Preface

Chaos in electronic circuits can be dated back to 1927 in experiments conducted by Van Der Pol and his colleagues [1, 2]. Chaotic phenomena in engineering systems have been extensively studied and analyzed in the last few decades, but the applications have mainly been one of detection of chaos and how it can be avoided. Since the discovery by Pecora and Carroll that chaotic systems can be synchronized, the topic of synchronization of coupled chaotic circuits and systems has been investigated intensely and some interesting applications such as broadband communication systems have come out of this research. The purpose of this book is to study some aspects of synchronization of chaos in circuits and systems. Synchronization of chaos is a large research area with many topics and only a subset of these topics is discussed. In particular, the focus is on complete synchronization, where every circuit is synchronized to every other circuit, since this case is more amenable to analysis. Interesting phenomena can occur, such as clustering, wave phenomena and Turing patterns, when not all circuits are synchronized. Other related topics which are not discussed in this book include generalized synchronization and control of chaos. The reader is referred to `http://www2.egr.uh.edu/~chengr/chaos-bio.html` for Guanrong Chen's comprehensive list of papers in the area of synchronization and control of chaos up to 1997. A bibliography on the more general topic of chaos and nonlinear dynamics can be found in CHAOSBIB at `http://www.uni-mainz.de/FB/Physik/Chaos/chaosbib.html`. The prerequisite for this text is a basic knowledge of linear algebra and differential equations.

The organization of this book is as follows. After a brief introduction in

Chapter 1, synchronization in two coupled systems is discussed in Chapter 2 including applications such as communication systems. In Chapter 3, we study synchronization in arbitrarily coupled arrays of chaotic circuits and systems where the coupling elements do not have dynamics of their own. In Chapter 4 the more complicated case of dynamic coupling is considered. In Chapter 5 the relationship between the topology of the underlying graph and the synchronization criteria in arrays of oscillators is examined. So far, most of the synchronization results are obtained by means of Lyapunov's direct method. Finally, in Chapter 6 the Lyapunov exponents approach to synchronization is studied. Some background material is covered in the appendices.

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