

In this case wisdom assume that such an individual could transmute this energy into discriminative conscience interested and attentive to everything that comes into contact to in conclusion transmuting into an interrogative lucidity that opens a new path for communication serving the purpose of seeing and understanding people as individuals approaching them with sympathy and compassion.

2.4. THE ENVY/JEALOUSY

The nevrotic energy specific to envy or jealousy (the compassion that the individual constantly makes between him or her and the other people) is spent in a destructive way into judgments full of resentment towards others achievements situation due to their paranoid fear that others would perform better than them. They also tend to insist on having an appraising attitude maintaining this way condescension and o sort of restless talent for directing things to the point where they appear exactly as the individual thinks in best for imposing his/her point of view.

Acquiring wisdom in this case means that the nevrotic energy is transmuted into real competence that allows activities performed by a person capable of bringing up to date his/her potential to blossom, getting precise goals adapted to real opportunities.

2.5. THE INDIFFERENCE / LAZINESS

The nevrotic energy to indifference/laziness (listless) is chaotically scattered in choosing the easiest ways and avoiding doing what has to be done or it would be proper or efficient.

Wisdom would mean transforming the energy sent by the lazy bones into a profound and contemplative experience capable of generating peace and vastity. One of the greatest qualities of human mind is that it can support changes during individual evolution being transformed by itch experience.

3. CONCLUSIONS

In a paradoxical way the foundation of anything that has ever been built is the very banality of the orders given and executed by the individual, the fact being given that in the last resort however, each and every human act or deed remains the result of an individual choice. Moreover, it has been proven scientifically that human groups tend to behave like the individuals, only to a more primitive and immature level.

This is also the cause of entropy in certain organizations.

The question is:

“Why is the group less than the sum of its components?”

“Why is group behaviour so strikingly immature?”

The science of the organizational behaviour and psychology reveal some of the causes.

- The first and hardest to control cause of group immaturity is **specialization.** The issue of group specialization must be tackled with as much caution as required for a nuclear reactor. How can specialization lead to immaturity in a group? Answer: “**through the fragmentation and dilution of consciousness**”, i.e. through the transfer of responsibility to another part of the group. What does the lack of responsibility lead to?

Answer: There are two inauspicious consequences of the dilution of the group responsibility: **incorrect action** (materialized in fraud/abuse/atrocities) and **cover-up** (either due to fear, or due to the refuse to assume the committed evil owing to the fact that is not perceived as a correct or rightful action)

- The second possible cause of a group immaturity is **chronic stress**. In a situation of prolonged stress, an overwhelming majority of a group's individuals have the tendency to either **regress,** behaving in a primitive manner and abandoning their moral principles, or be **psychically paralyzed,** adapting themselves up to the point of numbness, not being able to respond to other people's suffering or their own. It is a scientific and not only religious fact that **stress is a test for goodness**. **The people who are genuinely good are the ones who do not abandon their integrity, maturity and sensitivity in times of stress. Nobility can be defined as the ability of not regressing as a response to degradation, of not becoming insensitive to pain, of tolerating torment and remain unchanged. "The best measure of a person's greatness is the capacity to suffer" (M. Scott Peck)**

- The third cause of a group immaturity is the **leader dependence.** There are relatively few persons with genuine managerial abilities. In fact, most people want to be led by others. Why? I think the reason is laziness. It is unquestionably much easier to be led than to be a ruler/manager/leader because:

- there is no need to make decisions for others or on behalf of other people;
- there is no need to make plans;
- there is no need and you really don't have to exercise your initiative;
- there is no need to assume the risk of being unpopular, inconvenient;
- there is no need to prove out one's courage.

In fact, by assuming the role of subjects, the members of the group hand their personal power, their command of themselves, as well as the maturity to decide on their own behalf to their leader. Thus, they consent to depend on the ruler/manager/leader of the group just as a child depends on his/her parents. It is a scientific fact that **as soon as he/she becomes the member of a group, the average individual has the tendency to regress emotionally**. Through the nature of its mission, the army cultivated regressive dependence that naturally appears in the individuals of a group. Therefore, one can rightfully ask, **what should mature, independent thinking mean for the members of a group**, even a military one? A famous experiment conducted by Stanley Milgram gave the answer to this question: **mature independence means to refuse to obey an illegal order.**

- The fourth cause of a group's immaturity resides in **narcissism.** Like everything else in this world, this concept is considered to have a good side and a bad side. In its benign form, narcissism stimulates the **group cohesion,** acting as a corpus spirit. Rulers have always reinforced the group cohesion in times of failure by channelling the member's hatred towards something alien and hostile. The malignant form of narcissism appears in the **construction of the enemy** or in the **hatred towards a scope-goat**. In this case, the responsibility of the group disappears and all that matters is cementing the group through the arousal of hatred towards an external enemy. In the most serious cases, the external enemy coincides with what the group members perceive as different from them and thus every attempt to evolve is brutally stopped. Therefore, the group's deficiencies are overlooked by focusing one's attention on the flaws of a scope-goat or another rival group. The malignant narcissistic behaviour of evil individuals who avoid assuming their guilt or self-analysis, placing the blame and trying to destroy anyone who discloses their deficiencies develops in a natural manner inside groups. The group that fails is likely to behave in the worst manner. Failure hurts their pride and this is the reason for an animal and rebellious behaviour. In the case of a healthy organism (individual/group), failure is the most efficient way and at the same time a stimulus for self-analysis and criticism, leading to the lessening of pride and cohesion

in order to create the premises for change and adaptation, survival and evolution.

On the whole, specialization / chronic stress / dependence / narcissism are part of the causes that have been scientifically proven to dilute the group's consciousness and dissipate the responsibility of its members respectively.

The means of correction that can and must be used as a response to the immature/irresponsible actions of groups are known or should be known by the holders of managerial positions in organizations. In practice, these employees must be seen as persons with the capacity of acting in real time within the organization, at the price of risking their own spiritual integrity in a face-to-face combat with the organizational evil, by accepting that:

- evil is opposed to life, nevertheless being a form of life;
- by trying to destroy evil we come to destroy ourselves spiritually, if not physically;
- man's life has its own purpose in the battle between good and evil;
- the hope that good will prevail gives one a reason for living;
- evil can be conquered only by love.

The way of love is a dynamic balance of opposite poles, a painful creative tension of uncertainties, and a difficult path between extreme actions.

Those of us who are blessed with a ruler's vocation must be tolerant and intolerant, rigid and flexible. An almost godly compassion is needed. It is not easy to embrace ugliness with the sole hope that, in an unknown way, it could turn into beauty. But the myth of the frog that turns into a prince remains. Love works in many ways. And none of them is foreseeable.

All religions promote the fact that reconciliation to oneself is the key to get through problems calmly and wisely being understanding to yourself and others. The inner peace reflecting in time on everything that is around us.

The only freedom an individual possesses is the capacity to discover and unblock the spiritual reality that already exists in him/her according to Sri Aurobindo. Our greatness as human beings does not consist in the fact that we can change world but as Ghandi said that we can change ourselves.

Love is very patient and kind, never jealous or envious; she does not brag; she never boast of, neither is she selfish or haughty or indecent. Love does not have it her own way according to her wishes. She is not irritable or suspicious. She does not bear malice against somebody and almost she does not notice others mistakes. She never rejoices in injustice but she happy anytime truth wins.

Therefore three things remain: faith, hope and love – and among them love is the greatest. (Chapter I Corinthiens , verse 13)

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REGIONALISM AND SECURITY IN THE WIDER BLACK SEA REGION

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***Abstract**: The geopolitical aspect of Europe was radically changed by the end of the "cold war", the colapse of the global geostrategic balance - because of the end of the bypolar phenomenon, the metamorphosis and the expending phenomenon of NATO and EU. Therefore, the Black Sea, that used to be a regional area of interests, became a highly strategic space concerning the interests of the global actors: Russia, USA, NATO and EU. The solution to reinforcement security and stability is the cooperation policy, so that each state can have an opinion and in the same time doesn't feel threatened. As a NATO and EU member, Romania is permanently involved in all missions of both organizations, having an important contribution to their fullfilment.*

***Key words**: Security, National Security, Regional Security, the Wider Black Sea Region, the Co-operation Policy, BSEC, GUAM, CSI.*

1. REGIONAL SECURITY - A NECESSITY REQUIERED BY MULTIPLE DETERMINATIONS

The concept of "regional security" comes out as a subject of research in the international relations after the Second World War. It is described almost completely by the logic of the Cold War. The accent lays on the military and political issues.

At the beginning of the 9o's, the regionalism phenomenon became an important issue, due to the necessity to explain the appearance of a number of organizations, regional agrements and arrangements, immediatly after the end of the Cold War [1]. Unlike previous moments, scientific investigations did not generate significant inovations, as the general tendency was to describe in a more substantial and more accurate manner all proceses that refere to the term of "region".

Perhaps nothing could have been done beeter under the circumstances of the end o the past century and the beginning of the 21th century, a period that allowed simultaneous progress of some events, phenomenons or historycal processes that will mark for a long time the society becoming, in it's regional or global form [2]. Since the security options and the foreign affairs are not two similar notions, ant the security chalenges od the main powers can not be transferred on to other regional areas, first we can observe that most states act international on the regional level, than second we can observe that if a state is less powerfull, militay or economicaly, it's security options are limited at actions and strategies of a regional level.

At the same time, so far the experience proves that a series of political, economical, security and cultural matters can be better approached and solved in a relatively homogeneous enviroement, where there is certain cohesion and a common development background. So, the regions cand offer the propicious environment to establish some cooperation mechanisms in order to contribute to an international security climate.

Four of the most important global actors (The Federation of the Russian States, USA, NATO and EU) focused their political attention on the wider Black Sea region. The security is mainly dictated by the interests for the energetic resources of the recions (USA, EU), the solution for the "freezing conflicts" (NATO and EU) or the application of the "neighbourhood proximity" strategy by the

view of the global actor role (The Federation of Russia).

