Preface

Most real-world systems evolve in continuous time. However, digital implementation is almost universally used in practice. Hence, a crucial ingredient in practical estimation and control is an understanding of the impact of sampling on continuous-time models and systems. In this context, the aim of this book is to reduce the gap between continuous-time and sampled-data systems theory. The subject of sampling is huge—no one book can cover all aspects. Thus, the book emphasises exact and approximate models for sampled-data systems. Questions such as the following will be addressed:

- *What can one say when the sampling rate is high relative to the dynamics of interest?*
- *Do natural convergence results apply as the sampling rate increases?*
- *Do there remain any special features of sampled systems which are not associated with underlying continuous systems?*

The authors' motivation for writing the book was threefold:

 (i) Whilst most systems evolve in continuous time, all modern control and signal processing equipment is computer based. Hence, sampling arises as an inescapable aspect of all modern control and signal processing applications.
 (ii) Sampling is, at first glance, a straightforward issue. However, on closer examination, if sampling is not treated properly, misleading or erroneous results can occur.
(iii) The authors have found that many aspects of sampling are not completely understood by engineers and scientists, even though these issues are central to many of the applications with which they deal.

The goal of this book is to provide a guide for students, practising engineers, and scientists who deal with sampled-data models. The book is intended to act as a catalyst for further applications in the area of nonlinear estimation and control.

Four classes of systems are treated:

 (i) linear deterministic systems,
(ii) nonlinear deterministic systems,

(iii) linear stochastic systems, and

(iv) nonlinear stochastic systems.

Several applications are also presented. These applications embellish the core ideas by showing how they impact several important problems in signals and systems.

The book was written in Valparaíso (Chile) and Newcastle (Australia) during enjoyable collaborative visits by the authors. The book assembles contemporary work of the authors and others on sampled-data models. The authors hope that, by setting these ideas down in one place, we can instill confidence in readers dealing with sampled-data issues in real-world applications of signal processing and control.

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