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Evaluation of Relative Performance of a QRS Complex Detection Algorithm QRS Complex Detection by Morphological Filter **Development and Evaluation of a New QRS Detection Algorithm Using the IBM PC** *On-Line QRS Complex Detection Using Wavelet Filtering* QRS Complex Detection in Single Lead Electrocardiograms **QRS Detection Using Wavelet Transform Optimal QRS Detectors for ECG Analysis, Design and Evaluation Improved QRS Detectors for Nonlinear ECG Analysis** Implementing QRS Complex Detection Using Mathematical Morphology **Prototyping of Fetal Qrs Complex Detection Algorithm Neural Network Based Adaptive Matched Filtering for QRS Detection** *A Low Computational-Complexity QRS Complex Detection Algorithm Realized in an MCU-Based System and Tested with a Three-Lead Synthetic ECG Generator* **Cardiology Explained** Developments and Applications for ECG Signal Processing *QRS Complex Detection Algorithm and FPGA Realization* **Wavelets for QRS Detection ECG Signal Processing, Classification and Interpretation** BIOMEDICAL SIGNAL ANALYSIS: A CASE-STUDY APPROACH **QRS Detection Using Automata Theory in a Battery-powered Microprocessor System** High Performance and Power Efficient Electrocardiogram Detectors Innovations in Biomedical Engineering **Electronic Systems and Intelligent Computing** Advanced Methods and Tools for ECG Data Analysis **Real Time Matched Filter Detection of the QRS Complex by Replica Correlation An Efficient Algorithm for ECG Denoising and Beat Detection Wavelet Applications in Signal and Image Processing V Algorithms for Real-time ECG Compression and Analysis A Battery-powered Portable Arrhythmia Monitor with Software QRS Detection and Discrimination Performance of Three QRS Detection Algorithms During Sleep: A Comparative Study Application of the Dyadic Wavelet Transform for the Detection of the QRS Complex Parameter Optimization Based on Graphical Evaluation Methods for Time-domain Multi-level QRS Complex Detection in ECG Signal Processing Advances on P2P, Parallel, Grid, Cloud and Internet Computing** *2018 9th International Symposium on Signal, Image, Video and Communications (ISIVC)* **A Microprocessor-based Method to Detect the QRS Complex Using a Wave Shape Model The 16th International Conference on Biomedical Engineering Ultra Low Power ECG Processing System for IoT Devices 11th Mediterranean Conference on Medical and Biological Engineering and Computing 2007** EMBEC & NBC 2017 **4th Kuala Lumpur International Conference on Biomedical Engineering 2008** Enhancement of R-Wave Detection in ECG Data Analysis Using Higher-Order Statistics

This book aims to provide the latest research findings, innovative research results, methods and development techniques from both theoretical and practical perspectives related to P2P, Grid, Cloud and Internet computing as well as to reveal synergies among such large-scale computing paradigms. P2P, Grid, Cloud and Internet computing technologies have been very fast established as breakthrough paradigms for solving complex problems by enabling aggregation and sharing of an increasing variety of distributed computational resources at large scale. Grid Computing originated as a paradigm for high-performance computing, as an alternative to expensive supercomputers through different forms of large-scale distributed computing. P2P Computing emerged as a new paradigm after client–server and web-based computing and has shown useful to the development of social networking, B2B (Business to Business), B2C (Business to Consumer), B2G (Business to Government), B2E (Business to Employee), and so on. Cloud Computing has been defined as a “computing paradigm where the boundaries of computing are determined by economic rationale rather than technical limits”. Cloud computing has fast become the computing paradigm with applicability and adoption in all application domains and providing utility computing at large scale. Finally, Internet Computing is the basis of any large-scale distributed computing paradigms; it has very fast developed into a vast area of flourishing field with enormous impact on today’s information societies serving thus as a universal platform comprising a large variety of computing forms such as Grid, P2P, Cloud and Mobile computing. Biomedical engineering brings together bright minds from diverse disciplines, ranging from engineering, physics, and computer science to biology and medicine. This book contains the proceedings of the 11th Mediterranean Conference on Medical and Biological Engineering and Computing, MEDICON 2007, held in Ljubljana, Slovenia, June 2007. It features relevant, up-to-date research in the area. This book presents the latest developments in the field of biomedical engineering and includes practical solutions and strictly scientific considerations. The development of new methods of treatment, advanced diagnostics or personalized rehabilitation requires close cooperation of experts from many fields, including, among others, medicine, biotechnology and finally biomedical engineering. The latter, combining many fields of science, such as computer science, materials science, biomechanics, electronics not only enables the development and production of modern medical equipment, but also participates in the development of new directions and methods of treatment. The presented monograph is a collection of scientific papers on the use of engineering methods in medicine. The topics of the work include both practical solutions and strictly scientific considerations expanding knowledge about the functioning of the human body. We believe that the presented works will have an impact on the development of the field of science, which is biomedical engineering, constituting a contribution to the discussion on the directions of development of cooperation between doctors, physiotherapists and engineers. We would also like to thank all the people who contributed to the creation of this monograph—both the authors of all the works and those involved in technical works. This volume presents the proceedings of the 16th ICMBE held from 4th to 7th December 2016, Singapore. Topics of the proceedings include 6 tracks: BioImaging and BioSignals, Bio-Micro/Nano Technologies BioRobotics and Medical Devices, Biomaterials and Regenerative Medicine.