The international terrorism is structured in transfrontalier and inneficient network forms with wide operational impat and at the same time it is imposible tu apply specific monitoring. This represents a serious threat against security especially in the European side of the euro-athlantic space.

The transborder risks represent at the same time one of the most serious threats against security, especially regarding the European security. The active policys face the new dinamism threats. The absence of permanence in the economic globalization process and in the government, reduces the contribution of the same states to the regional security and also global security, and endangers their own security also.

Therefore, is not only legitimate to study the regions and the regional security situations, but it is essential to understand the character and the dynamics of the security problems in order to reduce the risk of failure in the decisional real process [1].

2. THE OFFICIAL CO-OPERATION AT THE BLACK SEA

The end of the past century and the beginning of the 21th century marked in the Black Sea region the appearance of many international co-operations initiatives, some of these including the whole region, others involving just certain states that were intergovernmental or with non-governmental actors.

For a long time, the Black Sea region was one of the regions for whom the great powers confronted upon; the Black Sea has become the border for the competition between the interest spheres. In the context of the new geopolitical configuration, at least one of the great actors tends to encourage the regional cooperation: the European Union.

From the global security point of view EU wants to include the Russian Federation in the building process of regional stability structures.

The EU, working on the principle that a security area at the new proper borders provides a "continental sfaety"[1] initiated a number of projects regarding regional cooperation. This type of cooperation provides stability and progress both nationally and regionally.

NATO can represent another important intitution that guarantees the cooperation in this ares. Initially, after the end of the confrontation East-West, NATO dind't identify an exact regional role, using the Black Sea region as a logistic space for intervention in Central Assia, Sout East Europe and Middle Orient; afterwords by the delopment of the security concept on the long terme, the potential development of the regional cooperation unde the NATO's umbrella grew up considerably. Alone, it is unlikely or inefficiently in the Nord Atlantic Alliance to elaborate a policy engagement od the states fron the region in the reform process tah places the accent upon democracy and good government.

The attraction for the extension process of NATO, including the Membership Action Plan (MAP); it has demonstrated it's powers as an internal changing instrument for east european states. This experience cand be easy reproduced for the states for the wider Black Sea region.

2.1. The Black Sea Economic Cooperation (BSEC). The Black Sea Economic Cooperation (BSEC)[2] has turned up like a unique and promising model of politic and economic multilateral initiatives that have as a purpose the acceleration of economic and social development for the member states (Fig. 1). In this way can be achieved an upper level of integration in the european and global economy, by using the advantages tht result form the geographical proximity and from the national economics similarities. Considered

[1] Solana Strategy " A Secure Europe in a Better World" was adopted by the European Conseil in december 2003 and it represents the first european security strategy.

[2] BSEC was founded in June 1992 by governments of 11 states: Albania, Armenia, Azerbaidjan, Bulgaria, Georgia, Greece, Moldavia, Romania, Russia, Turky and Ucraine. In 2004, the first extension took place and the organization has included another two states: Serbia and Montenegro.
The source: http:/ ro.wikipedia.org/wiki/OCEMN

unfit for that moment, political or security objectives were not included in this program.

From the point of view of the economic co-operation evolution in the Black Sea region, we can identify many stages, but an important moment in the evolution of the organization was the adoption of the common statement in 2oo4, regarding the contribution at security and stability in the Black Sea region. In this way, the organization follows the political co-operation direction.

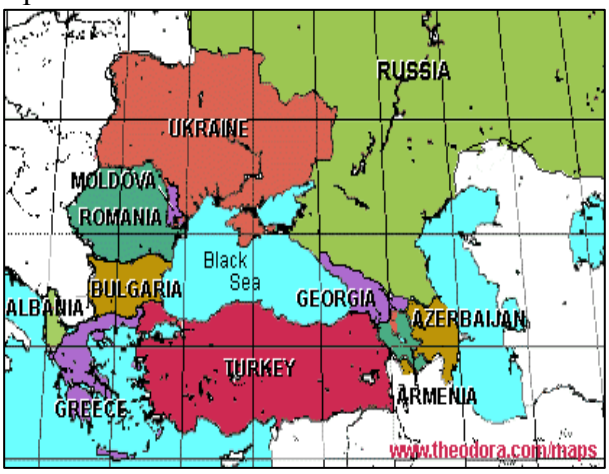

Fig. 1 The BSEC map

In the course of time, the organization's activities included domains that haven't been stipulated in the original concept like: government, institutional reforms and economic reconstruction. These preoccupations are signs of permanent adaptive capacity to the new evolution plan, regionally and internationally. Some regions from the Black Sea area have still serious problems in the security domain, especially in what concerns the dreeying conflicts and non-conventional threats.

The reform process of the organization is a necessary condition in order to obtain a pragmatic, flexible and transparent character. In the spirit of there principles, as well as to intesify the co-operation in interest domains for all the states from the Black Sea region BSEC assigned the next direction of action: the reorganization and the reorientation of the activities so that these will be able to responde to the new evolutions from the regional and the international plan; he identification od the priorities of action, the revitalization of some work groups as part of BSEC: the increasement of actions in order to establish ones parterschip relations with the EU in the favourable context created by the new neighbourhood european policy; the support of the effort od the states from the East Europe and the Caucasians to strenghten the democratic processes and the required reforms to realise the transition to the market economy; the development of BSEC's contribution to the improvement of the security and stability in the Black Sea region, including by attracting the USA, EU and NATO in this actions; the extension of the BSEC's cooperation upon another regional organizations and structures.

Even if the general impression is that that the co-operation in the Black Sea region has extended but not strenghtened, the the wide spectrum of BSEC activities, the mentioned area is approaching gradually to the european criteria of regional co-operation, as a support and precondition to security and prosperity.

2.2. The Organization for Democracy and Economical Development (GUAM). The Organization for Democracy and Economical Development (GUAM)[3], was initially created to counterbalance the influence of Russia in the region; after that the activities of the organization served to the development of the reciprocal co-operation in order to fortify the stability and security in Europe. GUAM is used as a support for the following principles: respect of the sovereignity; teritorial integration; nonviolation of the state borders; democracy; sovereignity of the law; protection of the human rights.

The most important event in formation and certification of this group in it's capacity as a regional organization took place in June 2oo1 when[4] there were established the co-operation priorities as part of GUAM: to intensify and to extend the comercial-economic relations; to develop the infrastructure of the transport corridor by harmonizing the legislative support

[3] GUAM was founded in October 1997 by Georgia, Ucraine, Azerbaidjan and Moldavia. The organization included Uzbekistan in 1999, but this state decided to retire 6 years leter. The source: http:/ ro.wikipedia.org/wiki/GUAM

[4] The Yalta Chapter was signed by cheefs of GUAM states and established the purposes, the principles and the co-operation domains of the member states.

in this area and the connection of the taxes and custom terms; the fight against international terrorism, organized crime, illegal migration and drugs traffic. Although the organization seems to stagnate for the moment, the last years marked some revitalization signs: The Common Declaration "in the name of democracy, stability and development" that decided that each state member should contribute to the peace and stability support, using the political and miliar arguments and peace operations; it changed it's structure, being created three specific commitees (regarding politic and judicial matters, economic and commercial issues and scientifical, cultural and educational matters); it announced it's intention to create the proper peacekeeping forces. In 2oo6 took place the reaffirmation of the organization on the international level.

The new mission really meand the transformation of the organization in an waiting-room for NATO and EU, all member states admitting that the main objective is the euro-atlantic integration. Even in there conditions, no one of the member states don't want that the organization substitutes the Commonwealth of the Independent States (CSI) and neither to be straightened against this, especially because all four are members of CSI[5].

The survivor capacity of GUAM is directly proportional with the interest of the USA and EU in the region. GUAM's success is conditioned also by the changing of Russia's negative attitude regarding this regional organization. The Federation of Russia still lookes at GUAM as to a threath to its political, economical, and security interests in ex-soviectic area.

The possible creation of a security community system in GUAM region awakened the most anxiety. Russia first has to understand that the organization has a strategic importance for the security of the transport of natural gas and crude oil from the Caspic Sea and Central Asia to the West, as for the transformation the Black Sea into a stability area: the key to the the future of the organization can be the correlation between this objectives and also a coherent strategy with the purpose to strenghten his international statute.

2.3. The Commonwealth of the Independent States (CSI). The Commonwealth of the Independent States (CSI)[6] was crated in December 1991 on the ruin of the ex-soviectic empire, including 12 form 15 sovietic republics. The confederation wanted to be an instrument of the "civilized divorce" of the ex-soviectic republics, a structure for a free market and unique currency, beside a military co-operation. CSI started under the improvisation sign and afterwords the failure of the alliance was determined by: the absence of any prograss in the solution of regional conflicts; the failure of member states in creating a free market area; Kremlin's preoccupation regarding the attempt of the West to counterbalance russian influence in the ex-sovietic area (the extension process of NATO and EU).

The organization made recovery efforts, and any attempt was a real succes: the Common Economic Space (Ucraine refused to sign the joined agrements and the final term to begin working was established from 2oo5 to 2o12); the treaty for Collective Security (from a military alliance able to guarantee the peacefull finish of regional conflicts, was limited at some military exercises).

In termen of the new characteristics concerning the security environment from the beginning of the 21th century, we can notice that the tendency of the member states is to orientate to a European and euro-atlantic future. In this way, the abbility of Russia to maintain a high cohesion degree in the region raises important question marks. Also this situation is prejudicial to the CSI [3]. Therefore the future of the Community remains uncertain.

[5] Popa, V., Sarcinschi, A., *The view in the evolution of the international security organizations,* Ed. U.N.Ap., Bucharest, 2007, p. 42

[6] 11 states signed the establishment agreement at 21 october 1991: Armenia, Azerbaidjan, Belarus, Kazahstan, Kyrgystan, Russia, Tadjikistan, Ucraine, Uzbekistan, Turkmenistan and Georgia, two years later. After 14 years, Turkmenistan, and 1 year later, Georgia, withdraw. The source: http:/ ro.wikipedia.org/wiki/CSI

3. A REGIONAL SECURITY MODEL

Nowadays, the Black Sea region, due to it's position and the extraordinay potential of development, has the chance to play a new role in the european system. There ins't only one organization or one political actor that can solve all the problems in this area. The co-operation policy is the solution to the security and stability so that each state can have an oppinion and at the same time not fell treatened.

