Ecg Signal Processing Classification And Interpretation A Comprehensive Framework Of Computational Intelligence

This book provides a comprehensive review of progress in the acquisition and extraction of electrocardiogram signals. The coverage is extensive, from a review of filtering techniques to measurement of heart rate variability, to aortic pressure measurement, to strategies for assessing contractile effort of the left ventricle and more. The book concludes by assessing the future of cardiac signal processing, leading to next generation research which directly impact cardiac health care.

This book constitutes the refereed proceedings of the 13th Joint International Symposium on Artificial Intelligence and Natural Language Processing, iSAI-NLP2017, held in Prachuap Khiri Khan, Thailand, in August 2017, and the 10th International Conference on Knowledge, Information and Creativity Support Systems, KICSS2015, held in Phuket, Thailand, in November 2015. It presents 22 carefully reviewed full papers on the following topics: artificial intelligence; machine learning; decision support systems; data mining; data analysis; natural language processing; multilingual processing; language and ontology unification; text classification; knowledge-based information systems; tracking systems; virtual reality; pattern recognition and image processing; signal classification; object detection and recognition; real-time sensor network; cloud-based services; and information security.

Developments and Applications for ECG Signal Processing: Modeling, Segmentation, and Pattern Recognition covers reliable techniques for ECG signal processing and their potential to significantly increase the applicability of ECG use in diagnosis. This book details a wide range of challenges in the processes of acquisition, preprocessing, segmentation, mathematical modelling and pattern recognition in ECG signals, presenting practical and robust solutions based on digital signal processing techniques. Users will find this to be a comprehensive resource that contributes to research on the automatic analysis of ECG signals and extends resources relating to rapid and accurate diagnoses, particularly for long-term signals. Chapters cover classical and modern features surrounding f ECG signals, ECG signal acquisition systems, techniques for noise suppression for ECG signal processing, a delineation of the QRS complex, mathematical modelling of T- and P-waves, and the automatic classification of heartbeats. Gives comprehensive coverage of ECG signal processing Presents development and parametrization techniques for ECG signal acquisition systems Analyzes and compares distortions caused by different digital filtering techniques for noise suppression applied over the ECG signal Describes how to identify if a digitized ECG signal presents irreversible distortion through analysis of its frequency components prior to, and after, filtering Considers how to enhance QRS complexes and differentiate these from artefacts,

noise, and other characteristic waves under different scenarios

The book is a compilation of selected papers from the conference on Physics and Control 2009, presenting a unified perspective underlying the thematics and strategies related to the control of physical systems with emerging applications in physics, engineering, chemistry, biology and other natural sciences. The selected papers reflect the state-of-the-art of the more advanced theoretical and practical studies in the field of control of complex systems. The contributions provide a comprehensive view on some selected topics of particular importance at the disciplinary borderline between Physics and Control.

This book focuses on analysis and modelling of active bio potential signals addressing the real time challenges in biomedical signal processing used in a variety of applications such as analysis, classification and identification of different disorders in healthcare systems.

The prime objective of this piece of work is to devise novel techniques for computer based classification of Electrocardiogram (ECG) arrhythmias with a focus on less computational time and better accuracy. As an initial stride in this direction, ECG beat classification is achieved by using feature extracting techniques to make a neural network (NN) system more effective. The feature extraction technique used is Wavelet Signal Processing. Coefficients from the discrete wavelet transform were used to represent the ECG diagnostic information and features were extracted using the coefficients and were normalised. These feature sets were then used in the classifier i.e. a simple feed forward back propagation neural network (FFBNN). This paper presents a detail study of the classification accuracy of ECG signal by using these four structures for computationally efficient early diagnosis. Neural network used in this study is a well-known neural network architecture named as multi-Layered perceptron (MLP) with back propagation training algorithm. The ECG signals have been taken from MIT-BIH ECG database, and are used in training to classify 3 different Arrhythmias out of ten arrhythmias. These are normal sinus rhythm, paced beat, left bundle branch block. Before testing, the proposed structures are trained by back propagation algorithm. The results show that the wavelet decomposition method is very effective and efficient for fast computation of ECG signal analysis in conjunction with the classifier.

