CHAPTER 61

TECHNOLOGY
INSTRUMENTATION AND CONTROL
ENGINEERING

Doctoral Theses

01. AGARWAL (Shivangi)
Design and Analysis of Digital Filters Used in Devices for Monitoring Biomedical Signals.
Supervisor: Prof. Vijander Singh and Prof. A. P. Mittal
Th 23619

Abstract
(Not Verified)

The present work explores the of low cost FPGA based medical system in emergency situations requiring high speed processing. Biomedical Signals are the most effective diagnostic techniques toevaluate the electrical activity in various organs. As important information of biomedical signals lies inthe peak of signal, therefore artifacts and noise from these signals are filtered by a variety of real timesignal processing. Efficient pre-processing allows accurate classification so as to diagnose variousdisease correctly. SavitzkyGolay Smoothing filter (SGSF) is implemented for preprocessing of realtime smart medical systems. As SGSF preserves the peaks and minimize the signal distortion, its usein cascade may further enhance its capability. Hence cascaded SGSF is proposed and cascadedMAF, MAF-SGSF, SGSF-Binomial and single stage SGSF are also designed The designed filters aretested on synthetic signals of EEG and ECG by adding Gaussian and non Gaussian noises. Realtime EEG, ECG and EOG signals are also considered for experimentation. It is revealed from theresults that CSGSF outperforms the other designed filters. High speed algorithms may beimplemented on reconfigurable architectures to achieve high speed, low cost, low power consumptionand less area. The fast and efficient implementation of SavitzkyGolay (SG) filter is not proposed yet,therefore SGSF is realized on FPGA platform. The experimental results show that FPGA-SGSF significantly reduces the processing time and preserves the actual features of signal.Multiplierless SGSF based on distrubuted arithmetic (DA) is also implemented for compact and mobile applications. It is observed that DA based architecture increases processing speed, reduceschip area and preserves the original features of filtered signal. Hence it is suggested that SGSFimplemented on FPGA may provide economic, fast and efficient filtering of biomedical signals

Contents

1. Introduction 2. Biomedical signals and field programmable gate arrays 3.Research methodology 4.Results and discussion 5. Experimental results of fpga 6. Conclusions and future scope.List of publications. Bibliography. Appendix. Biodata of author.

02. ARORA (Parul)
Investigation of Soft Computing Techniques for Biometric Applications.
Supervisor: Prof. Smriti Srivastava
Th 23607

Abstract

The focus of this thesis is to investigate soft computing methods for different biometric modalities.The main soft computing approaches used are fuzzy set theory, information set theory, extensionneural network and nearest neighbor. Fuzzy set theory is the traditional method to deal with theuncertainty present in the information, while to deal with the uncertainty present in fuzzy set itself,information set theory is proposed. The uncertainty in a fuzzy set represented by the possibilisticdistribution of its property/attribute values which are termed as information source values evolvesinto Information set theory using an entropy function. Extension neural network evolves fromextension set theory and neural network. Nearest neighbor method estimates the nearestpossible member by calculating the distance between the samples using Euclidean measure.To start with, Information set theory has been used for model free feature extraction of gaitmodality.We have also used Extension Neural Network as classifier for Gait Information Images and opticalflow based features.Next, we have used the feature descriptor called Histogram of oriented gradient (HOG) on gaitinformation images. This descriptor aims at capturing edge information inside the person's gaitinformation image.Further, we have also explored model based gait recognition like beizer and hermite and fuzzyinference for classification.Another biometric modality called Palm Dorsal Vein is also explored. The information set theory is applied to extract features and for the development of a classifier that uses both the informationset theory and t- norms.Finally, a multimodal biometric system comprising gait which is a behavioral biometric modalitycalled gait and Palm Dorsal vein pattern which is a physiological biometric modality is developed.Then the score level fusion is attempted features extracted from both modalities. For furtherimprovement in performance, refined scores approach based on cohort scores is proposed

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1. Introduction 2. Gait recognition system using information set theory 3.Impact of histogram of oriented gradient (hog) on gait information images 4. Extension neural network with information set theory 5. Model based recognition with fuzzy classifier 6. Dorsal hand vein authentication system using information set theory 7.Multimodal biometric system 8. Conclusion and future work

03. NIKHIL (Pachauri)

Analysis, Simulation and Control of Non-Linear Process.