In the present international context, the region presents a considerable political and academical interest. On one hand this situation cand solve the sercurity interdependence from the Black Sea region, and on the other hand can outline the security complex in this area.

Concerning the first aspect, specialists identified some important security characteristics oh the region: the foreign politics of Russia in this area, the tensions from Caucasians, the proximity to the Middle East, the oil transportation problem from the Caspic Sea, the new neighbourhood of the EU.

Regarding the official co-operation at the Black Sea, there are many solutions: the increasement of the BSEC actions, the development of GUAM's influence or a new structure to improve the connection between the states from this area. But any option that is chosen to confere a common identity for this region should be addopted considering the next 10 priorities set:

1. *The strategic reconsideration of all initiatives not only at the proper area, but taking into account the evolutions from a larger area*. Once the immobility and the inactivity of the institutions reuniting exclusively the states situated next to the Black Sea was observed the solution can not come only from the internationalization of the region.

2. *The specified institutions on the restricted domains of activity must identify, in order to articulate and promote the common interests of states from the wider Black Sea region*. The targets that can't be accived at dead line must be replaced. Punctual measures like the functional integration of the main railroad system, the development of the Black Sea ring- shaped highway, building some pipelines to transport the natural gas and oil, the interconnection of the electrical network and communication system or the development of the maritime highways should constitute a good starting point.

3. *The realization of a "precise division of labour" among the regional organizations*. No matter when, the attempt to identify and later to solve the specific and the common interests problems should represent a necessary condition to the positiv evolution in the Black Sea region of the political, social and economic aspects.

4. *The preparation of a solution against new threats and natural disasters or disasters produced by man*. The introduction of a solidarity clause for these cases and at the same time the necessity of assistance form western states realised by training first intervention units, cand constitute ain methods for an efficient answer.

5. *The reconsideration of negociation method in all freezing conflicts.* The mistaken principle in keeping that there conflicts are of artificial creation, is not in the interest of a solution to them. A new analysis is necessary, starting with the level of democracy of the local administration, and then with the capitalization of local communities - that can form the base of the civile society. In this way we can obtain the free and qualified expression of options of this population.

6. *The development of a constructive and structural relation between the regional and international actors*. It is vital for the Black Sea regionalism that BSEC and GUAM (which are the most advanced forms of regional co-operation from this area) to develop a constructive relation between them, and international actors such as the EU, that owns the resopurces and the experience in order to involve in regional projects. Transforming BSEC and GUAM into trustworthy partners will supply a new understanding to the regional cencept of the Black Sea in a united and democratic Europe.

7. *The creation of a co-operation process basedon the affair interests including the private sector*.

8. *The re-movement of "security dilemma"*. The situation in the wider Black Sea Region is this: Romania, Bulgaria, Greece and Turky are NATO members; Ucraine and Moldavia remain captive of fault between Russia and euro-atlantic community; the whole caucasian area is a fault area between Russia and the Middle East; Georgia, although is economically dependent by Russia, chose to approach NATO; Armenia and Azerbaidjan remaine captive between the economic dependency towards Russia and the negative influence of the islam in the region.

9. *The integration of Russia in the building process of the regional stability structures*. Russia had at the beginning a negative attitude especially regarding GUAM (the only regional organiyation it doesn't belong to), that was percieved as a threat to it's political, economical and security interests from the ex-sovietic area.

10. *Ukraine has to play a significant role in the organization of a new regional order system.* Ucraine used an unjust manner in order to obtain a leading role among regional conveyers of oil. Even Russia developed actively the transport corridors round Ucraine, Kiev owns the control on the energetic European transport route for the West Europe, Uncraine becomes a regularity center of the geo-economic problems.

4. CONCLUSIONS

- From the theoretical point of view, the analysis instrument regarding security problems at the regional level are still insufficiently developed.. However, the theorteical debates like this one should generate working instruments especially fot the decision factors.
- The Wider Black Sea region is space where a regional identity conscience manifests. At a closer look, the region appears more like a homogenous area: almost identical socio-economical structure (corruption, weak democratic institutions, and fragile market economy), same challenges but at different intensity.
- In "the Black Sea equation" two of the aspects are vitall: the energy (the strengthen of the energetic east-west link and the security of this, the ensurance of free acces to the energetic resources of the region, the oppening of the alternative energetic routes).
- Although the interest and the involvement of the important international actors is isgnificant, the Black Sea region is far from solving its problems. The prolongued conflicts and the political tensions apply a supplimentary tension upon the security enviroement.
- It will be very difficult to build a governmental space up the EU's standards without the intesification of the regional cooperation and without the involvement of all parties.
- Regarding the institutionalization of the co-operation al the Black Sea, there are many possibilities: either the increasement of the OCEMN's actions, either an enhacement of of GUAM's influence, or the building of some new structure in order to improve the conections between the states from this area.
- The wider Black Sea region could be a regional complex of security, if, after the identification of the priorities, these will be approaced in an efficient and long termed manner.

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ANALYSIS OF THE BUDGET CHAPTER WITHIN THE MINISTRY OF DEFENCE OF THE CZECH REPUBLIC IN RELATION TO THE GOVERNMENT ASSETS

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Abstract*: The article analyses budget chapter 307 - Ministry of Defence for 2009 with the outlook until 2011. It compares selected macroeconomic indicators with those in the previous year - 2008. It describes the fundamental - primary classification of government assets (assets of the Czech Republic) which are the main and the largest group of assets used by the organizational component of the state - the Ministry of Defence of the Czech Republic.*

Keywords*: Financial management, particular chapters, tangible assets, intangible assets, government asset management system, stock, minor long-term tangible assets, long-term tangible assets, minor long-term intangible assets, long-term intangible assets.*

1. INTRODUCTION

The State Budget is a plan of the financial management of the state usually for one year. It takes a form of an act and is proposed by the government and authorized by the Parliament. The State Budget contains the estimate of incomes from various sources and the distribution of expenditures among various chapters. As soon as the budget is authorized, the employment of finances of particular chapters is in the competence of the government, ministries and other institutions.

The budget chapter of the Ministry of Defence of the Czech Republic (MoD CR) is designated by number 307. The financial resources from chapter 307 are used by the MoD CR to acquire assets and to procure services.

Assets together with services belong inherently to logistic support provided by military logistics. The importance and role of assets in the process of satisfying ACR troops' needs are unsubstitutable in accordance with norms, allowances, requirements, directives, etc. Assets exist in two forms – tangible and intangible assets. The tangible assets include materiel and general use material. More tangible assets exist than intangible assets.

In addition to assets owned by the government (i.e. government assets), assets not owned by the government (non-owned assets, i.e. assets borrowed or assets owned by the Alliance or any other Alliance country) are also used within the MoD CR.

2. BRIEF ANALYSIS OF THE CHAPTER WITHIN THE MINISTRY OF DEFENCE IN 2009

The State Budget of the MoD chapter for 2009 results from the present budget structure of the MoD and the legislation of the Czech Republic[1]. It takes into account the organizational structure of the MoD CR and the structure of action programs approved by the Directive of the Minister of Defence; it considers the present program structure, set goals and tasks.

[1] Act No.218/2000 Coll., *on Budgetary Rules*; Government Decree No. 736/2008, *on Preparation of the State Budget and Medium-Term Prospect;* Instruction of the Ministry of Finance No. 293/2008, *formulation of the CR State Budget Proposal for 2009*.

In spite of the complicated financial situation in the world, no active expenditure measures (limitations) have been applied by the government of the Czech Republic (CR) in the process of preparing the State Budget estimate for 2009. The limitations have affected other budget chapters of the CR departments[2], but not the budget chapter of the MoD.

The financial resources from the MoD budget chapter are used for various types of expenditures, including asset acquisition and services procurement within the competence of military logistics in the Army of the Czech Republic. The financial volume of the MoD budget chapter is different for each year; it is based on the long-term and medium-term plans specified for a training year. The total planned expenditures of the MoD budget chapter for the period from 2009 to 2011 amount to 179.2 thousand million (bil) Czech crowns (CZK). The financial volume and the percentage share are illustrated in Fig. 1.

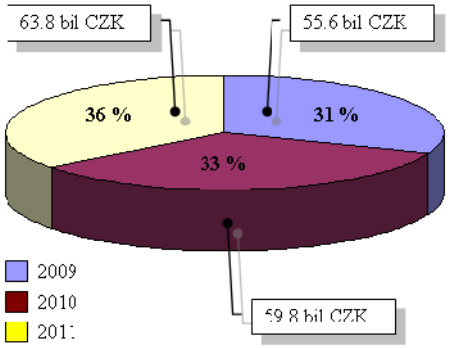

Fig. 1 Planned expenditures of the MoD budget chapter for the period from 2009 to 2011

Inflation is presumed to revert to lower values (1.36 - 1.35 %)[3] in the next years after the nonrecurring increase in 2008 (6.1%). However, the further development of inflation is unknown with regard to the impacts of the financial crisis, the reduction of gross domestic product (GDP) rate and possible operative budget adjustment. The reality (2008 and 2009) and vision (2010 and 2011) of the MoD budget chapter with regard to the macro-economic indicators are shown in Table 1.

Table 1 Expenditures and income of the MoD budget and other macroeconomic indicators

Macroeconomic indicator / Economic value	Year			
	2008	2009	2010	2011
Gross domestic product (in bil CZK)	**3 827**	**4 087**	**4 395**	**4 736**
Expenditures – MoD budget (in bil CZK)	54.1	55.6	59.8	63.8
MoD expenditure as a percentage of GDP	1.42	1.36	1.36	1.35
Average inflation (in %)	**6.1**	**2.9**	**2.5**	**2.5**
Income – MoD budget (in bil CZK)	2.9	2.7	2.8	3.0
The CR state budget expenditures (in bil CZK)	**1 107**	**1 152**	**1 088**	**1 133**
MoD expenditure as a percentage of the State Budget	4.89	4.83	5.49	5.63

Assets and services related to assets, and other services in the competence of the ACR logistics are acquired in compliance with financial possibilities within the MoD on the basis of planning outputs. Regular requirements for assets and services are included in all basic groups of the MoD budget classification. The review of basic groups of the MoD budget and their financial volume for 2009 are illustrated in Fig. 2.

