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Guaranteed Estimation Problems in the Theory of Linear Ordinary Differential Equations with Uncertain Data

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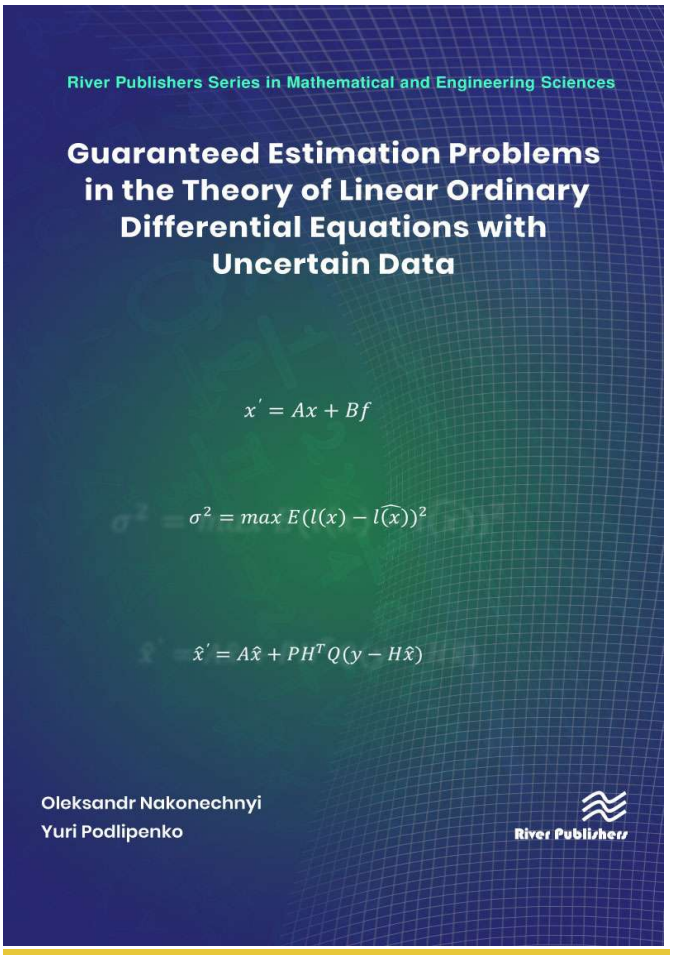
This monograph is devoted to the construction of optimal estimates of values of linear functionals on solutions to Cauchy and two-point boundary value problems for systems of linear first-order ordinary differential equations, from indirect observations which are linear transformations of the same solutions perturbed by additive random noises. It is assumed that right-hand sides of equations and boundary data as well as statistical characteristics of random noises in observations are not known and belong to certain given sets in corresponding functional spaces. This leads to the necessity of introducing the minimax statement of an estimation problem when optimal estimates are defined as linear, with respect to observations, estimates for which the maximum of mean square error of estimation taken over the above-mentioned sets attains minimal value. Such estimates are called minimax or guaranteed estimates. It is established that these estimates are expressed explicitly via solutions to some uniquely solvable linear systems of ordinary differential equations of the special type. The authors apply these results for obtaining the optimal estimates of solutions from indirect noisy observations.

Similar estimation problems for solutions of boundary value problems for linear differential equations of order n with general boundary conditions are considered. The authors also elaborate guaranteed estimation methods under incomplete data of unknown right-hand sides of equations and boundary data and obtain representations for the corresponding guaranteed estimates. In all the cases estimation errors are determined.



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