Extraction and application of knowledge from pattern generators

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A proper definition and preservation of knowledge needed for creation of patterns with a particular characteristics style represents a hard interdisciplinary problem [1]. It is especially burning at the extraction, compression, storage and retrieval of various artistic produces, as for example paintings, since its solution requires joining of methods from several complimentary fields such as: art, science and information processing. Methods for the solution of this problem are generally still not well elaborated, and consequently, our aim is to provide a basis for advancement in this field [2,3]. For this purpose we present in this talk an intelligent system with a structure of an artificial sensory-neural network that has been recently developed for modeling and prediction of dynamic fields representing turbulent flows, roads traffic, etc [4-6]. The fundamentals for the specification of the system structure stem from the statistical theory of chaotic phenomena and evolution of natural patterns that are briefly explained in the introduction [2,3,6]. The neural network obtains from the sensory network several samples of input patterns and extracts from them characteristic relations between elements composing the patterns. Based upon self-organized learning, which optimally preserves the information presented by patterns, the system forms a representative set of samples of these relations and stores them in the memory of the neural network [6]. The information cost function that is minimized in this process is comprised of the new information and redundancy that are expressed in terms of information entropy. It is characteristic that the representative set generally contains much lesser number of samples as the training set. Consequently, the method could be applied for an efficient extraction and compression of huge amount of data representing numerous patterns [3]. The representative samples are further applied by the system when generating completely new patterns, but with similar stylistic properties as those exhibited by patterns utilized in learning. In the article the operation of the system is demonstrated on examples of patterns generated by roads traffic [4,6], turbulent phenomena, acoustic emission signals from deformed materials, and various manufacturing processes [5]. In the presented article the meaning of the memorized samples of relations is first explained based upon analysis of traffic data [Fig. 1]. In this case characteristic samples represent typical days of a week and their frequency of occurrence [Figs. 2 & 3]. The method is next demonstrated on modeling an application of turbulent plasma field generator [5]. In parallel with this example it is explained how our method can be adapted to characterization of various artistic styles in the fields of music, painting, and sculpturing [1]. In the first case the system creates a time series of musical notes, in the next one a picture of field, etc. The main purpose of the research work on the presented system is to provide a basis for development of intelligent manufacturing systems capable to learn from a set of patterns their stylistic characteristics and further apply them at an autonomous self-organized production of items with similar properties [5]. The same system could be applied also for extraction, compression, storage and retrieval of data representing various artistic styles [1].

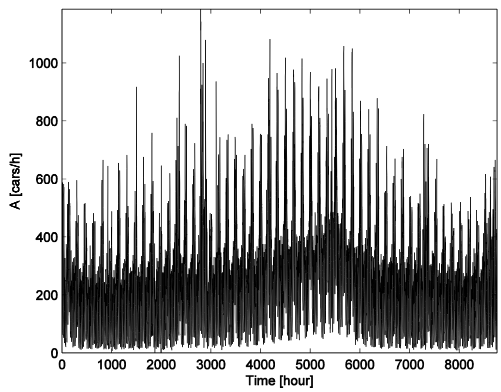

Fig. 1. A record of traffic flow rate

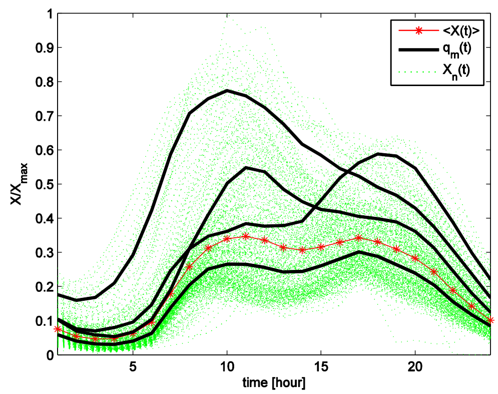

Fig. 2. X_n (dotted) - traffic day-vectors formed from traffic flow record, q_m (bold) representative vectors, (-*-) the mean vector of samples. 365 samples are optimally represented by 4 prototypes.

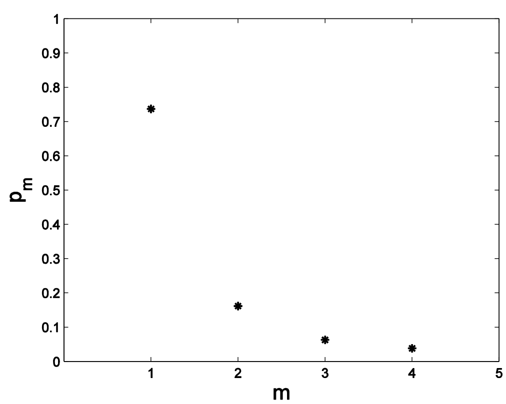

Fig. 3. The distribution of probabilities p_m corresponding to representative traffic day-vectors q_m.

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