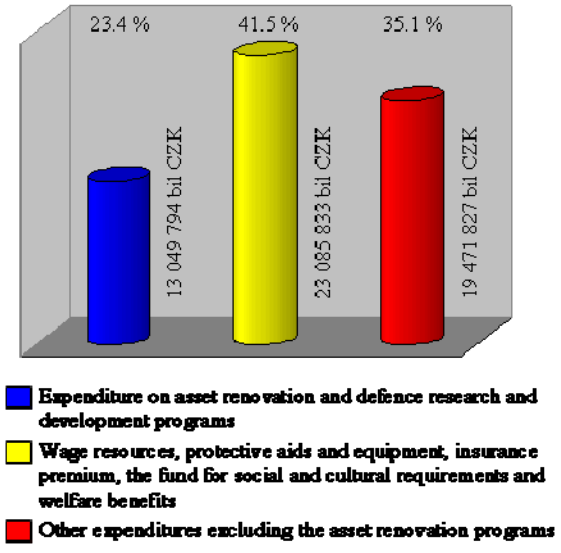

Fig. 2 Basic groups of the MoD budget and their levels in 2009

[2] For example the reductions of the budget in the chapter: General Cash Administration Office by 8.8 bil CZK; the Ministry of Transportation by 7.3 bil CZK; the Ministry of Agriculture by 3.9 bil CZK; the Ministry of Health by 1.6 bil CZK and Ministry of Education and Physical Training by 1.5 bil CZK.

[3] Inflation in 2008 was caused governmental interventions, e.g. increase in the value added tax, rent and the increase in the price of oil.

The expenditures on asset renovation programs in 2009 are lowered by 1.7 bil CZK (decline by 12%) in comparison with 2008. In the sphere of wage resources, protective aids and equipment, insurance premium, the fund for social and cultural requirements and welfare benefits, the finances for 2009 are higher by 692 thousand million CZK (increase by 3.1%) in comparison with 2008. Other expenditures excluding asset renovation programs are increased by 1.9 bil CZK (increase by 11 %) in comparison with 2008.

3. IMPORTANCE OF ASSETS FOR EXECUTING MATERIAL PROVISION

The nomenclature norm describes assets as a set of things having tangible as well as intangible character, finances, rights to intangible assets and claims.

The government asset management system within the MoD CR includes the following processes: asset acquisition (purchase) process; asset handling process; accounts and records process; asset use process; maintenance process; asset protection process and surplus asset disposal process (see Fig. 3). However, assets or services relating to property are always an objective concern of all processes.

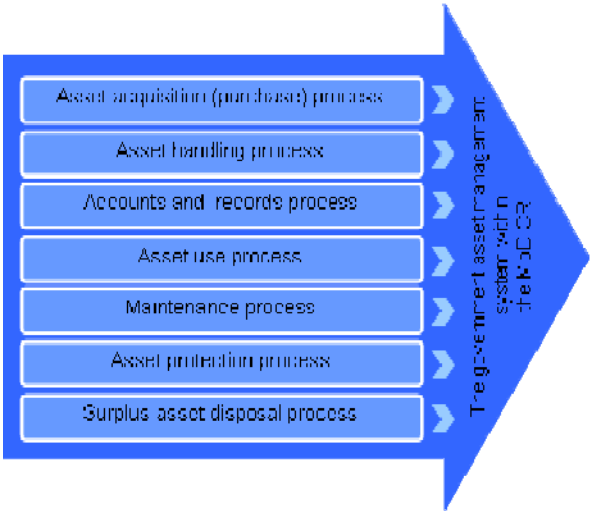

Fig. 3 Processes of the asset management system within the MoD CR

Executing material provision is characteristic of many of the following:

- Control measures;
- Organizational measures;
- Human labour and effort;
- Financial resources.

Assets (tangible and intangible) are of high importance within the by the Ministry of Defence of the Czech Republic to support any task, service and work activities, directives and orders. Many assets for fulfilling tasks are directly dependent on the need and extent of tasks to be fulfilled, on timeliness and required level.

The flow of assets, e.g. from a depot to a unit is accompanied with an information flow. Assets can be understood as an economic source, the role of which is unsubstitutable to support performance of tasks set by the Ministry of Defence of the Czech Republic, the government of the CR and Parliament.

The CR legislation defines main principles incidental to the activities of MoD CR officials in tangible and intangible asset management. The defined principles are mandatory for all by the Ministry of Defence of the Czech Republic organizational units and the military units and installations subordinated to them.

The provisions of CR legislation and MoD CR internal regulations are obligatory for subsidized organizations as well as state-owned companies established by the MoD CR if they manage government assets which the MoD CR entrusted them with, to fulfil tasks according to the scope of activities specified in the memorandum of association.

The Basic Code[4] is a primary and the only internal regulation approved by the CR President. All the internal regulations issued within the MoD CR result from the provisions of the Basic Code. Among other things, the Basic Code specifies general requirements for care of government assets which are used within the MoD CR.

4. BASIC CLASSIFICATION OF GOVERNMENT ASSETS

Government assets within the MoD CR are divided into intangible and tangible assets (see Fig. 4).

[4] Základ-1 *Základní řád ozbrojených sil České republiky*, MO ČR, Praha, 2001.

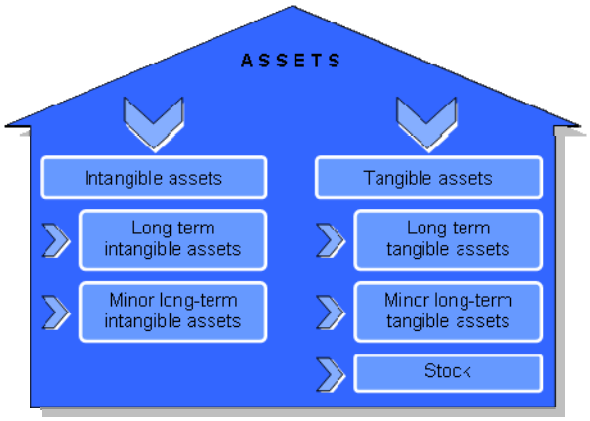

Fig. 4 Basic (primary) classification of assets

4.1. Intangible Assets

Intangible assets are divided into long-term intangible assets and minor long-term intangible assets.

4.1.1. Long-Term Intangible Assets

Long-term intangible assets contain intangible research and development results, software and valuable rights having a usable life longer than one year, within which the market price exceeds the amount of 60 000 Czech crowns.

From the viewpoint of supply, bookkeeping and cataloguing processes long-term intangible assets are classified as follows:
1. Intangible research and development results;
2. Software; and
3. Valuable rights.

1. Intangible research and development results are understood as results of successful papers that are not an object of intangible assets rights and other valuable rights, they have been obtained independently, i.e. they are not a part of acquired long-term tangible assets and their appraisal.

2. Software (SW) is understood as a programme product for one user or for a defined number of participants in a defined network.

3. Valuable rights are understood as rights in assets and other valuable asset values. Valuable rights are as follows:

- Know-how, i.e. a summary of all knowledge, experience and information required for production and technical realization of production, i.e. all that is not or cannot be an object of intangible assets rights or literary assets.
- Licence, i.e. an approval to use intangible assets or to handle them. Licences are as follows:

- Passive - designation of a licence from the viewpoint of a buyer (it is used by the MoD CR);
- Active - designation of a licence from the viewpoint of a seller (it is provided by the MoD CR);
- Non-exclusive - a proprietor of a right provides the right for the use of his/her own solution through the licence when he/she holds the right to provide the licence to other persons concerned on the same territory and simultaneously he/she has the capacity to use the object of the licence himself/herself;
- Exclusive - an assignee is exclusively and entirely authorized to use the provided solution on a particular territory, i.e. the object of the licence cannot be used even by the owner of the solution who, simultaneously, is not authorized to provide this right to another person.

4.1.2. Minor Long-Term Intangible Assets

Minor long-term intangible assets include intangible research and development results, software and valuable rights having a usable life longer than one year, within which the market price exceeds the amount of 7 000 Czech crowns and does not exceed the amount of 60 000 Czech crowns.

4.2. Tangible Assets

Tangible assets are divided into long-term tangible assets, minor long-term tangible assets and stock (including spare parts).

4.2.1. Long-Term Tangible Assets

Further, long-term tangible assets are divided into the following:

- Lands regardless of their market price (if they are not wares);
- Structures (buildings, construction works, technical restorations, flats, non-residential premises) regardless of their market price and a usable life;

- Independent things possessed or perhaps sets of things possessed having independent technical economic determination, the market price of which is higher than 40 000 Czech crowns including precious metals;
- Cultivator's units of permanent vegetation having the fruiting rotation longer than three years regardless of their price (fruit trees, bushes and vineyards);
- Herds of cattle and draft animals regardless of their price; and
- Works and objects of art regardless of their price (acquired for the purpose of decoration and interior complement – not gallery and museum exhibits).

4.2.2. Minor Long-Term Tangible Assets

Minor long-term tangible assets include things possessed or sets of things possessed having an independent technical economic determination, with which the usable life is longer than one year and the market price of one item is 3 000 Czech crowns and higher and does not exceed 40 000 Czech crowns.

4.2.3. Stock

Stock (including spare parts) means a set quantity of a given class of assets stored in facilities (storage depots) to support the needs of ACR units and installations.

The status and changes of inventories acquired by in-house manufacture are kept in accountancy books (some stock which is not included in accountancy books is kept by cost centres in complementary records).