Advanced techniques in image processing have led to many innovations supporting the medical field, especially in the area of disease diagnosis. Biomedical imaging is an essential part of early disease detection and often considered a first step in the proper management of medical pathological conditions. Classification and Clustering in Biomedical Signal Processing focuses on existing and proposed methods for medical imaging, signal processing, and analysis for the purposes of diagnosing and monitoring patient conditions. Featuring the most recent empirical research findings in the areas of signal processing for biomedical applications with an emphasis on classification and clustering techniques, this

essential publication is designed for use by medical professionals, IT developers, and advanced-level graduate students.
The book shows how the various paradigms of computational intelligence, employed either singly or in combination, can produce an effective structure for obtaining often vital information from ECG signals. The text is self-contained, addressing concepts, methodology, algorithms, and case studies and applications, providing the reader with the necessary background augmented with step-by-step explanation of the more advanced concepts. It is structured in three parts: Part I covers the fundamental ideas of computational intelligence together with the relevant principles of data acquisition, morphology and use in diagnosis; Part II deals with techniques and models of computational intelligence that are suitable for signal processing; and Part III details ECG system-diagnostic interpretation and knowledge acquisition architectures. Illustrative material includes: brief numerical experiments; detailed schemes, exercises and more advanced problems.
This book presents an interdisciplinary paradigms of computational intelligence techniques and biomedical signal processing. The computational intelligence techniques outlined in the book will help to develop various ways to enhance and utilize signal processing algorithms in the field of biomedical signal processing. In this book, authors have discussed research, discoveries and innovations in computational intelligence, signal processing, and biomedical engineering that will be beneficial to engineers working in the field of health care systems. The book provides fundamental and initial level theory and implementation tools, so that readers can quickly start their research in these interdisciplinary domains. Provides an introduction to computational intelligence and biomedical signals, including swarm intelligence, soft computing methods, and classification techniques, Presents the fundamental signal processing and classification approach, Includes implementation of techniques with examples, general programming codes and MatLab scripts.
?This book describes an ECG processing architecture that guides biomedical SoC developers, from theory to implementation and testing. The authors provide complete coverage of the digital circuit implementation of an ultra-low power biomedical SoC, comprised of a detailed description of an ECG processor implemented and fabricated on chip. Coverage also includes the challenges and tradeoffs of designing ECG processors. Describes digital circuit architecture for implementing ECG processing algorithms on chip; Includes coverage of signal processing techniques for ECG processing; Features ultra-low power circuit design techniques; Enables design of ECG processing architectures and their respective on-chip implementation.
Biomedical Signal Processing and Artificial Intelligence in Healthcare is a new volume in the Developments in Biomedical Engineering and Bioelectronics series. This volume covers the basics of biomedical signal processing and artificial intelligence. It explains the role of machine learning in relation to processing biomedical signals and the applications in medicine and healthcare. The book provides background to statistical analysis in biomedical systems. Several types of biomedical signals are introduced and analyzed, including ECG and EEG signals. The role of Deep Learning, Neural Networks, and the implications of the expansion of artificial intelligence is covered. Biomedical Images are also introduced and processed, including segmentation, classification, and detection. This book covers different aspects of signals, from the use of hardware and software, and making use of artificial intelligence in problem solving. Dr Zgallai's book has up to date coverage where readers can find the latest information, easily explained, with clear examples and illustrations. The book includes examples on the application of signal and image processing employing artificial intelligence to Alzheimer, Parkinson, ADHD, autism, and sleep disorders, as well as ECG and EEG signals. Developments in Biomedical Engineering and Bioelectronics is a 10-volume series which covers recent developments, trends and advances in this field. Edited by leading academics in the field, and taking a multidisciplinary approach, this series is a forum for

cutting-edge, contemporary review articles and contributions from key 'up-and-coming' academics across the full subject area. The series serves a wide audience of university faculty, researchers and students, as well as industry practitioners. Coverage of the subject area and the latest advances and applications in biomedical signal processing and Artificial Intelligence. Contributions by recognized researchers and field leaders. On-line presentations, tutorials, application and algorithm examples.

