

THE ENTROPY MAXIMUM PRINCIPLE  
IN THE STRUCTURE IDENTIFICATION OF DYNAMIC SYSTEMS.  
AN ANALYTIC APPROACH

A.V. Daneyev, V.A. Rusanov, and D.Yu. Sharpinskii

The subtitle of the article “An analytic approach” is due to the two reasons. First, the entire conceptual discussion of the problem of the a posteriori mathematical modeling of dynamic systems ( $D$ -systems) is performed in the framework of the entropy analysis [1], [2], the general identification theory [3], and the Kalman–Mesarovic realization theory [4]–[9]. Second, the program given below indicates five areas of research in the framework of a unified structure [10]–[12]:

— the *analysis of types* must determine the type of the structure of a  $D$ -system represented by a collection of pairs “trajectory, control”;

— the *synthesis of types* is intended for finding the conditions of conservation of the previously determined type of the structure of the  $D$ -system under investigation when the information on its behavior increases;

— the *analysis of representations* must determine the analytic representation (form) of the structure of a  $D$ -system in the situation when its type is known;

— the *synthesis of representations* is intended for description of the invariance of the form of the structure of a  $D$ -system under investigation with respect to increasing of the information on its behavior;

— the *construction* supposes “manipulation” of the numerical parameters of the mathematical model of a system in the framework of the analytic structure that has been fixed as a result of solving the four foregoing problems.

Note that, formally, to the type of a structure there corresponds [13] its *genus* on the corresponding grades of the set scale, and the form of a structure is the restriction of the type of the structure to a fixed class of mathematical models of systems with finite identification dimension ([11], definition 8). For comparison with the above program one can recommend the “three steps” in the set-model approach to the choice and confirmation of the structure of the model of a system suggested in [3] (p. 349).

## 1. Preliminaries

Throughout the sequel, the term “structure” is understood in the sense of [13] (p. 245), and the notation  $(\Delta, S_\Delta)$  means that a set  $\Delta$  is endowed with a structure  $S_\Delta$ .

**Definition 1** ([12], p. 10). A  $D$ -system is an ordered triple of pairs  $\{(T, S_T), (W, S_W), (\Omega, S_\Omega)\} =: \Sigma$ , where  $T$  is the set of time moments,  $W$  is the set of the alphabet of signals,  $\Omega$  is the behavior of

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