Preface

During the past decade, the emerging event-based control and estimation technology has found wide applications, ranging from signal processing, control systems, to various cyber-physical systems. The primary reason of this increasing popularity is that event-based control and data transmission policies have the potential of maintaining system performance at reduced communication/computation costs, the challenge being that performance guarantees (for instance, stability and optimality) are difficult to be established theoretically.

This book focuses on event-based estimation in a stochastic setting, and captures a number of interesting recent developments on this topic. Many of the results are from the papers written by the authors and other researchers in this area during the past few years and have been published in the well-recognized journals or conferences in the field of control systems; however, a comprehensive summary of these results seems necessary, as the relationships among the results presented in different papers need to be carefully synthesized to provide a high-level, systematic overview of the developments as well as the open problems in this topic, which forms the motivation of writing this book.

As a prerequisite, an ideal reader would have some exposure to classic probability theory and techniques in optimal state estimation, especially the Kalman filtering theory, although we have included well-detailed proofs for the results presented for completeness in developing the book. Brief reviews of the theory of probability and random processes, and the standard results in optimal estimation are provided in the appendices to help the readers.

The book starts with an introduction chapter (Chap. 1), which provides a concise introduction of sampled-data systems, event-based sampling, and event-based estimation as well as an up-to-date review of the recent developments in these topics. Before introducing the detailed developments in event-based state estimation, basic results on event-triggered sampling are discussed in Chap. 2. The main contents of the book feature four types of approaches to event-based estimator design: the approximate filtering approaches, the constrained optimization approach, the stochastic event-triggering approach, and the set-valued filtering approach.

In addition to the discussions on various technical derivations, application examples and illustrations are also included to provide a better understanding of the methods. The related materials are summarized in the notes and reference section in each chapter as well, which provides interested readers with necessary references for further studying.

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