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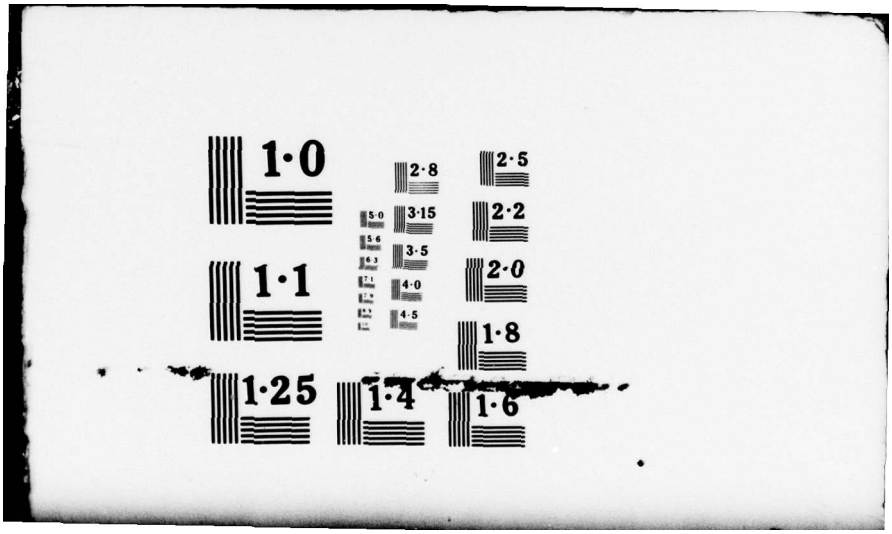
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By

Lt. Colonel Marko Kolev

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EDITED TRANSLATION

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By: Lt. Colonel 10 Marko Kolev

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by: Lt. Colonel Marko Kolev

The identification of military objects is a vital necessity during the organization of the effective fight against the means of military attack as well as during the defense of the troops who are in motion in military operations.

The instances are quite common where the enemy will attempt to camouflage their military devices with shams. So for example, the strategic brain of the operational-tactical rocket can be protected by several false objectives. In such a situation if it hasn't been determined what the real battle goal is, the probability that it will be hit by the anti-aircraft and anti-satellite defense will be intolerably small.

Therefore the automatic identifying systems have great significance, are found and will be found in still wider application in the modern radar systems in the armament and the organization of the PVO and the other military branches. They have a wide diapason by spheres of application and can be used not only for identification of the enemy's means of attack but also for identification of operational-tactical situations and for automatic diagnoses. The identification of

the operational-tactical situations in one forceful, dynamic military situation during a large flow of data will alleviate greatly the timely making of decisions.

Many investigations are known concerning the seperate problems and tasks from the theory of automatic identification. The very theory of automatic identification still isn't organized as a finished, constructed system. But this is easily explained if one takes into consideration "the age" of the scientific developments and investigations in this area.

Nevertheless, from the investigations which have been made so far by many individuals from various countries one common structural design will be shown which must have one identifying system. Figure 1.

Its elements are obligatory for every specific technical or biological identifying system. In the biological systems these elements are usually joined spatially and functionally. The singularity of the biological identifying systems is this, that they

have a wide number of local feedbacks which assures the preservation and interchangeability of the elements. Therefore the biological systems are lacking, up to now technical certainty during work and a long life.

The community at work in the tactical and biological identifying systems permits the basic characteristics to be determined which must have the seperate elements of the structural design of the technical systems while their knowledge is used for the biological systems.

The identification in most instances can be determined as a process, during which there occurs a refering of the objects or phenomena to one of the several previously determined classes (types), on the bases of an analysis of the characteristic features. From here it follows that the automatic machine doesn't identify the seperate objects and phenomena, but only their class (type)-classes are identified but not their seperate, specific representatives.

Let us determine, for example, M class for identification: $\{A\}=A_1, A_2 \ldots A_i \ldots A_M$

The totality of M class objects in fact contains T number representatives, named REALIZATIONS. T-~ is possible in most common cases. The totality of all realizations will signify: $\{B\}=B_1, B_2 \ldots B_j \ldots B_T$

Every one specific realization can belong to a given class A_1. In order to determine to what class the identified realization must be referred, it is necessary to determine the signs, according to which the identification will be carried out and the model of the identification, that is, the mode according to which the class realizations will be identified.