The stock is as follows:

- Material up to the instant of consumption – raw materials, consumables and spare parts, packaging, if they are not long-term assets, and other things possessed having a usable life of one year and shorter regardless of the value;
- Work in process, semi-finished products of own making, products and animals (young breeding animals, animals to be fattened);
- Supplies (articles on stock).

5. CONCLUSION

The State Budget is a fundamental part of public finance because it centralizes the bulk of the budget system income and has a share in irrevocable redistribution of a considerable part of GDP using the budget system. The redistribution of national income related to the accomplishment of political, economic, social and defence tasks of the state is the basic function of the State Budget.

The government refunds he expenditures incidental to the preparation for state defence (peacetime strength of the army) and to state defence in a state of emergency (in the event war breaks out) and during a state of war. The MoD CR acquires assets and procures services for this purpose.

Not only the Ministry of Defence of the Czech Republic, but also all organizational components of the state (ministries, the Government Office, courts of justice, etc.) deal with government assets. In addition to the assets owned by the government, the assets not owned by the government are used within the Ministry of Defence of the Czech Republic as well.

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ANALYSIS OF THE EXPENDITURES WITHIN THE MINISTRY OF DEFENCE CHAPTER FOR 2009 IN RELATION TO THE ASSETS OF THE MINISTRY OF DEFENCE

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***Abstract**: The article analysis expenditures drom budget chapter 307- the Ministry of Defence for 2009. It prezents and compares selected groups of expenditures related to the acquisition of assets for the MoD CR. It describes the secondary classification of assets (material).*

***Keywords**: Government asset management system, financial resources, classification of assets based on composition, classification of assets based on specific conditions, classification of assets based on the method of use, classification of assets based on the method of allocation, classification of assets based on determination and sorting, classification of assets based on types.*

1. INTRODUCTION

The State Budget of the Czech Republic (CR) is formed by two parts - income and expenditures. Before the State Budget approval, the expenditures are drawn up by the CR Ministry of Finance in cooperation with chapter managers[1], regional self-governing units[2] and state funds[3].

When drawing up expenditures, the results regarding the income from government operations in the previous budget period, the goals and objectives of the government economic policy, the expected economic development of the national economy, etc. are taken into account. The Ministry of Finance submits the State Budget bill to the government for approval. The Ministry of Defence of the Czech Republic (MoD CR) is considered to be an organizational component of the state[4] which manages government assets (the assets of the CR) acquired from the MoD budget chapter. Property of the organizational component of the state, i.e. MoD CR property, is a name for all state assets which the MoD CR was given the right to manage based on the CR legislation and internal regulations. The MoD tangible part of property is formed by its specific part - military material.

2. ANALYSIS OF EXPENDITURES RELATING TO BUDGET CHAPTER 307 - MINISTRY OF DEFENCE IN 2009

The State Budget is a system of public budgets which represent central monetary funds created and used by the government including public authorities on local levels for a particular period (fiscal year). It is formed by budget chapters which are established by the law on the State Budget for a given calendar

[1] State administration central bodies and other organizational components of the state which have independent chapters in the State Budget are managers of the State Budget chapter.

[2] Under conditions of the Czech Republic a region, e.g. South Moravian Region is considered to be an administration unit of the CR self-administration.

[3] The state funds of the Czech Republic are legal entities which associate assets for a certain purpose. The state funds are e.g. the State Fund of Housing Development, the State Fund of Transport Infrastructure, the State Fund of the Environment of the Czech Republic, etc.

[4] The ministries of the Czech Republic, state administrative authorities, etc. are organizational components of the state.

year[5]. The total expenditures of chapter 307 - Ministry of Defence for 2009 amount to 55.6 thousand million (bil) Czech crowns (CZK). The total amount of chapter 307 for 2009 can be divided into current expenditures (see Fig. 1) and program financing expenditures (see Fig. 2) using the so-called accounting decomposition.

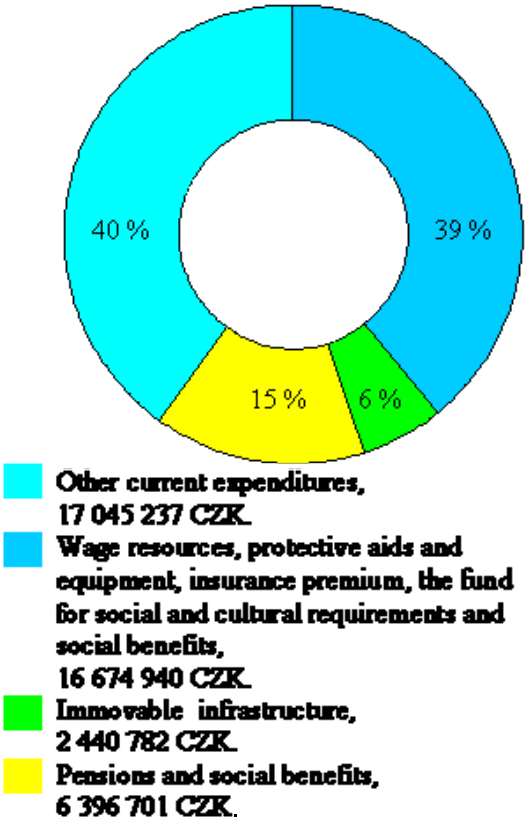

Fig. 1 Current expenditures of the MoD chapter in 2009

As apparent from Figure 1, other current expenditures which are characteristic of all organizations form the highest financial volume of current expenditures. In chapter 307, other current expenditures in 2009 are represented by the following groups of expenditures - see Table 1. As apparent from Fig. 2, the absolute magnitude of expenditures for program financing is aimed at asset renovation programs. Out of 18 asset renovation programs 16 asset renovation programs continue. The following 6 renovation programs belong to decisive modernization programs for armaments and immovable infrastructure - see Table 2.

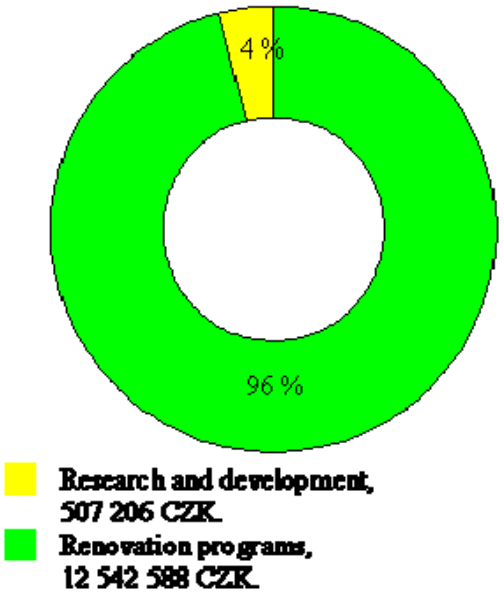

Fig. 2 MoD chapter expenditures in 2009 on program financing

Table 1 Accounting decomposition of the other current expenditures in 2009

Type of the other current expenditure	Total (in thousands of CZK)	Percentage
Purchase of material	4 234 715	25
Purchase of POL	1 035 741	6
Purchase of services and other purchases (especially repairs)	5 651 780	33
Noninvestment contributions, compensations, transfers and other expenses	6 123 101	36

Table 2 Review of major asset renovation programs in 2009

Name of the other current expenditure	Total (in thousands of CZK)
Enhancement of the Air Force capabilities	896 000
Rearmament of the ACR with armoured personnel carriers	3 631 418
Purchase of supersonic aircraft and support of their operations	3 109 789
Support of the ACR forces and equipment in international operations	551 672
Build-up, restoration and operation of the MoD communication and information system and modernization of the MoD communication infrastructure	1 648 720
Purchase and repair of medium military cross country vehicles	801 247

All assets acquired using financial resources of chapter 307 are catalogued in

[5] Act No. 475/2008 Coll., on the State Budget of the Czech Republic for 2009.

compliance with the North Atlantic Treaty Organization (NATO) standards. The assets within the MoD CR are classified based on six aspects - see point 3.

3. CLASSIFICATION OF ASSETS WITHIN THE MINISTRY OF DEFENCE OF THE CZECH REPUBLIC

With regard to the considerable scope and diversity of assets which are delivered to and used by ACR military units and installations, all assets are classified based on the following aspects:

1. Types;
2. Determination and sorting;
3. Method of allocation;
4. Method of use;
5. Specific conditions;
6. Composition (see Fig. 3).

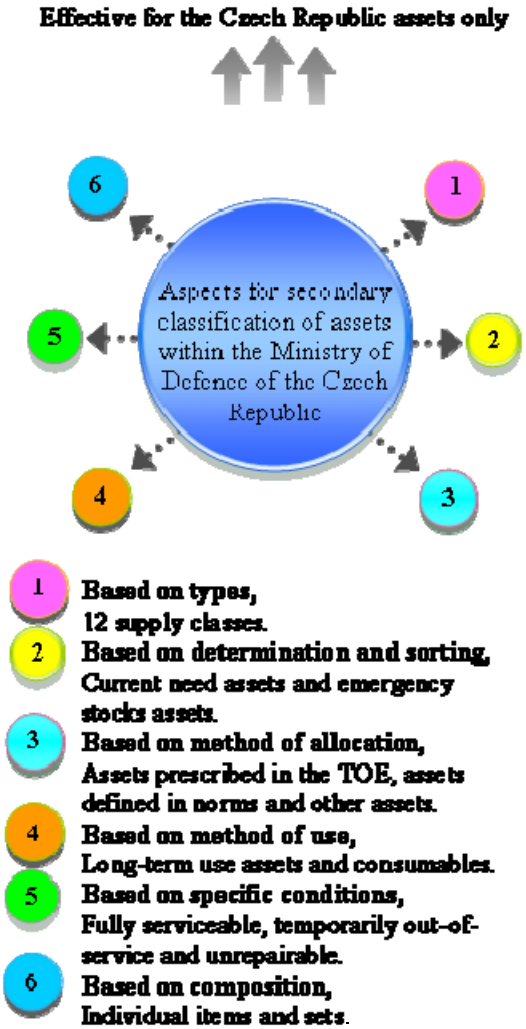

Fig. 3 Secondary classification of assets within the MoD CR

3.1. Classification of Assets Based on Types

Assets are divided into supply classes based on types. Supply class is a designation for a summary of items of given assets arranged within the framework of uniform assets classification which are managed in the MoD CR.

