

Preface

The knee plays an important role in human locomotion activities and daily performance. However, the knee joint often suffers from different inflammations and impact trauma such as osteoarthritis, tears of meniscus, and cartilage disorders. Vibration arthrometry is a noninvasive technique which has high potential for effective detection of knee pathology in routine examinations. This book provides a systematical description on the vibroarthrography methodology, along with the recent advances in vibroarthrographic signal preprocessing, feature analysis, and pattern classification. The overall context of the book is composed of five chapters.

Chapter 1 presents knee anatomy, together with the descriptions of joint structures in detail. The text introduces knee biomechanics and different types of knee joint disorders. An overview of knee joint pathology detection methods, such as X-ray imaging, computed tomography, magnetic resonance imaging, ultrasonography, optical coherence tomography, arthroscopy, and vibroarthrography, is given in the chapter as well.

Chapter 2 provides the flowchart that shows the entire procedures of knee joint vibroarthrographic signal analysis. The chapter concentrates on the instrument settings and experiment protocol for signal acquisition, as well as the artifact removal in the signal preprocessing. The text describes several signal processing methods to eliminate the baseline wander, random noise, and muscle contraction interference.

Chapter 3 discusses the vibroarthrographic signal processing and analysis approaches in time and frequency domains. The spatiotemporal processing methods contain the temporal waveform analysis, adaptive segmentations, and time-variant signal fluctuation or complexity analysis. The frequency and time-frequency analysis based on Fourier transform and matching pursuit decomposition are also provided with the detailed mathematical representations. The chapter also reviews the recent development of statistical analysis for vibroarthrographic signal feature extraction.

Chapter 4 first presents the advantages of feature selection and dimensionality reduction for signal pattern analysis. Then, the chapter introduces a few machine learning paradigms for vibroarthrographic signal classifications, including the

Fisher's linear discriminant analysis, radial basis function network, support vector machines, Bayesian decision rule, and multiple classifier fusion systems. The chapter also summarizes and compares the diagnostic results and key findings of several previous studies on vibroarthrographic signal classifications.

Chapter 5 concludes the book with a short review of the cutting-edge technologies for knee pathology diagnosis, and then summarizes the state-of-the-art methods for vibroarthrographic signal analysis. The chapter ends with a discussion on some interesting topics and challenges for future research.

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