It is known that every one real object or phenomenon can be characterized by several objective features, named SIGNS. The same realizations can be identified not only by number of the distinctive signs, but also by the quantitative values of the common features. Then the totality of signs: $\{X\}=x_1, x_2 \ldots x_k \ldots x_N$ will be portrayed as both every class and also the seperate realizations during the help of the various gradations of the values of every sign: $\{X^k\}=x^k_1, x^k_2, \ldots x^k_l \ldots x^k_R$

In the most common case, when the number of the realizations from a given series of classes A_1, $A_2 \ldots A_n$ is largely endless then the values of the signs are

transformed from discreet into continuous values, which are changed into determined limits.

In order to construct the identification model it is necessary to know the character of the quantitative correlation both between the classes and between the values of the signs, by which the seperate realizations are depicted. Generally the numerical values of the signs are changed accidently and continuously. Therefore the identification model must be probable (statistical).

During the construction of the statistical model of identification it is necessary that we arrange by the probabilistic characteristics of the series of classes. They are of two types. The first type is the distribution of the values of the signs for every class- $p(x_1, x_2 \dots x_k \dots x_N(A_i) = p\left(\bigcup_{k=1}^{N} X_k/A_i\right) = p(B/A_i)$. when the signs have discreet values and when the signs have continuous values. $\int\left(\bigcup_{k=1}^{N} X_k/A_i\right)$. The second type of probable characteristics shows how often one or another class of realization is met. For example, during the defense of a given object from the air adversary, it is important to know what the probability of attack is in being carried out by jet bombers or by strategic

bombers and rocket carriers. This fact is reported on during the identification by the distribution of the probabilities of the classes: $p(A)=P(A_1), P(A_2)\ldots P(A_i)\ldots P(A_M)$. The totality of the distribution $\int\left(\bigcup_{k=1}^{N} X_k/(A_i\right)$ and the probability $P(A_1)$ is called a description (standard) of the class A_1.

The presence of descriptions (standards) for every class enables the statistical model of identification to be created and an automatic identifying device to be constructed.

With the help of the given basic divisions one can examine the functioning of the structural system of the automatic identifying device (Figure 1.) Some realizations B_1 of the identified objects or phenomena are fed into the entrance of the automatic identifying device. The receiving apparatus presents the specific physical signs in total from electrical signals, that is, it transforms the values of several parameters of the electrical signals by which a signal code for description of the realizations is created and which are presented for identification- $b_j=x^1_{j1}, x^1_{j2}\ldots x^k_{jk}\ldots x^N_{jN}$

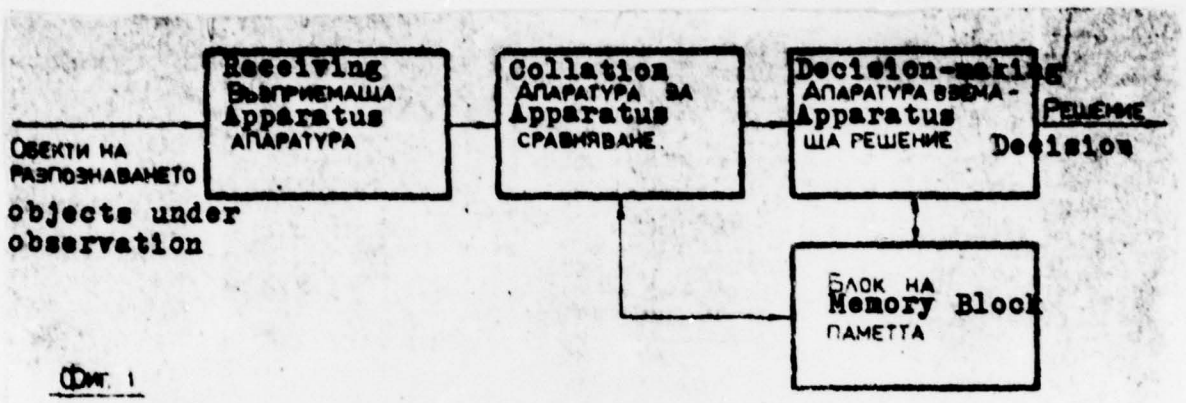

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Figure 1.

