

A new approach to linear filtering and prediction problems.

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A New Approach to Linear Filtering and Prediction Problems

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ARTICLE

Abstract

The classical filtering and prediction problem is re-examined using the Bode-Shannon representation of random processes and the state-transition method of analysis of dynamic systems. New results are: (1) The formulation and methods of solution of the problem apply without modification to stationary and nonstationary statistics and to growing-memory and infinite-memory filters. (2) A nonlinear difference (or differential) equation is derived for the covariance matrix of the optimal estimation error. From the solution of this equation the coefficients of the difference (or differential) equation of the optimal linear filter are obtained without further calculations. (3) The filtering problem is shown to be the dual of the noise-free regulator problem. The new method developed here is applied to two well-known problems, confirming and extending earlier results. The discussion is largely self-contained and proceeds from first principles; basic concepts of the theory of random processes are reviewed in the Appendix.

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