COMPARATIVE APPROACHES TO MEDICAL REASONING

ADVANCES IN FUZZY SYSTEMS – APPLICATIONS AND THEORY

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COMPARATIVE APPROACHES TO MEDICAL REASONING

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PREFACE

In the last four decades, since the advent of the digital computer, numerous approaches have been tried to establish the computer as a tool to assist in medical decision making. Medical decision making is a good model for all types of decision making under uncertainty, in which some principles are known and others are not known or are only partially understood. This volume is a collection of papers which use unique approaches to deal with medical decision making. In order to facilitate comparison of methods, all papers deal with the same medical application: heart disease. The reader should be aware, however, that the contents of this book are in no way restricted to this area. In fact, each paper explains theoretical techniques which are applicable to any field in medicine, indeed to any field in which computer decision support tools are required. The use of a common problem makes it easier for readers to compare and contrast different approaches and see in practice the strengths and weaknesses of each approach.

The book is divided into five sections. The first section contains two chapters which deal with knowledge-based systems. These papers address some of the major issues confronting this approach, including handling of uncertain information and combination of diverse data types. The first paper by Kohout et al. focuses on interval-based fuzzy logic for decision making involving risk and uncertainty. The paper by Muscari addresses the role of varying data types, including temporal data, in the diagnostic process.

Section 2 focuses on neural network models, and contains four chapters. Proliferation of neural network systems in the last decade has led to considerable confusion. The four papers in this section contrast various approaches as well as represent the broad range of variables present in medical decision making. The first paper by Akay et al. uses three-layer back propagation to combine analysis of diastolic heart sounds with physical examination results. Paper two by Ding and Gupta addresses the use of fuzzy neural networks based on fuzzy min-max neurons. The paper by Kostis et al. uses a data base of 49,000 patients, some with five-year follow-up data, to predict long-term mortality in myocardial infarction. The concluding paper in this section by Sabbatini et al. uses a complex mixture of predictor variables for prognosis of one-year mortality for patients with congestive heart failure.

Section 3 addresses statistical approaches. The two papers in this section illustrate important extensions to traditional statistically-based systems. The paper by Patrick uses the CONSULT^R software developed by the author which includes a novel approach encompassing categories and subcategories of disease in which each subcategory uses a priori knowledge. The second paper by Römer and Kandel develops a generalized Bayes' Theorem for fuzzy evidences by means of Dempster-Shafer theory.

Section 4 presents two contributions using modeling techniques. The papers in this section illustrate the importance of physiologic modeling and its contribution to medical decision making when such models are available. The paper by Akay et al. uses multiresolution representations of heart fluctuations to characterize the autonomic nervous system regulation of cardiovascular activity before and after carotid surgery. The paper by Bachárová introduces a new concept for noninvasive diagnosis of left ventricular hypertrophy.

Finally, Section 5 contains three chapters on hybrid systems which use two or more of the techniques described in Sections 1 through 4 which have been integrated into a single comprehensive system. Assanelli et al. combine automatic electrocardiogram interpretation and measurement, questionnaire data, clinical observations, and epidemiological risk estimation. The contribution by Barschdorff et al. uses interpretation of filtered phonocardiographic signals by means of a neural network model. The final paper by Hudson, Cohen, and Deedwania combines a knowledge-based system, neural network model, and analysis of chaotic data to produce a comprehensive decision aid for chest pain.

Each approach in this book provides flexibility in application, and should be of interest to anyone working in the field of automated decision making. The contributions represent state-of-the-art work in medical decision making, and as such are also of interest to medical researchers in all areas, but especially in cardiology.

CONTENTS

Preface	v
1. Knowledge-Based Systems	
CLINAID: Medical Knowledge-Based System Based on Fuzzy Relational Structures <i>Ladislav J. Kohout, Isabel Stabile, Wyllis Bandler, John Anderson</i>	1
Diagnostic Aspects of Diastolic Dysfunction: Representation in D-Log Language <i>Antonio Muscari</i>	26
2. Neural Network Models	
Improved Noninvasive Diagnosis of Coronary Artery Disease Using Neural Networks <i>Metin Akay, Yasemin M. Akay, Walter Welkowitz</i>	52
Fuzzy Neural Network-Based Adaptive Reasoning with Experiential Knowledge <i>Hong Ding, Madan M. Gupta</i>	70
Estimation of Long-Term Mortality of Myocardial Infarction Using a Neural Network Based on the Alopex Algorithm <i>William J. Kostis, Cheng Yi, Evangelia Micheli-Tzanakou</i>	93
Neural Network-Based Approach to Outcome Prognosis for Patients with Dilated Myocardial Disease <i>Renato M. E. Sabbatini, Juarez Ortiz, Cláudia G. M. Ghefter</i>	106
3. Statistical Approaches	
Implementation of Statistical Pattern Recognition for Congestive Heart Failure <i>Edward A. Patrick</i>	146
The Application of Bayesian Inference with Fuzzy Evidences in Medical Reasoning <i>Christoph Römer, Abraham Kandel</i>	190

4. Modeling Techniques

24 Hour Analysis of Heart Rate Fluctuations Before and After Carotid Surgery
Using Wavelet Transform

*Metin Akay, Yasemin M. Akay, Walter Welkowitz, Giora Landesberg,
Dan Sapoznikov*

202

Reasoning for Introducing a New Parameter for Assessment of Myocardial
Status - The Specific Potential of Myocardium

Ljuba Bachárová

217

5. Hybrid Systems

Correct Diagnosis of Chest Pain by an Integrated Expert System

*Deodato Assanelli, Massimo Strambini, Giuseppe Maifredi, Livio Cazzamalli,
Maria L. Poeta, Maurizio Marconi, Odoardo Visioli*

242

Phonocardiogram Analysis of Congenital and Acquired Heart Diseases Using
Artificial Neural Networks

Dieter Barschdorff, Stephan Ester, Eckhard Most

271

Hybrid System for Diagnosis and Treatment of Heart Disease

Donna L. Hudson, Maurice E. Cohen, Prakash C. Deedwania

289

Index**311**