

Preface

This book as titled is prepared with a clear aim to bridge exiting representative theoretical results to the development of design prototype, algorithms, and applications. The readers/users are targeted for a wide range of groups from university, research, and development institute to industry, but for the reference of top academic peers to write their theoretical papers. It is not our intention to cover all disciplines of electrical engineering systems of recent control-related contributions, but priority has been placed on the application of recently reported techniques on sliding mode techniques, their significant impact on stability robustness, and their challenges over the last decade. The integrated approaches on sliding model control contribute to some sort of a state of the art in modeling and controlling of complex dynamic systems with feasible and concise solutions. This book is made of 16 invited chapters have been written by leading researchers covering recent theoretical developments and applications of the sliding mode techniques to class of systems from the electrical engineering fields.

The book presents theoretical explorations on several fundamental problems for several kinds of systems. By integrating fresh concepts and state-of-the-art results to form a systematic approach for controlling complex systems, fundamental theoretical approaches and practical framework have been established.

This book is intended for readers from a wide spectrum of specialties in electrical engineering fields and shall educate them about the fundamental advances in SMC techniques. It is expected that the readers will require limited background knowledge to understand various concepts and results outlined in the book. Furthermore, a notable feature of this book is to provide not only theoretical results and techniques, but also experimental case study on a test bed of robotic system, which is anticipated to highly motivate young students and researchers.

The book has been organized into the following chapters which are regrouped into three parts.

- The first part contains four chapters detailing fundamentals of sliding mode control. Then, the book is opened with a review chapter presenting a state of the art of the sliding mode control (SMC) techniques by providing some

generalities, notions, and classifications of different SMC control strategies accompanied with explanatory examples and detailed discussion. The rest of the chapters covers a broad scope of topics in sliding modes from theoretical investigations to significant applications. Chapter 2 presents disturbance rejection for discrete first, second order and repetitive sliding mode controllers. Chapter 3 gives robust exponential higher-order sliding mode controllers. The interest of chapter concerns four sliding functions using LMIs approach for time-delay systems.

- The second part is dedicated to sliding mode controller applied to robotic systems. It contains six chapters. Chapter 5 applies the sliding mode control to underactuated quadrotor. Chapter 6 applies the sliding mode control of an inverted pendulum. Chapter 7 considers the autonomous surface vessel. Chapter 8 consists to apply the first and the second order sliding mode controls with time-delay control for robot manipulators. Chapter 9 is an application of sliding mode control for a 5DOF serial robot for tele-echography. Chapter 10 applies the sliding mode control for an active exoskeleton robot. Chapter 11 is an application to multiagent systems
- The third part consists to apply the sliding mode control to power systems. Chapter 12 considers the application of this technique to photovoltaic power systems. Chapter 13 considers the sliding bifurcations for a two-cell DC/DC buck converter. Chapter 14 applies the control by sliding mode of induction motor drives. Chapter 15 applies the sliding mode control for a fault induction machine. Finally, Chap. 16 studies an electrohydraulic system controlled by sliding mode control.

We wish to express our sincere gratitude to many colleagues who have contributed to this book. First of all, we are particularly indebted to our colleagues who have contributed their excellent research in order to bring the valuable materials for graduate students, researchers, and practitioners. We greatly appreciate the contributors to this book for their patience and time taken to collaborate with us to finally complete this book. Next, particular thanks go to students and colleagues who helped engaging in the preparation and assisted us to improve this book. Finally, we would like to sincerely express our deepest gratitude to the Springer editorial staff for their continuous support, assistance, and significant improvement in the manuscript. Without their help, the book would not be published as scheduled.

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