

Book reviews

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BOOK REVIEWS

NONLINEAR SYNTHESIS. Edited by Christopher I. Byrnes and Alexander Kurzhanski, Birkhäuser Verlag, Basel 1991, price 128,- sFr.

The proceedings of a IIASA workshop on nonlinear synthesis represents the ninth volume of the Birkhäuser series Progress in Systems and Control Theory. Different methods are used to study different aspects of controlled systems governed mostly by ordinary differential equations (ODE). The book contains 23 contributions.

The original viability approach by *J.P. Aubin and H. Frankowska* to the controlled invariance of systems with state-space constraints (Viability Kernel of Control Systems) seems to be fruitful. The application of differential geometry and related theories is represented by the contributions of *A.A. Agrachev and S.A. Vakhrameev* ("Morse Theory and Optimal Control Problems" applying the concerned theory to manifolds with corners and the results to constrained control problems), of *M.I. Zelikin and V.F. Borisov* (Optimal Synthesis Containing Chattering Arcs and Singular Arcs of the Second Order) and of *L.F. Zelikina* (The Invariants of Optimal Synthesis) while *A.V. Sarychev* uses just more topological than geometrical approach to overcome difficulties with bad input data (Nonlinear Systems with Impulsive and Generalized Function Controls). *H. Nijmeijer* in "Factorization of Nonlinear Systems" starts to form a decomposition method to these systems. *M.S. Nikolskii* investigates the convex set-valued mappings and approximates them by various type of "polynomials" (On the Approximation of Set-Valued Mappings in a Uniform (Chebyshev) Metric).

Several authors concern in some sense zero dynamics and stability problems of closed loop systems: *C.I. Barnes and A. Isidori* ("New Methods for Shaping the Response of a Nonlinear System", where the nonlinear regulator problem is investigated with the help of partial differential equations of the Lyapunov and Riccati type and also of the Hopf bifurcation theory), *H.W. Knobloch and D. Flockerzi* ("Invariant Manifolds, Zero Dynamics and Stability", where a.o. locally invariant bifurcating manifold is used), *S. Monaco and D. Normand-Cyrot*, where a.o. the instability of the zero dynamics with respect to the sampling is overcome by some kind of discretization (Multirate Sampling and Zero Dynamics: from linear to nonlinear). The feedback stabilization is studied also by *W.P. Dayawansa and C.F. Martin* (in "Asymptotic Stabilization of Low Dimensional Systems" e.g. by means of different indices and degrees), by *M. Fliess and F. Messenger* ("Methods of Nonlinear Discontinuous Stabilization" which can be made in some situation by smooth feedback).

The field of adaptive control of stochastic dynamical systems is treated by *G.B. di Masi and M. Angelini* (Adaptive Methods for Piecewise Linear Filtering). Different approach to the nonlinear synthesis were done by *V.M. Kuntzewich* ("Synthesis of Control Systems Under Uncertainty Conditions (Game Theory)", where the identification procedure generates a sequence of parameter estimates in the form of belonging to convex sets and for the statement of the control problems the game approach is exploited), by *A.B. Kurzhanski and I. Vályi* (in "Ellipsoidal Techniques for the Problem of Control Synthesis" the ellipsoidal-valued calculus and related approximation techniques are used for set-valued mappings with the final aim to obtain algorithmic procedures and simulations with computer graphics) and by *H. Schätter* (in the survey paper "Extremal Trajectories, Small-time Reachable Sets and Local Feedback Synthesis: A Synopsis of the three-dimensional case", where the

particular attention is paid to possibility to remove the difference between the necessary and the sufficient optimality conditions). Some type of parameter identification is studied by *C.F. Martin and A. Soemadi* (Extended Gaussian Quadrature and the Identification of Linear Systems). The research of differential-game problems is made by *A.G. Pashkov* (in "Estimation of a Guaranteed Result in Nonlinear Differential Games of Encounter"). The limit behaviour of dynamical systems is studied by *N.N. Petrov* (Limit Sets of Trajectories).

Some of contributions using mostly contemporary advanced methods are motivated by practical problems, particularly by control of robots: "Zero Dynamics in Robotic Systems" by *A. de Luca*, "Nonlinear Feedback Control for Flexible Robot Arms" by *X. Ding, T.J. Tarn and A.K. Bejczy* and "Tracking Control for Robotic Manipulators by Local Linear Feedback" by *H.P. Kobayashi*.

The survey of contribution shows, even in this limited space, the extent of studied problems and employed methods at the conference. The book collects original and interesting ideas and methods explained mostly with high clarity and some of them seem to be really important for the concerned field. Therefore it is worth to be strongly recommended for specials.

Jiří Jarušek, Praha

B. Opic, A. Kufner: HARDY-TYPE INEQUALITIES. Longman Academic, Scientific & Technical, Essex.

The monograph presents a well organized, clear and concise exposition of various types of inequalities arising from classical one dimensional inequality due to G.H. Hardy. It can be read as embedding of spaces of functions having first derivatives in weighted L^p space and satisfying zero boundary condition on a part of the boundary into a weighted L^q space.

Generalizations preserving one space variable are discussed in the first chapter. They deal with general weights, higher order derivatives and various types of boundary conditions. Special care is devoted to embeddings: compactness of embedding operators is studied and best estimates of their norm are given. Higher dimensional case is presented in chapter 2. Conditions on weight functions guaranteeing continuous and compact embeddings on unbounded domains are thoroughly investigated in the last chapter.

The book collects a large amount of material widely spread in literature and completes it with authors' new results. Even in the well mapped one dimensional case the work contains new original extensions and gives sharp estimates.

The integrated and systematic presentation is of interest to researchers as well as to post-graduate students in such diverse fields of mathematics as real function theory, functional analysis, partial differential equations and approximation theory.

Jana Stará, Praha