Radioelectronics and Communications Systems
Vol. 46, No. 1, pp. 40–43, 2003

Izvestiya VUZ. Radioelektronika
Vol. 46, No. 1, pp. 58–63, 2003
UDC 621.391:519.28

SYNTHESIS OF BAYES ALGORITHMS FOR MULTIALTERNATIVE RECOGNITION OF PATTERNS SET BY SOPHISTICATED STANDARD DESCRIPTIONS

G. V. Pevtsov

Kharkov, Ukraine

The author applies the Bayes approach to synthesis of algorithms for multialternative recognition of patterns represented by sophisticated standard descriptions in the form of sets of standard values and/or intervals of standard values of attributes. For the efficiency criterion of the algorithms synthesized, the full probability of the pattern recognition error is suggested.

Development of algorithms for pattern recognition often necessitates some sophisticated standard description of images as a set of standard values and/or intervals of standard values of their characteristics. This situation occurs, for example, if we try to identify the totality of various signals characterizing the current states of some physical, chemical, biological, or other processes. Each state of the process may be regarded as an image to be identified (the combination) while each type of signal taking part in one or several images — as an object to be recognized (the component). The frequency, time, and other observed parameters of the signals may be considered as the image attributes. In the general case, incompleteness of a priori information about the processes under investigation, simultaneous presence of several components to be recognized in the images, and nonoptimality of attribute classification give no way of describing each image by a point in the many-dimensional space of attributes. So there arises the necessity to introduce a sophisticated standard description of images (the standard pattern).

From the viewpoint of mathematical statistics, the problem of recognition of combinations set with the aid of standard patterns falls into a class of problems concerned with checking of nontrivial hypotheses. The general methods for treatment of such problems in the single-alternative case are developed for statistical radio-engineering applications and described, for instance, in [1]. However, the results obtained are based on the generalized representation of a priori distribution of the parameters to be analyzed, and do not refer specially to generation of standard patterns used in the image recognition. In [2] the recognition of various types of combined radiation is performed with the aid of specially introduced standard patterns, and an approach to synthesis of Bayes algorithms for checking one hypothesis between two alternatives is developed. However, in the majority of practical situations we deal with recognition of more than two possible combinations.

The purpose of this work is the development of a method for synthesis of Bayes multialternative algorithms able to identify images set by sophisticated standard patterns.

Assume that for a totality $\boldsymbol{U}$ of components the combinations $\boldsymbol{U}_i \subset \boldsymbol{U}$ are set, representing a totality of components to be recognized: $\boldsymbol{U}_i = \{u_{in}\}$, $i \in \{1, 2,..., L\}$, $n \in \{1, 2,..., \nu_i\}$, where L is the number of combinations; and ν_i is the number of components observed in the ith combination. Each combination is set by its standard pattern in the metric of the $\Im$-dimensional Euclidean space of attributes $\boldsymbol{S}$. The standard pattern of each ith combination represents a $\Im$-dimensional joint probability density $W(\boldsymbol{s}|\boldsymbol{U}_i) = w_i(\boldsymbol{s})$ of the mixed-type vector of attributes $\boldsymbol{s}$ on the totality $\boldsymbol{U}_i$, when the above probability density is defined in the domain $\boldsymbol{S}_i$ of the attribute space. Assume also that ζ observations have been performed.

REFERENCES

1. B. R. Levin, Theoretical Principles of Statistical Radio-Engineering, Book 2 [in Russian], Sov. Radio, Moscow, 1975.

2. G. V. Pevtsov, Izv. VUZ. Radioelektronika, Vol. 41, No. 4. pp. 49–57, 1998.

19 September 2000