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Book review:

Variational Calculus, Optimal Control and Applications

by

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Editors

The book under review is a proceeding of the 12th conference "Variational Calculus, Optimal Control and Applications" which took place in 1996 in Trassenheide on the Baltic Sea area traditionally an important meeting place for scientists from eastern and western Europe as well as the USA. The conferences were founded and led by Professor Bittner and Professor Klötzler who both celebrated their 65th birthday in 1996 and hence the 12th conference was dedicated to L. Bittner and R. Klötzler. Seventy mathematicians from ten countries participated.

The aim of the conferences was to promote the exchange of research results and practical applications. Especially the 12th conference is set by a wide spectrum of practical problems, e.g. questions from flight dynamics, biology, geometry or collision avoidance.

The book consists of four chapters:

1. Existence Theory and Optimality Conditions
2. Analysis and Synthesis of Control and Dynamic Programming
3. Numerical Methods and their Application to Flight Path Optimization and Fluid Dynamics
4. Applications to Mechanical Systems and Aerospace Systems.

The first chapter contains twelfth articles written by: L. Bittner, R. Klötzler, S. Butzek and W. H. Schmidt, Z. Denkowski and S. Migórski, U. Felgenhauer, M. Goebel, A. Hamel, A. Nowakowski, U. Raitums, T. Roubiček, Ch. Tammer, V. Tikhomirov. We meet in this chapter among other: relaxed problems from various standpoints, from the classical point of view as well as of L. C. Young, optimal shape design and extremal problems for system governed by elliptic inequality and equality, a Ritz type discretization of constrained optimal control problems, optimality conditions for system governed by second order differential equation, existence results and second order sufficient optimality conditions for nonlinear processes. Suboptimality conditins are obtained by using the variational principle of Ekeland. An overview on the theory of extremal problems

The second chapter consists of sixth articles written by: I. Capuzzo Dolcetta, Z. Emirsajlow, M. Kiehl, O. I. Kostyukova, A. B. Kurzhanski, D. Liebscher. We find there a moder interpretation of a solution of the Hamilton-Jacobi-Bellman equation as well as a concise overview of some problems of feedback control under uncertainty and state constraints with indications to the dynamic programming. The first is closely connected to the equation of real-time or feedback control. New results for controlling under uncertainty are given and the problems of sensivity and observability are investigated.

Recent advances in the field of numerical analysis and their applications are contained in the third chapter - having four articles. They are written by: Ch. Büskens and H. Mauer, K. Chudej, A. Barclay, and P. E. Gill, and J. B. Rosen, E. Grigat and G. Sachs. The reader will find here sensitivity analysis via nonlinear programming methods, accelerated multiple shooting and a new Predictor-Corrector homotopy methods, the overview on SQP methods.

The fourth chapter consists of eleven articles written by: H. Abesser and M. Katzschmann and J. Stegenberger, E. Andreeva and H. Behncke, U. Klent, A. Karipfganz, B.Kuglman, R. Lachner and M. H. Breitner and H. J. Pesch, G. Leitmann, H. Leonpahe and D. Kraft, A. Pawell, G. Sachs andd R. Mehlhorn and M. Dinkelmann, D. W. Tscharnuter. Among the space flight problems one can find in the last chapter solutions for many other complex practical optimal control problems: mobil robot controlling, geometrical extremal problems, fluid transport, fluid waves and human sciences.

Most of the articles in the book are genuine research paper, only a view is an overview type. The original papers introduce to theory of optimal control many new concepts and methods. Concerning the existence of optimal control and optimality conditions we find e.g. relaxation of the original problem with the aid of a least number of additional control paramaters, trasportation flow problems as an improvement of L. C. Youngs concept of "generalized flows", the conjugate point concepts for discontinuous controls, optimal shape design and optimality conditions for elliptic systems. For numerical analysis is proposed a robust nonlinear programming method to compute the sensivity derivatives of of optimal solutions, acceleration of multiple shooting method, Predictor-Crrector homotopy method. Especially interesting are papers on highly nontrivial applications to many aspects of mechanical and aerospace systems: global stabilization of a simple mobil robot, competitive running by means of control theory, convex domain with greatest volume, minimizing the noise of an aircraft during landing approach, optimal collision avoidance strategy to synthesize implementations with neural networks, a screening policy in the control of an infectious disease, optimal trajectory path planning for the motion of open fluid filled containers, motion of an inviscid and incompressible fluid in a basin with free surface waves, modelling of the thrust force direction, controllability region for the re-entry of a spacecraft.

The most value of the book is to join together in a unique way theoretical

control and very important, difficult problems from real world.

The book is very carefully prepared for editions with known high standard of Birkhäuser Verlag.

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