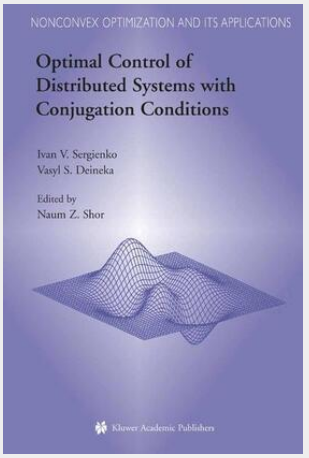
Sergienko / Deineka / Shor

Optimal Control of Distributed Systems with Conjugation Conditions



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At present, in order to resolve problems of ecology and to save mineral resources for future population generations, it is quite necessary to know how to maintain nature arrangement in an efficient way. It is possible to achieve a rational nature arrangement when analyzing solutions to problems concerned with optimal control of distributed systems and with optimization of modes in which main ground medium processes are functioning (motion of liquids, generation of temperature fields, mechanical deformation of multicomponent media). Such analysis becomes even more difficult because of heterogeneity of the region that is closest to the Earth surface, and thin inclusions/cracks in it exert their essential influence onto a state and development of the mentioned processes, especially in the cases of mining. Many researchers, for instance, A.N. Tikhonov - A.A. Samarsky [121], L. Luckner - W.M. Shestakow [65], Tien-Mo Shih, K.L. Johnson [47], E. Sanchez-Palencia [94] and others stress that it is necessary to consider how thin inclusions/cracks exert their influences onto development of these processes, while such inclusions differ in characteristics from main media to a considerable extent (moisture permeability, permeability to heat, bulk density or shear strength may be mentioned). XII An influence exerted from thin interlayers onto examined processes is taken into account sufficiently adequately by means of various constraints, namely, by the conjugation conditions [4, 8, 10, 15, 17-20, 22-26, 38, 44, 47, 52, 53, 68, 76, 77, 81, 83, 84, 90, 95, 96-100, 112-114, 117, 123].

This work develops the methodology according to which classes of discontinuous functions are used in order to investigate a correctness of boundary-value and initial boundary-value problems for the cases with elliptic, parabolic, pseudoparabolic, hyperbolic, and pseudohyperbolic equations and with elasticity theory equation systems that have nonsmooth solutions, including discontinuous solutions. With the basis of this methodology, the monograph shows a continuous dependence of states, namely, of solutions to the enumerated boundary-value and initial boundary-value problems (including discontinuous states) and a dependence of solution traces on distributed controls and controls at sectors of n-dimensional domain boundaries and at n–1-dimensional function-state discontinuity surfaces (i.e., at mean surfaces of thin inclusions in heterogeneous media). Such an aspect provides the existence of optimal controls for the mentioned systems with J.L. Lions' quadratic cost functionals. Besides this, the authors consider some new systems, for instance, the ones described by the conditionally correct Neumann problems with unique states on convex sets, and such states admit first-order discontinuities. These systems are also described by quartic equations with conjugation conditions, by parabolic equations with constraints that contain first-order time state derivatives in the presence of concentrated heat capacity, and by elasticity theory equations. In a number of cases, when a set of feasible controls coincides with corresponding Hilbert spaces, the authors propose to use the computational algorithms for the finite-element method. Such algorithms have the increased order of the accuracy with which optimal controls are numerically found. Audience This book is intended for specialists in applied mathematics, scientific researchers, engineers, and postgraduate students interested in optimal control ofheterogeneous distributed systems with states described by boundary-value and initial boundary-value problems.

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