Supply classes are set or cancelled by the Minister of Defence CR or an official appointed by the Minister of Defence CR.

Based on types, assets are divided into supply classes as follows (supply class number and name of supply class):

1.0 – Foodstuffs;
2.1 – Individual use material including spare parts (incl. s. p.);
2.2 – Weapons and weapon systems (incl. s. p.);
2.3 – Military transportation and support equipment (incl. s. p.);
2.4 – Electronics and optics (incl. s. p.);
2.5 – Medical and veterinary supplies (incl. s. p.);
3.0 – Petroleum, Oils and Lubricants, consumables and gases;
4.1 – General use assets (incl. s. p.);
4.2 – Construction and fortification material (incl. s. p.);
5.0 – All types of ammunition (incl. s. p.);
6.0 – Intangible assets; and
7.0 – Immovable assets.

Supply classes ranging from 1.0 to 6.0 are related to movable assets, supply class 7.0 is related to immovable assets.

Supply class manager[6] for novel assets is appointed in a document dealing with the introduction of new assets (equipment) to be used within the MoD CR. He/she is then charged with responsibility for assets[7].

[6] Supply class manager is a senior employee of an organizational unit within the MoD CR who is charged with responsibility for one of more types of assets within the complex support of the MoD CR. He/she is responsible for assets in the field of supply of specific type of assets including its cooperative cataloguing.

[7] Responsibility for assets is a summary of rights and duties which belong to commanders (supply class managers) in the field of management of a given type of assets within a supply class. Their rights and duties result from CR legislation and internal regulations.

Supply classes support compatibility with the NATO supply system.

3.2. Classification of Assets Based on Determination and Sorting

Based on these criteria, assets are classified as follows: 1. Current need assets; and 2. Emergency stocks assets.

1. Current need assets are intended for supporting training, classes, combat readiness and survivability of troops in peacetime. They include the following:

- Assets prescribed by the Table of Organization and Equipment (TOE);
- Assets defined by allowances and norms;
- Assets for the build-up carried out within the framework of troops training, for the operation and repairs of permanent structures;
- Drill assets intended for military schools and units selected for training specialists.

2. Emergency stocks assets are intended for supporting combat and mobilization readiness of units. They include the following:

- Assets in the quantity given by the difference between peacetime and wartime TOE;
- Assets defined in norms of supplies for combat use.

The principles for making emergency stocks and their management are defined by internal regulations approved by the Chief of General Staff of the ACR.

3.3. Classification of Assets Based on the Method of Allocation

Based on the method of allocation assets are classified as follows:

1. Assets prescribed in the TOE;
2. Assets defined in norms;
3. Other assets.

1. These are assets specified in the TOE in peacetime and the TOE in wartime. The types of assets prescribed in the TOE in peacetime and in wartime are as follows:

- Assets required for tasks performed by individuals, small units and large units;
- Assets related to a particular military occupational speciality which must be monitored centrally for the benefit of supporting defence ability of troops.

2. Assets not requiring inclusion in the TOE from the viewpoint of organization and support of troops are allocated based on norms. Generally, a norm specifies inventory status of assets intended for a soldier, unit, equipment, etc. Norms are designated by particular supply class managers using internal regulations.

3. In exceptional cases particular types of assets can be allocated to users based on special directives and regulations.

3.4. Classification of Assets Based on the Method of Use

Based on the method of use assets are classified as follows:

1. Long-term use assets;
2. Expendables supplies (consumables).

1. These are individual items or sets of items having independent individual technical economic determination which are long-term or minor long-term assets. These are items of supply classes such as weapons and weapon systems, military transportation and support equipment and others.

2. Assets which are a stock. When used (after issue from a depot) they are fully used up, depreciated or become a part of another item. They consist of supply classes, such as foodstuffs, Petroleum, Oils and Lubricants (POL) consumables and gases, ammunition and others. With the exception of ammunition and some spare parts, consumable supplies are not viewed according to quality in complementary records and they are not usually subject to cancellation.

3.5. Classification of Assets Based on Specific Conditions

Based on specific conditions long-term use assets and some consumable supplies are listed in categories. The inclusion of assets in a particular category is influenced by the length of life, wear or deterioration. It is an orientation indicator of quality and expresses its usability at the same time. Assets are classified based on specific conditions as follows:

- First category, i.e. fully serviceable assets;
- Second category, i.e. temporarily out-of-service assets which require repair beyond the army level (e.g. in a military repair base); and
- Third category, i.e. out-of-service, unrepairable assets (for liquidation in military logistics bases or beyond the MoD CR in reasoned cases).

With regard to the second and third categories it is always considered whether repair would be practicable and whether it would fulfil its purpose. Second category assets are not collected in units, but they are sent to repair workshops or depots or superior level facilities according to the superior's possibilities. Supply class managers determine the inclusion of individual types of assets in categories in their special implementing regulations, directives, instructions, guidelines, etc.

3.6. Classification of Assets Based on Composition

Based on composition assets are classified as follows:

- Individual objects, substances, raw materials, semi-finished products, etc. with which their character, composition and purpose, characteristics and the method of application result uniquely from the name (e.g. service cap) and unit of measure;
- Sets that form groups of items and complexes intended for one purpose from the viewpoint of use (it is usually indicated directly in the name or expressed by a unit of measure that it is a set).

We differentiate between simple sets and combined sets based on the types of assets which a set is composed of.

Simple sets as well as their functional accessories contain assets of one supply class. Their handling usually does not require special organizational measures.

Combined sets mean a group formed by items of various supply classes. A supply class manager of such a set is the manager of supply class in which the whole set is included. A set composed of items which are not prescribed by the TOE or norms is also considered to be a combined set.

A simple as well as combined set is equipped with a log (of a simple or combined set) and an accompanying copybook. The log includes a list of items in a set – a statement of completeness.

The log lists records about the flow of assets when they are used. The accompanying copybook contains a list of functions for which a set is used.

4. CONCLUSION

In the first part, the article analyses the expenditures of the Ministry of Defence chapter for 2009. Attention is paid to those expenditures which are related directly to the assets (material) purchased for the MoD CR.

The budget is in the competence of the government and its bodies. Its nature is based on early and correct transfer of all budget receipts and on continuous and economical draw-down of budget expenditures. In the Czech Republic, the government is responsible for the State Budget to the Chamber of Deputies CR which it submits a report to where it evaluates the development of economy and the fulfilment of the State Budget after the end of each half a year.

The second part of the article deals with the secondary classification of the assets acquired and the existing assets within the MoD CR.

The primary classification of assets results from CR legislation and is valid for all organizational components of the state. The secondary classification of assets results from internal regulations of the Ministry of Defence of the Czech Republic and is a specific classification valid only for the Ministry of Defence of the Czech Republic.

The Ministry of Defence of the Czech Republic is an entity which is mainly budgetary; in a limited extent it is profit-making (gainful). CR legislation dealing with government assets is represented by laws and orders. Internal regulations issued within the Ministry of Defence of the Czech Republic dealing with government assets are represented by the Basic Code and service regulations.

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TERRORISM AS A RISC AND A THREAT TO NATIONAL SECURITY. PRESENTING INTERNATIONAL TERRORIST ORGANIZATIONS AND THEIR WAYS OF OPERATING ON ROMANIA'S TERITORY

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Abstract*: The democratic society will allways be aware that terorrism, în all of its forms, posts a major threat to national security, to human security and to individual freedoms, anywhere in the world. The states will have to condemn the oppression and the discrimination of which the ethnical and religious minorities fall victims, to ask the Parliaments to adopt laws which can guarantee the rights of the minorities, to identify all the acts of oppression and discrimination against them and to establish penalties against those who makes them. Knowing the multidimensional nature of the human security and being aware that the understanding of the human security must be dynamic and flexible, in order to respond to the numerous challenges regarding this matter that occur relating to Romania and its allies, it will lead to an universal consent.*

Keywords*: terrorism, national security, terrorist organization.*

1. TERRORISM AS A RISC AND A THREAT TO NATIONAL SECURITY

In the situation in wich at the beginning of the 21th century we became the citizens of an new millenia, marked by many changes and riscs, what had been considered untill now imposible and terrifiying scenarios for the humanity became an terrifying reality and a danger more and more obvious and present. *Hitting the present, spreading the evil and pretending to offer a better future* (Marret, 2002) the terrorism got at this beginning of century and millenia, through the magnitude and the diversity of its forms of manifestation, an complex character, extended to the scale of the whole world.

The chalenges are not any more conflicts between states, they are of a nature much more complex, belonging not only once to the zone of organized crime, terrorism, economical instability and not last to the threats to the enviroment. In this context it can be considered that we are facing new threats, agressive and unpredictable as potential, power of distruction, resources, global network like spreading, goals and targets. According to EUROJUST statistics a number of 706 individuals have been arrested in 15 of the countries member of the E.U. beeing suspected of felonies that are on the line between organized crime and terrorism.

The new types of riscs- difuse, hard to locate and practicly impossible to fight against with modern traditional means- require a new intergrated aproach, wich should combine the political, economical and financial instruments with a strategy regarding the usage of new technologies destined to counterfight the fenommenon in its whole.

Terrorism is not a new fenommenon. It had in contemporaneity an unprecedented growth and, through the new means of manifestation, through its more and more organized character, distinctive danger and the obvious internationalization, it represents a lasting threat to human community, to intitutions and even to countries.

It has to be remembered alsough the fact that terrorism in Europe has at its foundations the istorical, political, economical and social luggage of every state member of the E.U.

Starting from this point of knowledge, it can't be neglected neither the fact that European Union, as a political institution, is more and more identified as a symbol, involving the risc to become a target for terrorrism.

Relating, in a sequential analisys, to *islamic terrorism*, the terrorism in E.U., and in Romania, has to be aproached from a global perspective of the international security enviroment. This is the more imposed by the fact that terrorist organizations wich make propaganda in auxiliary states have used and use E.U. as a base of recruiting new members, Al-Qaida beeing more that an example.