When it is necessary, the receiving apparatus carries out a filtration, normalization or other transformations, which contribute to an increase of the economical description of the realization. Except in some cases the receiving apparatus causes the indicated removal of obvious defects from the realization, orientation, and so on.

The receiving apparatus is able to be constructed as a prescribed photoelectronic field together with the necessary system for development, depending on the purpose of the automatic identifying device. Such as apparatus for reception is used in the automatic identi-

fying devices for visual images, for example the automatic devices which read the printed or hand-written text. In other automatic devices the receiving apparatus can be constructed as a microphone with an analyzer of the sound wave spectrum, as in the automatic devices for sound identification or in combination with the echo-locating device. In radio location the receiving apparatus of the identifying device can be a combination of various measuring devices such as measurements of distance, of angles, of the polarization of the electromagnetic waves, frequency measures, phrasemeasures, etc.

The task of the receiving apparatus in the identifying system is to measure the numerical values of the signs and therefore the requirements for it are actually requirements for the different measuring devices for accuracy of the measurement, for perceptibility, fast action and certainty in the work.

The collation apparatus, in most cases, determines the distribution of the probabilities of the coincidence of the desciption of the receiving realization B_j with

the descriptions of all classes (with the standards). The description of the a posteriori probabilities of the classes, the description of the correlating coefficients, etc., will be received as a result of its work. In the first case, the apparatus for collation decides the Bias formula but in the second accomplishes a composition of the functional description of the realization with the standards or calculates the scaled production of the vector realization with the vector of the standards. Functional electronic or electronic ray transformers, optical correlators and other devices are used in the construction of the devices for description. The quality of their work is assessed by the indicated accuracy and speed of activity.

In the memory block of the automatic identifying device, as in every computing system, are kept the work programs, the initial, intermediate and final data. A typical feature of the memory block in the identifying systems is the necessity of the memory volume to be used mainly for preserving the descriptions of all identified classes.

Therefore in the non-training, identifying systems, the memory is constructed out of optical masks, perforated tapes, strength combinations, condensers and other devices. "Flexible" remembering apparati and elements such as magnetic drums, tapes, ferrous elements(small cubes) and others are mainly used in the automatic learning devices, which in the utilization process must replenish and renew the data, stored in the memory.

The decision-making apparatus determines to which class the represented realization must be added, on the basis of the perceived rule for decision making (identification criteria). At its egress the number (i) appears in the class or refusal if all probabilities of the hypotheses do not satisfy the identification criteria. In the constructed relation the decision-making apparatus is determined from the selected identification criterion. It can be executed in a type of threshold system which decides disparities from the model where X_{ii}, X^{k}_{ii} are the threshold values of the K sign of the representative realigation b_j for identification, belonging to the i class (A_i); $X^{k}_{ii'} \leq x^{k}_{i} \leq x^{k}_{i''}$.

x^k_1 - the measured, nemerical value of the k sign of the identification representative of realization b_j.

Then the decision will be in use in this class by which the disparity for each sign is satisfied.

The decision-making apparatus can also be an electronic system for locating an extremity, if in the identifying device the criteria of the ideal observer is used. In this case the remembering electronic system determines which of the hypotheses has a maximum a posteriori probability $p\left(A_i/U\overset{N}{\underset{k=1}{X^k_1}}\right)$ and decides on the attribute of the identified realization in use in the class, which a posteriori probability is larger.

The technical feasibility of the identifying system for the army's needs will be determined in full by the goals for which it is intended. Universal, complicated, technical systems with automatic identification of military objects can be constructed. However their universality makes them clumsy, difficult to remove, complicated during utilization and maintenance, expensive and difficult to hide and they become quite vulnerable to the enemy's striking means.

This is why, for the country's defense needs and for strategic security of the forces those most suitable will be the identifying devices which are mobile and specialized little, which permit team work with "the traditional" technical means such as radar, hydro-acoustical locators, etc. and will be able to work autonomously.

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