Computing Methodologies 2019 will provide an outstanding international forum for scientists from all over the world to share ideas and achievements in the theory and practice of all areas of inventive systems which includes artificial intelligence, automation systems, computing systems, electronics systems, electrical and informative systems etc Presentations should highlight computing methodologies as a concept that combines theoretical research and applications in automation, information and computing technologies All aspects of inventive systems are of interest theory, algorithms, tools, applications, etc

In the last decade, we have witnessed the rapid development of electronic technologies that are transforming our daily lives. Such technologies are often integrated with various sensors that facilitate the collection of human motion and physiological data and are equipped with wireless communication modules such as Bluetooth, radio frequency identification, and near-field communication. In smart healthcare applications, designing ergonomic and intuitive human–computer interfaces is crucial because a system that is not easy to use will create a huge obstacle to adoption and may significantly reduce the efficacy of the solution. Signal and data processing is another important consideration in smart healthcare applications because it must ensure high accuracy with a high level of confidence in order for the applications to be useful for clinicians in making diagnosis and treatment decisions. This Special Issue is a collection of 10 articles selected from a total of 26 contributions. These contributions span the areas of signal processing and smart healthcare systems mostly contributed by authors from Europe, including Italy, Spain, France, Portugal, Romania, Sweden, and Netherlands. Authors from China, Korea, Taiwan, Indonesia, and Ecuador are also included.

Digital Signal Processing, Second Edition enables electrical engineers and technicians in the fields of biomedical, computer, and electronics engineering to master the essential fundamentals of DSP principles and practice. Many instructive worked examples are used to illustrate the material, and the use of mathematics is minimized for easier grasp of concepts. As such, this title is also useful to undergraduates in electrical engineering, and as a reference for science students and practicing engineers. The book goes beyond DSP theory, to show implementation of algorithms in hardware and software. Additional topics covered include adaptive filtering with noise reduction and echo cancellations, speech compression, signal sampling, digital filter realizations, filter design, multimedia applications, over-sampling, etc. More advanced topics are also covered, such as adaptive filters, speech compression such as PCM, u-law, ADPCM, and multi-rate DSP and over-sampling ADC. New to this edition: MATLAB projects dealing with practical applications added throughout the book New chapter (chapter 13) covering sub-band coding and wavelet transforms, methods that have become popular in the DSP field New applications included in many chapters, including applications of DFT to seismic signals, electrocardiography data, and vibration signals All real-time C programs revised for the TMS320C6713 DSK Covers DSP principles with emphasis on communications and control applications Chapter objectives, worked examples, and end-of-chapter exercises aid the reader in grasping key concepts and solving related problems Website with MATLAB programs for simulation and C programs for real-time DSP

Recent advancements and innovations in medical image and data processing have led to a need for robust and secure

mechanisms to transfer images and signals over the internet and maintain copyright protection. The Handbook of Research on Information Security in Biomedical Signal Processing provides emerging research on security in biomedical data as well as techniques for accurate reading and further processing. While highlighting topics such as image processing, secure access, and watermarking, this publication explores advanced models and algorithms in information security in the modern healthcare system. This publication is a vital resource for academicians, medical professionals, technology developers, researchers, students, and practitioners seeking current research on intelligent techniques in medical data security.