Funding of terrorism covers, according to some open information sources (TE SAT 2007) two distinct domains marked by the funding of the terrorist atacks and the funding of terrorist networks.

The funds are obtained through the creation and the management of small companies, as sources of legal income, wich this way are used for the support of the terrorist groups inside and outside E.U.

According to those presented here, another important source is obtained from the private donations and the unpropper usage of the "AKAT" meaning, "the third part of the income wich has to be given by the muslins to the poor and unhelpfull". In the situations in wich the string of illegal sources for the funding of terrorism covers, for the biggest part, the majority of the criminal actions, from the technique related to falsifying identity and travelling documents, to felonies of financial nature, as the usage of false credit cards, the evaluation of the total summ of the illegal incomes used to fund the terrorism is almost impossible.

In our oppinion, Europe constitues for terrorism, an authentic *theatre of action* wich starts in the Urals and spreads to the Atlantic, the central-european region beeing paticularly exposed to this atack, because of geografical and political reasons. It is a sad reality that the majority of the leaders of the terrorist organizations can cross almost unhindered the borders, that enourmous summs of money can travell from an continent to other in a matter of hours, however when it is about those who apply the law, paradoxical, the borders become a serious obstacle.

Otherwise, from the reports and the international conferences (*The Conference of Ministers from Justice Departments, Moscow, 4-5 oct 2006*) results undoubtfull "that the concern raised by the terrorism can't be solved solely through individual actions beying necessary the usage, especially, of the means offered by the international criminal law". In the situations where national laws and strategies fail to keep up to the trends of the transnational crime and its high technologies it becomes more and more obvious the fact that national security and applying the law must becone inseparable notions.

In the E.U. terrorism and organized crime are in essence transnational fenommenons. As we related before, the year 2006 was marked by an amplification of the manifestastions of the terrorist fenommenon. The sepparatist terrorists have deployed no less that 424 terrorist atacks in the European zones. The Group ETA (*Euskadi Ta Askatasuna*) had claimed a number of 11 atacks in Spain, while the IRRINTZI movement had claimed the responsibility of 4 attacks in France. A number of 6 atacks, deployed in Madrid and Barcelona, has been claimed by GRAPO (*First of October Antifascist Resistance Group*). In this context, we have clues (TE SAT 2007) and about the fact that half of the 282 attacks registered in 2006 in Corsica have been claimed by the *Front Liberation Nationale de la Corse* (FLNC) and *Union des Combattants* (UDC) groups, these two having exact information about their targets.

Italy knew a growth of the number of attacks from the anarchist and the left wing groups like BR-PCC (*Brigate Rosse per la Construzione del Partito Communista Combattente*) and FAI (*Federazione Anarhica Informale)*, responsible for one, respective 9 attacks in Rome, bur also in other cities from the northers part of the country and from Toscana.

Without having the intention to dwell about the manifestantions of the terrorism, we have to reiterate the fact that the posibilities to counterfight it require a sustained exchange of intelligence and a permanent cooperation

among the specialized structures in the antiterrorist retort, either that we stand with those external like: GSG - 9 (*The Antiterrorist German Commando*), SEK (*SpezialeEinsatz Kommando*), SAS (*Special Air Service*), GIGN (*The Intervention Group of the French Jendarmerie*), OSASTO KARHU - Helsinki („The BEAR" Unit) sau GIS (*Groupe Italian Interventional Speciale*), NOCS (*Nucleo Operativo Centrale di Securezza*), GEO (*Grupo Especiale Espagnol de Opertiones*), or that we remember, not last, the specialized internal units like: „Vlad Tepes" Brigade or „ACVILA" from Ministry of Administration and Interior, „B-AT" from Romanian Intelligence Service or „the Special Intervention Unit" from The Protection and Guard Service.

The exchange of intelligence, with the goal of preventing and counterfighting the terrorism, is imposed so much more while, untill present days, in Romania, the fenommenon of terror has not manifested to the magnitude and amplitude found in the western countries (Germany, Dennmark and, repeatedly, in Great Britain) and neither have not grown distinctive criminal organizations like YAKUZA (Japan), KASTAFARIS (Jamaica) or like the Chinese Triads.

There are registered, tough, a series of propper and even stimulent social and economical factors for the internal organized crime, beeying manifested obvious tendencies of swift joining of it to the process of globalization and internationalization of the present criminal organizations in the majority of the world states.

The development of the organized crime in Romania could be interpreted, lato senso, from the perspective offered by the democratization process and, by default, by the intregation in the world economical circuit. Also, „the opening of the borders, doubled by an relaxed customs control" has given an impulse, to unprecedented heights, to the movement of people and goods, to illegal imigration, grand theft auto, traffic with false currency, traffic with radioactive materials, traffic with art work, and, not last, to the economical and financial crime and that wich uses fizical aggresion.

While the specialists fail to get to an consent in the definition of the concept of terrorism, organized crime (*Ad-Hoc Group for Organized Crime of E.U., 2005*), mafia or corruption, that can be defined from different angles and experiences, the structures of the organized crime prove more and more that they can adapt easely to the changes of the situations and conditions (INTERPOL, 13-14 december 2005), heading swiftly to economical spaces wich offers them the biggest income and obvious posibilities to penetrate social and juridical institutions.

Far from beeying considered only a banal joinning of two or more felons to brake into homes or grand theft auto and selling the stealed goods, the organized crime, unlike the terrorist organizations, has objectives established for a long time, in the economical, political, and social area and have the goal to aquire profil and power. In the terrorism tends to change a political system, the groups of the organized crime folow only continuous incomes.

In this manner, reported to the terrorist fenommenon, Europe confronts its self with an amplification of the crime actions like: counterfeit, false currency, illegal traffic with drugs, arms, munitions, explosives, false coins and persons traffic. In this context significant are the actions deployed by the members of the nowadays KADEK (detached from PKK- The Workers Party from Kurdistan) in the domain of drug traffiking and by PKK in the domain of arms, munitions and explosives traffiking and also the traffic of persons.

What Romania concerns, the existence of such structures that are part of international terrorist organizations is most highlightedby specialized sources (www.sri.ro), among the major threats to national security. Organizations like: The Front for Liberation of Palestine, Muslim Brothers(FM), ABU NIDAL, HEZBOLLAH, HAMAS, HIZB-AL TAHRIR (*The Party of Islamic Liberation*) or the GIA (*The Armed Islamic Group*) and not last.

The Gray Wolfs have, through their nucleas of reprezentation, an virtually real potential of affirmation, beeying instructed to „adopt reserved positions that should not atract

retorts from the authorities of the romanian state" (Antipa, 2004).

Although untill nowadays, at least in the terrorist area, have not been highlighted important conections between the big structures of the international organized crime, the most representative remaining the italian MAFIA, on one side, and the terrorist groups or organizations, on the other side, the distinctive danger posed by the crime actions deployed by the international organized crime on Romania's teritory made of this the object of investigations from the intitutions wich have this jurisdiction.

This way, it can be estimated that, to the distinctive threats posed by the terrorism and the organized crime to european security, where subscribes national security too, adds up new risc factors, resulted from the interface of the two fenommenon and represented by:

1. financial means obtained by the terrorist groups from activities of organized crime, these allowing the development of their own management and operational capabilities;
2. generation of interests conflicts, by implying terrorism in organized crime, wich can be solved through means of an extreme degree of violence;
3. amplifying an concern status regarding the perspective of installing and consolidating, on national teritory, of structures linked to organized crime, related with the revival of the international terrorist fenommenon.

Starting from those here presented it can be estimated that the criminal and terrorist organizations converge multiple charasteristics that alows them a close cooperation and that this alows the existence of an high strctural hierarchy, with decisional domains, with objectives and competences well defined. In the same time, in the deployment of the peculiar activities, these use official covers, beeing targeted illegal activities of great amplitude, the violence beeing the main rule of action.

With the intent of supporting a better knowledge of the fenommenon of terrorism and transnational organized crime we appreciate that Al-Qaida represents *the quinteseence* of these manifestations.

To be remembered is also the fact that the simbiosys between terrorism and organized crime influences, obviously, the world economy too. Thus, the evolution of the capital and bourse market have become unpredictible, with negative impact on the economy of the developing states or of the young democracies from Central and Eastern Europe.

On this background the security strategies must be fundamentally rethinked, taking into account the inclusion of new vectors in the *national security equation* of each state. In the context where the continental and world forums channel their efforts in the direction of identifying the adequate solutions to eradicate the terrorist fenommenon, Romania has amplified its efforts to counterfight this scourge, in international domains and in internal ones. These efforts have as target the joinning of Romania in the international coallition, with the objective of counterfighting the terrorism, using all the national potential at disposal and intensifying the measures of updating the laws and the installation of the community's acquis.

Strating with 9/11, at the level of Ministry of Administration and Interior have been triggered a series of organized actions, distinctive, wich had the objective the prevention and counterfighting the transnational terrorism. As a part of The National System for Prevention and Counterfighting the Terrorism (SNPCT), the Ministry of Administrationa and Interior has taken concrete measures to stiffen the surveillance and the security of the borders, to make more effective the security, guard and order systems, in the area of embassies, legations, foreign reprezentations, and to the head-quarters of the local and central administrations.

During the applied procedures the Ministry of Administration and Interior has given priority to couterfight the traffic of persons and the illegal imigration, on one side, and to identify the leaders of those structures, respective the specialized guides in the illegal crossing of borders, on the other side. According totally to the dispositions of the *community's acquis* Romania remains an

active and effective member in the fight to prevent and to counterfight any type of riscs and threats related or directly linked to terrorism.

