

MINIMAX PROBLEMS FOR RANDOM FIELDS FROM OBSERVATIONS IN PERFORATED PLANE

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In engineering, geology, automatic control etc., one often has a number of data points, obtained by sampling which represents values of stochastic processes or random fields for a limited number of values of the independent variable. It is often required to interpolate (i.e. estimate) the value of processes or fields for an intermediate value of the independent variable. Methods of solution of linear estimation problems for stochastic processes and random fields were developed by A. N. Kolmogorov [1], N. Wiener, A. M. Yaglom, M. I. Yadrenko. Traditional methods of solution of these problems are employed under the condition that spectral densities are known exactly. In practice, however, complete information on spectral densities is impossible in most cases. To solve the problem the parametric or nonparametric estimates of the unknown spectral densities are found or these densities are selected by other reasoning. Then the traditional estimation methods are applied provided that the estimated or selected densities are the true one. This procedure can result in a significant increasing of the value of the error as K. S. Vastola and H. V. Poor have demonstrated with the help of some examples. This is a reason to search estimates which are optimal for all densities from a certain class of the admissible spectral densities. These estimates are called minimax since they minimize the maximal value of the error.

The problem of estimation of linear functionals which depend on the unknown values of a homogeneous random field $\xi(k, j)$ in the “perforated” [3] region $K \subset Z^2$ from observations of the sum $\xi(k, j) + \eta(k, j)$ at points

$(k, j) \in Z^2 \setminus K$ is investigated. Formulas for calculating the mean square errors and the spectral characteristics of the optimal linear estimate of functionals from observations in perforated plane are derived in the case where the spectral densities are exactly known. Formulas that determine the least favourable spectral densities and the minimax (robust) spectral characteristics are proposed in the case where the spectral densities are not exactly known while a class of admissible spectral densities is given.

References

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