- BioMechanics and Mechanobiology., Engineering/Synthetic Biology. This book details the characteristics of an ECG signal through the functionality and electrical activity of the human heart. This book provides a basic introduction and needs for developing implantable cardiac pacemaker systems. This book provides comprehensive details on ECG signal processing techniques that are useful for fast and accurate diagnosis of cardiovascular diseases. The book discusses the characteristics and parameters of a typical ECG signal and various noises that can corrupt an ECG signal. It also covers various challenges involved in different stages of signal acquisition, preprocessing, and detection of an ECG signal. The book also presents a detailed survey of various ECG signal detection and data compression techniques. The book contains detailed information on ECG signals and various noises that corrupt an ECG signal. It also includes de-noising techniques, ECG peak detection techniques, and ECG data compression techniques. It also includes step-by-step details to design various filters in MATLAB. This book, through detailed explanations, provides the reader with necessary information on ECG signal, ECG signal acquisition process, noise removal techniques, and the detection of ECG peaks. This book presents selected, high-quality research papers from the International Conference on Electronic Systems and Intelligent Computing (ESIC 2020), held at NIT Yupia, Arunachal Pradesh, India, on 2 – 4 March 2020. Discussing the latest challenges and solutions in the field of smart computing, cyber-physical systems and intelligent technologies, it includes papers based on original theoretical, practical and experimental simulations, developments, applications, measurements, and testing. The applications and solutions featured provide valuable reference material for future product development. This volume presents the proceedings of the joint conference of the European Medical and Biological Engineering Conference (EMBEC) and the Nordic-Baltic Conference on Biomedical Engineering and Medical Physics (NBC), held in Tampere, Finland, in June 2017. The proceedings present all traditional biomedical engineering areas, but also highlight new emerging fields, such as tissue engineering, bioinformatics, biosensing, neurotechnology, additive manufacturing technologies for medicine and biology, and bioimaging, to name a few. Moreover, it emphasizes the role of education, translational research, and commercialization. The report describes an approach to optimum detection of each cardiac cycle from noisy electrocardiograms.

A filter matched to the QRS complex of the electrocardiogram is proposed to achieve the results. It is demonstrated analytically that such a filter yields the optimum signal to noise ratio obtainable in the presence of stationary Gaussian noise. While this type of filtering is done on a digital computer, and not in real time, the advent of medium and large scale integrated circuit technology has made it feasible to implement a specific piece of hardware for this purpose. (Author). 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. One of the most time-consuming tasks in clinical medicine is seeking the opinions of specialist colleagues. There is a pressure not only to make referrals appropriate but also to summarize the case in the language of the specialist. This book explains basic physiologic and pathophysiologic mechanisms of cardiovascular disease in a straightforward manner, gives guidelines as to when referral is appropriate, and, uniquely, explains what the specialist is likely to do. It is ideal for any hospital doctor, generalist, or even senior medical student who may need a cardiology opinion, or for that ma. Due to physical variability of ECG waves, detection of the QRS complex becomes a difficult task in a real time situation. Jiau Pan and Willis J. Tompkins of the University of Wisconsin developed a real time QRS detection algorithm for a Z-80 microprocessor. They demonstrated a overall performance of 99.325% when tested against the MIT-BIH arrhythmia database. 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 A new way of detecting R-wave in QRS complex of electrocardiogram (ECG) based on higher-order statistics (HOS) is presented in this paper. The proposed method employs HOS-based parameters, such as skewness and kurtosis, in order to formulate an adaptive detector of R peak with high accuracy. Experimental results, when applying the proposed method to pre-classified ECG data from the Massachusetts Institute of Technology/Beth Israel Hospital (MIT/BIH) FCC database, prove that the proposed method exhibits over 99% of detectability, even when the ECG data are contaminated with noise. Due to its simplicity it could be feasible in a real-time context and it could be applied in routine ambulatory and/or clinical heart rate screening. 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. This paper examines the use of wavelets for the detection of QRS complex in ECG. Wavelets provide temporal and spectral information simultaneously and offer flexibility with a choice of wavelet functions with different properties. This research has examined wavelet functions with different properties to determine the effects of wavelet properties such as linearity and time frequency localization on the accuracy of QRS detection. The sum of false negatives and false positives (total error in detection) is the criterion for determining the efficacy of the wavelet function. The paper reports a significant reduction in error in detection of QRS complexes with mean error reduced to 0.75%. This is achieved with the use of Cubic Spline wavelet- a biorthogonal third order wavelet. This paper reports that the use of wavelets reduces the error in detection of QRS complexes and that wavelet functions that support symmetry and compactness provide better results. 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. 