

Preface

Biological systems have been known for many decades to produce measurable signals, which often reveal nontrivial information about the underlying processes at work. It is the hope of the scientific community that from the observation and processing of various biologically-generated signals one can draw unambiguous conclusions regarding the state of a biological system. This “state” is of outmost importance to a variety of applications, including disease diagnosis and detection of the onset of many deadly diseases, including heart attack, stroke, cancer, among other illnesses plaguing mankind today. This text will make an attempt to shed light on the concept of signals and systems not only from the “man-made” perspective, but also from the angle of nature-made or biologically-made viewpoint. Ultimately, the goal of this text is to enable the reader to bring to bear the vast knowledge of digital signal processing to tackle the biological signals in order to extract important information of clinical value. To achieve this goal, one has to acquire a healthy knowledge of non-biological signals and systems as well as signal processing techniques before embarking on an endeavor that brings into focus the need for somewhat different types of signal processing mechanisms, concerned with non-stationary signals impaired by nonlinear and even chaotic effects. It is the intention here to enable the reader to examine biological signals and systems from the digital signal processing perspective while keeping an eye on some of the shortcomings of the signal processing systems in use today, which rely heavily on the “linearity” assumption (or approximation) in order to arrive at implementable architectures. It is noteworthy that, throughout this text, we use the term “biological signals” to refer to signals originating from a biological entity. Rather seamlessly, we use the expression “biomedical signal processing” to refer to the signal processing tools that one brings to bear to study the behavior of biological signals.

Although this text is intended for an introductory class on biomedical signal processing for senior-level undergraduate or first-year graduate students, the text can readily serve as a reference textbook for professionals in the field concerned with the development of biomedical devices. To that end, many examples are

provided wherever possible to help the practicing engineer who may not be familiar with biological signals and systems or a practicing biologist with solid background in the field of biology who may lack an engineering insight to enhance his or her understanding of key concepts in signal processing.

Biological Signals Classification and Analysis

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