Estimation of a Signal Type and its Parameters under Uncertainty of Description and Unknown Stochastic Properties of Disturbances

Sergey Kumkov
Ural Branch of the Russian Academy of Sciences

The work deals with application of the informational sets method to a problem of estimation of a signal type and its parameters. The case is considered when the description of the signal is known approximately, the process has the auto-model character, it has a monotone character in time, but changes its type: it may be a constant, a linear function, or a quadratic polynomial. Moreover, the signal is represented by a sample of measurements disturbed by a noise with unknown statistical characteristics. The disturbance obeys the geometric constraints only, the outliers (misses) can be present in measurements, i.e., the sample can be inconsistent itself. Under such conditions it is very difficult to apply classic statistical methods.

As an alternative, methods of the optimal observation under uncertain conditions [1,2] or methods of the interval analysis [3,4] are efficient. Particularly, the informational sets method can be applied [5,6]. The approach can be also applied to processing video and harmonic signals [7,8]. In the case under discussion, the informational set is the collection of parameters (of the description function), which are consistent with the given sample of the process measurements, with the model of disturbance and the value of the error constraint. The emptiness of the informational set shows that the sample is inconsistent or the type investigated is unavailable. The informational set of parameters in a single way determines the set of admissible values of the process (the tube of trajectories).

Constructing the informational sets of parameters for each type of the description, the following important operations are accomplished: to analyze the consistency of the sample, to eliminate outliers from the sample, to divide the sample into consistent sub-samples, to analyze the dynamics of the informational sets, to make the decision on the type of the process, to build the tube of admissible trajectories of the process, and to carry out the forecast of the process behavior. The approach has been demonstrated in signal processing, observation and control in dynamic systems (space vehicles control, observation of Near-Earth space debris, air traffic control) and in

estimation and identification of experimental data (in meteorology, organic chemical synthesis, electro-chemistry, high-temperature super conductivity, thermo-physics, investigation of metals). Computer demonstration is suggested.

1 References

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