This book discusses feature engineering and computational intelligence solutions for ECG monitoring, with a particular focus on how these methods can be efficiently used to address the emerging challenges of dynamic, continuous & long-term individual ECG monitoring and real-time feedback. By doing so, it provides a "snapshot" of the current research at the interface between physiological signal analysis and machine learning. It also helps clarify a number of dilemmas and encourages further investigations in this field, to explore rational applications of feature engineering and computational intelligence in ECG monitoring. The book is intended for researchers and graduate students in the field of biomedical engineering, ECG signal processing, and intelligent healthcare.

This open access book presents theoretical framework and sample applications of variant construction. The first part includes the components variant logic, variant measurements, and variant maps, while the second part covers sample applications such as variation with functions, variant stream ciphers, quantum interference, classical/quantum random sequences, whole DNA sequences, and multiple-valued pulse sequences. Addressing topics ranging from logic and measuring foundation to typical applications and including various illustrated maps, it is a valuable guide for theoretical researchers in discrete mathematics; computing-, quantum- and communication scientists; big data engineers; as well as graduate and upper undergraduate students.

Generally speaking, Biosignals refer to signals recorded from the human body. They can be either electrical (e. g. Electrocardiogram (ECG), Electroencephalogram (EEG), Electromyogram (EMG), etc.) or non-electrical (e. g. breathing, movements, etc.). The acquisition and processing of such signals play an important role in clinical routines. They are usually considered as major indicators which provide clinicians and physicians with useful information during diagnostic and monitoring processes. In some applications, the purpose is not necessarily medical. It may also be industrial. For instance, a real-time EEG system analysis can be used to control and analyze the vigilance of a car driver. In this case, the purpose of such a system basically consists of preventing crash risks. Furthermore, in certain other appli- tions,asetof biosignals (e. g. ECG,respiratorysignal,EEG,etc.) can be used toc- trol or analyze human emotions. This is the case of

the famous polygraph system, also known as the "lie detector", the ef ciency of which remains open to debate! Thus when one is dealing with biosignals, special attention must be given to their acquisition, their analysis and their processing capabilities which constitute the nal stage preceding the clinical diagnosis. Naturally, the diagnosis is based on the information provided by the processing system.

This book examines the use of biomedical signal processing—EEG, EMG, and ECG—in analyzing and diagnosing various medical conditions, particularly diseases related to the heart and brain. In combination with machine learning tools and other optimization methods, the analysis of biomedical signals greatly benefits the healthcare sector by improving patient outcomes through early, reliable detection. The discussion of these modalities promotes better understanding, analysis, and application of biomedical signal processing for specific diseases. The major highlights of Biomedical Signal Processing for Healthcare Applications include biomedical signals, acquisition of signals, pre-processing and analysis, post-processing and classification of the signals, and application of analysis and classification for the diagnosis of brain- and heart-related diseases. Emphasis is given to brain and heart signals because incomplete interpretations are made by physicians of these aspects in several situations, and these partial interpretations lead to major complications.

FEATURES Examines modeling and acquisition of biomedical signals of different disorders Discusses CAD-based analysis of diagnosis useful for healthcare Includes all important modalities of biomedical signals, such as EEG, EMG, MEG, ECG, and PCG Includes case studies and research directions, including novel approaches used in advanced healthcare systems This book can be used by a wide range of users, including students, research scholars, faculty, and practitioners in the field of biomedical engineering and medical image analysis and diagnosis.

First published in 1986: The presentation of the material in the book follows the flow of events of the general signal processing system. After the signal has been acquired, some manipulations are applied in order to enhance the relevant information present in the signal. Simple, Optimal, and adaptive filtering are examples of such manipulations. The detection of wavelets is of importance in biomedical signals; they can be detected from the enhanced signal by several methods. The signal very often contains redundancies. When effective storing, transmission, or automatic classification are required, these redundancies have to be extracted.

