

# Preface

By writing this book we wanted to present a new approach to impulsive boundary value problems, which is applicable both to the state-dependent and the fixed-time impulses. Existence results for boundary value problems with state-dependent impulses are rather rare in the literature and are given mostly for periodic problems. Our main goal here is to provide general existence principles which can serve as a tool for the investigation of solvability of impulsive boundary value problems, in particular with impulses occurring at moments depending on the state variables. To demonstrate it, we bring new existence theorems and examples for such problems. On the other hand, though there is vast literature dealing with fixed-time impulsive boundary value problems, we decided to include existence results for several important problems of this type, for example, problems with time or space singularities.

The book is organized as follows:

Part I, which consists of Chaps. 2–5, is devoted to fixed-time impulsive boundary value problems. In Chap. 2 we discuss the solvability of the second order problem with nonlinear boundary conditions and show the application of the lower and upper functions method. Chapters 3 and 4 investigate the second order Dirichlet problems, time singularities being studied in Chap. 3 and space singularities in Chap. 4. Chapter 5 deals with higher order differential equations and with systems that are subject to general linear boundary conditions. The main purpose of Chap. 5 is, besides the existence results, to find an operator representation of the boundary conditions in the space of regulated functions, which is used in Part II.

All chapters of Part II are devoted to state-dependent impulsive boundary value problems. In Chap. 6 we develop a new approach giving effective conditions for the solvability of the second order Dirichlet boundary value problem with one state-dependent impulse condition imposed on the first derivative of the solution. In Chap. 7, a problem more general than the preceding one is investigated. It is shown that our approach can be easily extended to problems with a finite number of state-dependent impulses mentioned above. In Chap. 8, the Sturm–Liouville boundary value problem is investigated for a more general right-hand side of a

differential equation depending not only on a solution but also on its first derivative. Moreover, state-dependent impulse conditions are imposed both on a solution and on its first derivative. Further generalization to higher order differential equations or differential systems subject to general linear boundary conditions is presented in Chaps. 9 and 10.

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