Radioelectronics and Communications Systems
Vol. 47, No. 12, pp. 32–38, 2004

Izvestiya VUZ. Radioelektronika
Vol. 47, No. 12, pp. 45–54, 2004
UDC 621.391:519.28

SYNTHESIS OF STATISTICAL ALGORITHMS FOR RECOGNITION OF PATTERNS SET BY COMPOSITE STANDARD DESCRIPTIONS

G. V. Pevtsov

Kharkov, Ukraine

A model for a composite standard description of recognizable patterns is suggested as a totality of miscellaneous components. The model is a generalization of the former complex standard description and is used for the development of a new method of synthesis embodied in several algorithms of pattern recognition based on checking some complex statistical hypotheses. An example of synthesis of a particular algorithm for pattern recognition is included.

In the control and diagnostics of processes there often arises a necessity in the recognition of the state of the process by sampled values of its parameters or functions of the latter (we call them indices). Every state (pattern) to be recognized may be a priori put into correspondence with one or several intervals of standard values and/or one or several discrete standard values of the indices. For this class of problems we suggested [1] and developed [2, 3, and other] a method of synthesis of algorithms for pattern recognition based on checking some complex statistical hypotheses. The method is based on a new complex standard description of patterns in the form of $\Im$-dimensional simultaneous a priori conditional probability densities of mixed type for standard vectors of s independent indices s_j, $j \in \{1, 2, ..., \Im\}$, for each of L patterns U_i, $i \in \{1, 2,..., L\}$:

$$w_i(\boldsymbol{s}) = W(\boldsymbol{s}|U_i) = \prod_{j=1}^{\Im}\left[\sum_{r=1}^{R_{ij}} I_{ijr}\, p_{ijr}\, w_{ijr}(s_j, s'_{ijr}, s''_{ijr}) + \sum_{d=1}^{D_{ij}} I_{ijd}\, p_{ijd}\,\delta(s_j - s_{ijd})\right], \tag{1}$$

$$\sum_{r=1}^{R_{ij}} p_{ijr} + \sum_{d=1}^{D_{ij}} p_{ijd} = 1, \quad \sum_{r=1}^{R_{ij}} I_{ijr}\, p_{ijr} + \sum_{d=1}^{D_{ij}} I_{ijd}\, p_{ijd} = 1, \forall i \in \{1,2,\ldots,L\}, \forall j \in \{1,2,\ldots,\Im\},$$

where $w_{ijr}(s_j, s'_{ijr}, s''_{ijr})$ are a priori distribution densities of the index s_j (to be determined in the course of learning of the algorithm) on each of R_{ij} standard intervals $[s'_{ijr}, s''_{ijr}], r \in \{1,2,\ldots,R_{ij}\}$; $\delta(s_j - s_{ijd})$ are the Dirac functions as probability densities of the mean values s_{ijd} for each of D_{ij} of possible discrete standard values of the index s_j of the process under investigation; $d \in \{1, 2,..., D_{ij}\}$; p_{ijr} and p_{ijd} are a priori conditional probabilities of observation of the rth interval or dth value when we observe the pattern $\boldsymbol{U}_i$ in the metric of the index s_j; $I_{ijr(d)} \in [0, 1]$ are coefficients characterizing the relative "informativeness" of the rth interval or dth value of the index s_j, when we observe the pattern $\boldsymbol{U}_i$; and the total number of objects ν_i comprising the pattern $\boldsymbol{U}_i$, i.e.,

$$\nu_i = \prod_{j=1}^{\Im}\left(R_{ij} + D_{ij}\right). \tag{2}$$

As an example, Fig. 1*a* gives the geometric interpretation of standard description (1) of the pattern U_i at $\Im = 2$, $R_{i1} = R_{i2} = 2$, $D_{i1} = D_{i2} = 0$, $\forall i \in \{1, 2\}$. In conformity with (2), $\nu_i = 4$, $\boldsymbol{U}_i = \boldsymbol{u}_{i11} \cup \boldsymbol{u}_{i21} \cup \boldsymbol{u}_{i12} \cup \boldsymbol{u}_{i22}$. In other words, we assume, for

Radioelectronics and Communications Systems
Vol. 47, No. 12, 2004

REFERENCES

1. G. V. Pevtsov, Izv. VUZ. Radioelektronika, Vol. 41, No. 4, pp. 49–57, 1998.
2. G. V. Pevtsov, Izv. VUZ. Radioelektronika, Vol. 43, No. 4, pp. 38–45, 2000.
3. G. V. Pevtsov and V. A. Lupandin, Izv. VUZ. Radioelektronika, Vol. 44, No. 11, pp. 77–80, 2001.
4. B. R. Levin, Theoretical Foundations of Statistical Radio Engineering, Book 2 [in Russian], Sov. Radio, Moscow, 1975.

9 July 2002