

Preface

For many systems in engineering, control action does not take place everywhere in the system but only at certain points, for example at the boundary. In this SpringerBrief we consider systems of this type, where the system dynamics are governed by hyperbolic partial differential equations. As a typical example we consider the wave equation, and in the chapter about nonlinear systems also the Korteweg-de Vries and Burgers equations.

The aim is to familiarize the reader with the problems of optimal boundary control and stabilization that appear in this framework. We also introduce the notion of exact controllability, which is an essential concept in this context. To keep the presentation as accessible as possible, we consider the case of systems with a state that is defined on a space interval. In the case of a finite interval that is also relevant for many applications, there are two boundary points where the system can be controlled. In the optimal control problems, the aim is to find an admissible control that is optimal. Admissible means that the control has given desired properties, for example that it steers the system to a given terminal state. Optimal means that a given objective function that reflects the preferences of the decision maker is minimal, for example the control cost given by the norm of the control on the time interval. In the stabilization problems, the aim is to define a feedback law such that for the corresponding closed loop system the state approaches a given desired trajectory, for example a position of rest exponentially fast.

This text has grown from a lecture at the Friedrich-Alexander-Universität Erlangen-Nürnberg (FAU) in the summer term 2014. The aim of the text is to give an introduction to the subject that is accessible to graduate and Ph.D. students in mathematics and engineering and research workers in the field. In order to be able to proceed quickly to optimization and stabilization results, we do not introduce the general framework of strongly continuous semigroups. Introductions to the whole field of control of infinite dimensional systems based upon the concept of semigroups are given in [4, 41, 54].

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