Biomedical signal processing in the medical field has helped optimize patient care and diagnosis within medical facilities. As technology in this area continues to advance, it has become imperative to evaluate other ways these computation techniques could be implemented. Computational Tools and Techniques for Biomedical Signal Processing investigates high-performance computing techniques being utilized in hospital information systems. Featuring comprehensive coverage on various theoretical perspectives, best practices, and emergent research in the field, this book is ideally

suited for computer scientists, information technologists, biomedical engineers, data-processing specialists, and medical physicists interested in signal processing within medical systems and facilities.

This book constitutes the proceedings of the First International Conference on Intelligent Robotics and Manufacturing, IRAM 2012, held in Kuala Lumpur, Malaysia, in November 2012. The 64 revised full papers included in this volume were carefully reviewed and selected from 102 initial submissions. The papers are organized in topical sections named: mobile robots, intelligent autonomous systems, robot vision and robust, autonomous agents, micro, meso and nano-scale automation and assembly, flexible manufacturing systems, CIM and micro-machining, and fabrication techniques.

This book comprises a collection of papers by international experts, presented at the International Conference on NextGen Electronic Technologies (ICNETS2-2017). ICNETS2 encompassed six symposia covering all aspects of electronics and communications engineering domains, including relevant nano/micro materials and devices. Featuring the latest research on computational signal processing and analysis, the book is useful to researchers, professionals, and students working in the core areas of electronics and their applications, especially signal processing, embedded systems, and networking.

This book presents techniques necessary to predict cardiac arrhythmias, long before they occur, based on minimal ECG data. The authors describe the key information needed for automated ECG signal processing, including ECG signal pre-processing, feature extraction and classification. The adaptive and novel ECG processing techniques introduced in this book are highly effective and suitable for real-time implementation on ASICs.

Biosignal Processing and Classification Using Computational Learning and Intelligence: Principles, Algorithms and Applications posits an approach for biosignal processing and classification using computational learning and intelligence, highlighting that the term biosignal refers to all kinds of signals that can be continuously measured and monitored in living beings. The book is composed of five relevant parts. Part One is an introduction to biosignals and Part Two describes the relevant techniques for biosignal processing, feature extraction and feature selection/dimensionality reduction. Part Three presents the fundamentals of computational learning (machine learning). Then, the main techniques of computational intelligence are described in Part Four. The authors focus primarily on the explanation of the most used methods in the last part of this book, which is the most extensive portion of the book. This part consists of a recapitulation of the newest applications and reviews in which these techniques have been successfully applied to the biosignals' domain, including EEG-based Brain-Computer Interfaces (BCI) focused on P300 and Imagined Speech, emotion recognition from voice and video, leukemia recognition, infant cry recognition, EEGbased ADHD identification among others. Provides coverage of the fundamentals of signal processing, including sensing the heart, sending the brain, sensing human acoustic, and

sensing other organs Includes coverage biosignal pre-processing techniques such as filtering, artifiact removal, and feature extraction techniques such as Fourier transform, wavelet transform, and MFCC Covers the latest techniques in machine learning and computational intelligence, including Supervised Learning, common classifiers, feature selection, dimensionality reduction, fuzzy logic, neural networks, Deep Learning, bio-inspired algorithms, and Hybrid Systems Written by engineers to help engineers, computer scientists, researchers, and clinicians understand the technology and applications of computational learning to biosignal processing

This book includes the original, peer reviewed research from the 3rd International Conference on Intelligent Technologies and Engineering Systems (ICITES2014), held in December, 2014 at Cheng Shiu University in Kaohsiung, Taiwan. Topics covered include: Automation and robotics, fiber optics and laser technologies, network and communication systems, micro and nano technologies and solar and power systems. This book also Explores emerging technologies and their application in a broad range of engineering disciplines Examines fiber optics and laser technologies Covers biomedical, electrical, industrial and mechanical systems Discusses multimedia systems and applications, computer vision and image & video signal processing