2. PRESENTATION OF INTERNATIONAL TERRORIST ORGANIZATIONS AND OF THE MEANS OF ACTION ON ROMANIA'S TERITORY

„La Depeche Intemationale des Drogues" (DIG), one of the publications of „Observatoire Geopolitique des Drogues" (OGD), at the chapter Romania, analyzing the situation of drugs between the years 1995 - 1996 demonstrates that Romania, mostly between 1992 - 2005 has tranformed from a transit state in a country with a small start in producing drugs and a big consumption, mostly of heroin. There are shown three main causes of this catastrophic status: chaos in the domain of laws, corruption found at the highest levels and the tolerance in Romania of the mafia and crime organizations, known by their involvment in drug traffiking, where can be found guilty the authorities that where between 1992 - 1996. A first trend is that the drug traffikers don't limit them selfs only to transiting the drugs on Romania's teritory and selling them in Hungary.

The constitution of important stocks of drugs allows an redistribution, in the direction of the Schengen area, via Poland and Cech Republik. In only four yrears (1992 - 1996) the quantities of drugs stored in Romania - having one of the newest sources in Caucaz, with the transit of ucrainian and russian ports - have grown considerably. Almost 6 tonnes of drugs have been confiscated in 1996, mostly compounds of canabis, but also 180 kg of cocain and 62 kg of heroin, confiscated at the border by the hungarian customs officers, after it had crossed romanina border. The hasis from Romania came from the Golden Horn of Eastern Africa, marijuana from Nigeria, cocain from Colombia, Venezuela and Brasil. That's why it is considered that Romania of the years 1992 - 1996 transformed into an authentical casting plate of internationad high risc drugs traffic.

In 1997 Romania doesn't play only the role of an terestrial, aerial and naval transit of the drugs coming from South-East Asia, Turkey, Latin America and Africa. The new role of the country in drug traffic, most that of heroin, has been highlighted by more factors. The narcoactivities have exploited, after the falling of the communist regime, the disorder, an inadequate law, economical crysis and large scale corruption. The presence in Romania of a turkish minority and of the kurdish, iranian, albanian, chinese immigrants have favoured the traffic of this kind. Romania became an important base for the Workers Party of Kurdistan (PKK), organization wich is in war with the turkish goverment. Thus, alost side corruption, inadequate laws, disorder, the regime favoured the high risc drug traffic through the continuation of the links with a series of terrorist organizations (like PKK), well known for their involvment in drug traffic. We must observe that at this chapter it hasn't been anythig else done then to continue the well known link of the regime with terrorism. The Report of OGD for 1997 considers that „it is too early to know if the attempt to moralise the public life, taken by the new goverment, ellected in november 1996, will have durable effects".

„Reports of RIS"- 60% of the drugs wich came into Romania, between 1992 – 1996 came from Tukey. The most important capture, heroin(42 kg), has been made in 12 december 1996, in a bus property of the turkish company „Toros". The drug was stored in small packages, of 500 grammes. Usually, after they introduced the drugs in Romania, the turkish citizens used citizens from other countries as carriers. From 95 traffiker arreted in Bucharest in 1996, 41 proved to be iranians, 20 romanians and 14 turkish. The heroin that came from Afganistan and from the countrie of Central Asia, enteredn in Romania via Moldova and Ukraine. Untill 1995 this drug was swiftly send via Hungary and Slovakia to the countrie in Western Europe: mainly to Austria, Italy, Germany, Belgium and Holland.

A part of the traffic deployed in Romania was is the hands of the kurds, from wich the most were members of the terrorist organization PKK. The Workers Party of

Kurdistan, PKK, was hiding behing an mass organization genericaly named „ The Front for the Liberation of Kurds" (originally, ERNK), wich grouped different women, youth, students and bussinessmen organizations from Romania. About the kurdish bussinessmen, for example, it is known that they have been grouped in „The Association of the Bussinessmen from the East". There are some reports that confirm that this „association" was „an excellent link for the activities of the PKK". All the kurdish organizations from Romania in 1996 were under a strict control of PKK, and the leader was, in the same time, the leader of the front ERNK too. The direct responsible for the collecting of the income was the one and the same person with the delegate for the propaganda problems of the PKK and, in the same time, the director of the kurdish newspaper in Romania named „The Voice of Mesopotammia".

Newspaper wich was distributed unhindered, free, at the entrances of the Bucharest's Metro lines. We specify that this director was a prosper bussinessman, wich folowed english literature courses at Oxford. Almost 90% from the kurds from Romania were members of organizations wich were part of the ERNK and paid dues, in this way, to PKK. Important detail: 75% from these small oriental investors from Romania were of turkish nationality, but in reallity, they were kurds and ERNK gave to their disposition the initial income to start their small bussinesses, observes OGD/97.

According to the statistics of the Romanian Police, almost 65% from the total of the captures made at customs were from transport companies. The spokesmen from PKK and ERNK not only have denied that their organizations are involved in drug traffiking, but also have specified that, in fact, they collaborated with the Romanian Police (the antidrug services have been constituted in Romania after the 90's), four of the captures beeying made on the base of the information given by the kurdish organizations. Anyway, not even one kurdish citizen was ever involved.

According to OGD, the collaboration of PKK and ERNK with the police, was nothing else than an intelligent way to elliminate the competition from the drugs market, with the help of the Romanian Police.

The position of the Romanian Police, wich has appreciated this kind of collaboration remains anyway vague, it is specified in the report 00D197. The spokesman of RIS, had declared that the Romanian Intelligence Service detained clear information regarding the involvment of kurds in drugs and arms traffic, but could not make them public. It is remarkable that, although RIS knew perfectly what the organizations PKK and ERNK were doing in Romania, the regime had ignored the intell and preffered to continue the hidden cooperation with the kurds. It is easy to suppose why: hidden funds were at the disposal of the governing party and for their political clients.

The kurds were involved in the illegal traffic that was transiting from Turkey to Romania, via Bulgary, and in that wich was transiting Ukraine from Moldova, coming from the russian space. According to the Romanian Police „the drug that comes to us from the countries of the former USSR is under the control of the russian, caucasian and ucrainian mafia". PKK had links with all these mafia. The links of the kurds were favoured by the fact thei organizations are legal. In Russia they even have official representatives. A living symbol of the cooperation between the postcommunist regime and the kurds and the russian mafia contitues the illegal affairs. In september 1995 the turkish police arrested at Edime a romanian, along with other six kurds („turkish citizens"), wich were transporting 2kg of heroin, 5 guns and a assaul rifle.

The romanian had declared at the interogatory that he is at the eighths transport of heroin to Romania and of explosives to outside Romania. The romanian confessed that he was working for PKK. According to some confidential reports, sourses close to Romanian Secret Services have uncovered that the arrested romanian was one of their men and that he was also working for the transnistrian mafia. An officer of the 14th Russian Army declared to an OGD correspondent, that in 1995, „the russian troups favoured the comerce with drugs

coming from Extreme Orient". According to the officer the drug traffic in the area was leaded by an russian jew wich had swiss citizenship, an individual from the anturaje of president Snegur.

This jew was the object of an arrest warrant in Russia for traffiking industrial diamond and arms. It is about the well known gangster Boris Birnstein wich had in Moldova almost monopoly of the export of brute materialls (like wood), the monopoly on banks, on asurance conpanies, thru his big company named „Seabeco" the one who was controlling the imprint of the money in Moldova too. Along side with the monopoly of making passports, „Seabeco" controlled also the turism and became, in the mean time, the owner of the luxury hotel MOLDOVA from Chisinau, including the casino from the hotel, both property of KGB untill 1991. „Seabeco" was the owner in Moldova, in 1996, of 12 farms, wich produced 3500 tonnes of turkey meat for the western market, along side with the monopoly of drug traffic and stolen cars from Germany and Austria. One of hose cars was given as a gift from Birnstein to the ministry of Justice of Moldova, with wich he was caught in Vienna in 1992.

The car was in fact stolen by the ukrainean mafia in the city of Heilbron (Germany). The minister was only a courier for Birnstein, wich leaded affairs with persons traffiking too, where he has using moldavian girls for the hotels from Germany. In reallity Birnstein and Seabeco were in fact washing money for the russian mafia, money wich then were deposited „clean" in the banks in Switzerland. Who was in fact Birnstein? According to FBI and Interpol Birnstein immigrated from Russia to Israel in the 80's, reimmigrated wih a canadian passport so that, in 1991, using his old russian passport to come into Moldova where he obtained a moldavian passport. He lured Mircea Snegur with a large amount of gasoline, wich he then sold, in Snegur's name, to an much better price in Sweden and Finnland, dividing afterwards the profit with Snegur. Immediately, Birnstein obtained the first monopolies in Moldova: the making of driving licences and the import and export of gasoline. At the ellections in 1996 Birnstain funded the campaign of Snegur forcing thus him not to be invovlved into the liberation of the Ilascu group, wich the gangester considers to be nationalist.

Significantly, in 1992, Birnstein was the intermediate of the crisys wich led to the sepparation of Transnistria, region where one of the most important ballistical rockets arsenal can be found, according to the american services. Birnstein managed then to debark gen. Lebed, after he got his hands on a cassete where Lebed considers Eltin „drunken pig" and transmitted it to Kremlin. We stray on Boris Birnstein because his trusted link in Romania - in the years after the Revolution from 1989 - was the well known Vitali Ustroi(Usturoi), invoved in several affairs of traffic with strategic materials.

It should be remembered the affair with red mercury, from the parking lot at Vila-Lac Snagov, where were involved some officers from the Army. In the same report OGD/97 („La Depeche Intemationale des Drogues" (DIG), one of the publications of „Observatoire Geopolitique des Drogues" (OGD) is mentioned the drug traffic in wich was involved the italian mafia „Sacra Corona Unita". This organization controlled the drug traffic between Italy and Romania, mainly of heroin, brought from Turkey, and of cocain, brought from Brasil.

„Sacra Corona Unita" enjoyed, according to OGD/97 the complicity of some high clerks and from the police of the regime. The report OGD/97 notes: „The Parquet admitted for the first time that in Romania, the organized crime and the drug traffic enjoyed political support and that the „dirty money" were used by „some parties" to „fund the ellection campaigns".

At the end, the OGD/97 report states, black on white, that still exists the problem requiring to uncover „the links of the old afterrevolutionary goverment with the organized crime".

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