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 A comparison of the performance of three QRS detectors used in the analysis of electrocardiogram (ECG) during sleep in presented in this paper. Two widely used QRS detection algorithms based on digital filtering (DF) are compared with a newly introduced one, based on Higher-Order Statistics (HOS). The percentage of QRS complexes failed detection along with the number of false positives and false negatives are measured for quantitative performance evaluation. Experimental results, when applying the proposed methods to nocturnal ECG recordings from the Sleep Laboratory of the Philipps University of Marburg, Germany, prove that the HOS-based QRS detector exhibits higher overall QRS detection accuracy (99.95%) than the two DF-based ones (99.75% and 99.59%, respectively). Moreover, it has lower noise susceptibility despite the presence of different noise types, such as smooth or abrupt baseline drift, 50Hz powerline interference, electromyographic intervention or any arrhythmia effect due to sleep apnea. Market_Desc: The book is directed at engineering students in their final year of undergraduate studies or in their graduate studies. Electrical engineering students with a rich background in signals and systems will be well prepared for the material in the book. Practicing engineers, computer scientists, information technologists, medical physicists, and data processing specialists working in diverse areas such as telecommunications, seismic and geophysical applications, biomedical applications, and hospital information systems will find this book useful for learning advanced techniques for signal analysis. Special Features: · The author takes a case-study approach to solve problems in biomedical signal analysis.· Each chapter deals with a certain type of problems with biomedical signals.· Real-life case studies and the associated signals illustrate the problem to be solved.· Signal processing, modeling, or analysis techniques are then presented, starting with relatively simple methods, followed by more sophisticated ones.· Each chapter concludes with an application to a significant and practical problem. About The Book: The author takes a case-study approach to solve problems in biomedical

signal analysis. Each chapter deals with a certain type of problems with biomedical signals. Real-life case studies and the associated signals illustrate the problem to be solved. Signal processing, modeling, or analysis techniques are then presented, starting with relatively simple methods, followed by more sophisticated ones. Each chapter concludes with an application to a significant and practical problem. This paper presents a new QRS complex detection algorithm that can be applied in various on-line FCC processing systems The algorithm is performed in two steps: first a wavelet transform filtering is applied to the signal, then QRS complex localization is performed using a maximum detection and peak classification algorithm The algorithm has been tested in two phases, First the QRS detection in FCC registrations from the MIT-BIH database has been performed, which led to an average detection ratio of 99,50%, Then, the algorithm has been implemented into a microcontroller-driven portable Holter device. ISIVC is a high level international forum and an important event for researchers, engineers and scientists from around the world to present and discuss recent advances, technologies and applications in the fields of Signal, Image, Video Processing and Communications This year a particular attention will be paid to a novel track focused on Data Science and applications The symposium will feature world class speakers, plenary, regular, poster and special sessions as well as business and industrial exhibits On the occasion of the first death anniversary of the late Professor Driss Aboutajdine, this edition will be specially dedicated to his memory under the sign of fidelity and recognition The electrocardiogram (ECG) provides information about the heart. ECG is a biological signal which generally changes its physiological and statistical property with respect to time, tending to be non-stationary signal. For studying such types of signals wavelet transforms are very useful. The most striking waveform when considering the ECG is the QRS wave complex which gives the R wave peak which is time-varying. This report describes an algorithm for detection of QRS complex using the Wavelet transform. This detector is reliable to QRS complex morphology and properties which changes with time and also to the noise in the signal. The performance of the Wavelet transform based QRS detector is illustrated by testing ECG signals from MIT Arrhythmia database. We also compare the performance of Wavelet based QRS detector with detectors using Derivative based method. From the comparison, the Wavelet detector exhibited superior performance for different ECG signals like multiform premature ventricular contractions, bigemy and noisy signals. Fetal Electrocardiogram (FECG) signal contains potentially precise information that could assist clinicians in making more appropriate and timely decisions during labor. A Back-propagation Neural Network and Adaptive Linear Neural Network have been designed to extract the FECG from the abdominal ECG to assess the fetus during the pregnancy and labor. The neural network was trained to recognize the normal waveform and filtered out the unnecessary artifacts including noises in the ECG signal, including power line interference, motion artifacts, baseline drift, ECG amplitude modulation with respiration and other composite noises. The performance of the designed algorithm for FHR extraction is 93.75%. The algorithm has been modeled using VHDL for hardware modeling of FHR monitoring system, which has been synthesized and fitted into Altera's Stratix II EP2S15F484C3 using the Quartus II version 7.2 Web Edition where the logic and DSP block utilization were 89% and 50% respectively. This research will open up a passage to biomedical researchers and physicians to advocate an excellent understanding of FECG signal and its analysis procedures for FHR monitoring system.