Practical Guide for Biomedical Signals Analysis Using Machine Learning Techniques: A MATLAB Based Approach presents how machine learning and biomedical signal processing methods can be used in biomedical signal analysis. Different machine learning applications in biomedical signal analysis, including those for electrocardiogram, electroencephalogram and electromyogram are described in a practical and comprehensive way, helping readers with limited knowledge. Sections cover biomedical signals and machine learning techniques, biomedical signals, such as electroencephalogram (EEG), electromyogram (EMG) and electrocardiogram (ECG), different signal-processing techniques, signal de-noising, feature extraction and dimension reduction techniques, such as PCA, ICA, KPCA, MSPCA, entropy measures, and other statistical measures, and more. This book is a valuable source for bioinformaticians, medical doctors and other members of the biomedical field who need a cogent resource on the most recent and promising machine learning techniques for biomedical signals analysis. Provides comprehensive knowledge in the application of machine learning tools in biomedical signal analysis for medical diagnostics, brain computer interface and man/machine interaction Explains how to apply machine learning techniques to EEG, ECG and EMG signals Gives basic knowledge on predictive modeling in biomedical time series and advanced knowledge in machine learning for biomedical time series

This Edited Volume gathers a selection of refereed and revised papers originally presented at the Third International Symposium on Signal Processing and Intelligent Recognition Systems (SIRS'17), held on September 13–16, 2017 in

Manipal, India. The papers offer stimulating insights into biometrics, digital watermarking, recognition systems, image and video processing, signal and speech processing, pattern recognition, machine learning and knowledge-based systems. Taken together, they offer a valuable resource for all researchers and scientists engaged in the various fields of signal processing and related areas.

This practical book is the first one-stop resource to offer a thorough, up-to-date treatment of the techniques and methods used in electrocardiogram (ECG) data analysis, from fundamental principles to the latest tools in the field. The book places emphasis on the selection, modeling, classification, and interpretation of data based on advanced signal processing and artificial intelligence techniques.

Multiscale Signal Analysis and Modeling presents recent advances in multiscale analysis and modeling using wavelets and other systems. This book also presents applications in digital signal processing using sampling theory and techniques from various function spaces, filter design, feature extraction and classification, signal and image representation/transmission, coding, nonparametric statistical signal processing, and statistical learning theory.

This volume presents the proceedings of the International Conference on Medical and Biological Engineering held from 16 to 18 March 2017 in Sarajevo, Bosnia and Herzegovina. Focusing on the theme of 'Pursuing innovation. Shaping the future', it highlights the latest advancements in Biomedical Engineering and also presents the latest findings, innovative solutions and emerging challenges in this field. Topics include: - Biomedical Signal Processing - Biomedical Imaging and Image Processing - Biosensors and Bioinstrumentation - Bio-Micro/Nano Technologies - Biomaterials - Biomechanics, Robotics and Minimally Invasive Surgery - Cardiovascular, Respiratory and Endocrine Systems Engineering - Neural and Rehabilitation Engineering - Molecular, Cellular and Tissue Engineering - Bioinformatics and Computational Biology - Clinical Engineering and Health Technology Assessment - Health Informatics, E-Health and Telemedicine - Biomedical Engineering Education - Pharmaceutical Engineering

Green Computing and Predictive Analytics for Healthcare excavates the rudimentary concepts of Green Computing, Big Data and the Internet of Things along with the latest research development in the domain of healthcare. It also covers various applications and case studies in the field of computer science with state-of-the-art tools and technologies. The rapid growth of the population is a challenging issue in maintaining and monitoring various experiences of quality of service in healthcare. The coherent usage of these limited resources in connection with optimum energy consumption has been becoming more important. The major healthcare nodes are gradually becoming Internet of Things-enabled, and sensors, work data and the involvement of networking are creating smart campuses and smart houses. The book includes chapters on the Internet of Things and Big Data technologies. Features: Biomedical data monitoring under the

