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Colonius, Fritz; Kliemann, Wolfgang (Grüne, Lars) The dynamics of control. With an appendix by Lars Grüne. (English). [B] Systems and Control: Foundations and Applications. Boston: Birkhäuser. xii, 629 p. (2000). [ISBN 0-8176-3683-8]

This book is a treatise bringing together control theory and dynamical systems. The controls are also interpreted as perturbations without however going so far as to providing a simultaneous study of both controls seen as inputs and additional (time-varying) perturbations. In this new frame, the usual notions of controllability and stability are extended and investigated. The authors write that this is a "report about ongoing research" and not "a presentation of a complete history". They point out some open areas: the cases of loss of accessibility, discrete cases, computational aspects, large scale systems, bifurcation, stochastic aspects (including the problem of convergence of invariant measures for approximating flows to the nominal one), stabilization issues related to specific trajectories. A general nonlinear theory is presented in the first part, while the next one deals with linearization. The final part dicusses applications. Chapter two is of an introductory nature, showing how to express controlled ODEs as dynamical systems, explaining concepts of stability, leading via linearization to the Lyapunov spectrum. Chapter three explains control sets and the notion of chain controllability (one sends with the controls from one point arbitrarily close to the next in a given set of points in the state space). Chapter four deals with the objects of the previous chapter using an asymptotic approach. Control sets are related to mixing, while chain control sets involve transitive bahaviour. Then the location of ω-limit sets of controlled trajectories are considered. They intersect the control sets and are contained in chain control sets, but the issue is to know if they are contained in the interior of such a set. Chapter five studies linear flows on vector bundles generalizing linear time-varying systems. The authors look at the Morse spectrum, its boundary points and related invariant manifolds. Chapter six considers bilinear systems (Morse spectrum, Floquet spectrum, Lyapunov spectrum), and the results are specialized subsequently in the case of a linearization at a singular point.\par Part three starts next: The one-dimensional case allows explicit computations. The reader finds various practical examples and explorations including numerical ones on (robust) stability and stabilization. A chapter deals with the computation of the spectrum in dimension two. There are four appendices which are useful. The first one introduces differential geometric tools (assuming that the dynamics involving state and control is a direct product, a special case – it would have been a good idea to specify the general configuration of relevance here since the authors are preoccupied with global behaviour); then the authors deal with dynamical systems basics (Morse decomposition, chains). Finally the focus is on numerical computations (orbits, spectrum (this last part, written by L. Grüne, involves an optimal control method)). The bibliography contains 333 entries, and an index is included. The book is very interesting. The dynamical systems perspective provides a welcome new impetus to control theory, confirming once more the fertility of this discipline. [A.Akutowicz (Berlin)]