Internet of Things Environment data sensing and analyzing Big data analytics and clustering Machine learning techniques for sudden cardiac death prediction Robust brain tissue segmentation Energy-efficient and green Internet of Things for healthcare applications Blockchain technology for the healthcare Internet of Things Advanced healthcare for domestic medical tourism system Edge computing for data analytics This book on Green Computing and Predictive Analytics for Healthcare aims to promote and facilitate the exchange of research knowledge and findings across different disciplines on the design and investigation of healthcare data analytics. It can also be used as a textbook for a master's course in biomedical engineering. This book will also present new methods for medical data evaluation and the diagnosis of different diseases to improve quality-of-life in general and for better integration of Internet of Things into society. Dr. Sourav Banerjee is an Assistant Professor at the Department of Computer Science and Engineering of Kalyani Government Engineering College, Kalyani, West Bengal, India. His research interests include Big Data, Cloud Computing, Distributed Computing and Mobile Communications. Dr. Chinmay Chakraborty is an Assistant Professor at the Department of Electronics and Communication Engineering, Birla Institute of Technology, Mesra, India. His main research interests include the Internet of Medical Things, WBAN, Wireless Networks, Telemedicine, m-Health/e-Health and Medical Imaging. Dr. Kousik Dasgupta is an Assistant Professor at the Department of Computer Science and Engineering, Kalyani Government Engineering College, India. His research interests include Computer Vision, AI/ML, Cloud Computing, Big Data and Security.

An electrocardiogram (ECG) is a bioelectrical signal which records the heart's electrical activity versus time. It is an important diagnostic tool for assessing heart functions. In this book, pattern recognition techniques are used for the interpretation of an ECG signal. The techniques used in this pattern recognition application are, signal pre-processing, QRS detection, feature extraction and artificial neural network for signal and cardiac condition (healthy or a certain disease) classification. In this book, the signal processing and neural network toolbox are used in Matlab environment. The processed signal source came from the Massachusetts Institute of Technology Beth Israel Hospital (MIT-BIH) arrhythmia database which was developed for research in cardiac electrophysiology. Three conditions of ECG waveform were selected from MIT-BIH database in this book. The ECG samples were pre-processed, then features representing the each sample were extracted to produce a set of features that can be used in a neural network to make the classification of samples and the recognition rates were recorded. The book is focused on finding an easy but reliable feature extraction method.

It is with great pleasure that we present to you a collection of over 200 high quality technical papers from more than 10 countries that were presented at the Biomed 2008. The papers cover almost every aspect of Biomedical Engineering,

from artificial intelligence to biomechanics, from medical informatics to tissue engineering. They also come from almost all parts of the globe, from America to Europe, from the Middle East to the Asia-Pacific. This set of papers presents to you the current research work being carried out in various disciplines of Biomedical En- neering, including new and innovative researches in emerging areas. As the organizers of Biomed 2008, we are very proud to be able to come-up with this publication. We owe the success to many individuals who worked very hard to achieve this: members of the Technical Committee, the Editors, and the Inter- tional Advisory Committee. We would like to take this opportunity to record our thanks and appreciation to each and every one of them. We are pretty sure that you will find many of the papers illuminating and useful for your own research and study. We hope that you will enjoy yourselves going through them as much as we had enjoyed compiling them into the proceedings. Assoc. Prof. Dr. Noor Azuan Abu Osman Chairperson, Organising Committee, Biomed 2008

This volume constitutes the refereed proceedings of the 9th International Conference on Image and Signal Processing, ICISP 2020, which was due to be held in Marrakesh, Morocco, in June 2020. The conference was cancelled due to the COVID-19 pandemic. The 40 revised full papers were carefully reviewed and selected from 84 submissions. The contributions presented in this volume were organized in the following topical sections: digital cultural heritage & color and spectral imaging; data and image processing for precision agriculture; machine learning application and innovation; biomedical imaging; deep learning and applications; pattern recognition; segmentation and retrieval; mathematical imaging & signal processing.

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