Supervisor: Prof. Vijander Singh

Th 23620

Abstract
(Not Verified)

The main objective of the work is tight control of ethanol in bioreactor and effective treatmentof cancerous tumors in chemotherapy patient model. Initially inferential control scheme basedon Adaptive linear neural network (ADALINE) soft sensor is developed for control offermentation process. The soft sensor estimates ethanol concentration of bioreactor fromtemperature profile of the process. The prediction accuracy of ADALINE is enhanced byretraining it with immediate past measurements. The ADALINE and retrained ADALINE areused with PID and two degrees of freedom PID (2-DOF-PID) leading to APID, A2PID, RAPIDand RA2PID inferential controllers. The controller parameters in RA2PID are optimized usingNon-dominated sorted genetic algorithm-II (NSGA-II) leading to RAN2PID controller. Theproposed control scheme outperforms the other designed controllers.Further

desired product quality of bioreactor is also achieved by controlling reactortemperature. An amalgamation of fractional mathematics and IMC-PID is proposed for thecontrol purpose. Fractional order IMC-PID is modified (MFOIMC-PID) by incorporating anextra control loop with proportional gain. Water cycle algorithm is utilized for optimization ofcontroller parameters which leads to WMFOIMC-PID controller. PID and Fractional order PIDare also designed for comparative study. The performance of WMFOIMC-PID controller isfound superior to other designed controllers. A combination of fractional calculus and 2-DOFPIDis also proposed for desired temperature control. The design parameters are optimizedusing NSGA-II and cuckoo search algorithm. The NSGA-2-DOF-FOPID controller regulatestemperature of bioreactor in a more robust and efficient manner in comparison to otherdesigned controllers.Further chemotherapy patient model is considered to control drug concentration at tumor sitein minimum time. A modified fractional order IMC (MFOIMC) is considered for the purpose.Dragon fly algorithm (DA) is employed to optimize the controller parameters. Simulationresults reveal the superiority of DA tuned MFOIMC controller over IPD and other designedcontrollers.

Contents

1. Introduction 2.Literature 3.Research methodology 4. Ethanol concentration control of bioreactor 5. Drug concentration control During chemotherapy 6. Conclusion and future scope. List of publications. Bibliography. Appendix.

04. SHARMA (GREESHMA)
Performance Evaluation in Navigation Through Psychophysiological Assessment.
Supervisor: Prof. Alok Prakash Mittal and Prf. Vijander Singh
Th 23606

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1. Introduction 2. Literature survey 3. Methodology 4.Results and conclusion 5. Conclusions and future scope of work. List of publications. Bibliography.

05. SAXENA (Piyush)
Control Techniques for Renewable Energy.
Supervisor: Prof. Prerna Gaur and Prof. J.R.P. Gupta
Th 23621

Abstract
(Not Verified)

Renewable energy is obtained from alternative sources e.g. Wind, Sun, Bio-mass and hydro. Equipments, used to harness Electricalenergy from these resources, are being studied and worked upon to improve power quality and also the stability of these devices orsystems. The question arises why do we need renewable resources and the answer is the short fall of the conventional fossil fuel. Also theconventional harnessing of electrical energy introduces a lot of carbon and nitrogen compounds into the atmosphere causing pollution.There are various issues to be taken care in wind turbine; one of them is to control the pitch angle in order to harness maximum powerconstantly, irrespective of the wind direction and speed. Conventional controllers like PI, PID are used to control the pitch angle of thewind turbine. AI methods like tuning of the controller through genetic algorithm may give better controller.The renewable energy resources are being utilized in Hybrid Energy System for obtaining clean energy and replacing the declining fossilfuel. Optimization of the parameters is a foundation for the success of HES. The optimization can be done by FUZZY-PI method tuned byGenetic Algorithm and the results can be compared with the conventional PI method.Now a days, Model Reference Adaptive Control is used for controlling a nonlinear and

unstable system like wind turbine synchronousgenerator. Fuzzy Model Reference Adaptive Control is developed in the research and compared with the conventional method. The aimof the proposed FMRAC is to improve the performance parameters and response of MRAC.Permanent magnet synchronous generators are used to generate electrical energy driven by wind turbine. PMSG used in wind turbinesystems suffer with parametric uncertainty due to changing weather conditions. Kharitonov theorem and Routh stability criteria areproposed to deal with such problems in PMSG.

Contents

1. Introduction 2. Literature survey 3. Genetic algorithm based control of pitch angle in wind turbine 4. Genetic algorithm based control of power and frequency of renewable energy based hybrid energy system for isolated area 5. A comparative analysis between mrac and fmrac for unstable system.Robust stability analysis of pmsg with parametric uncetainty using kharitonov theorem. 7. Conclusion and future scope. References. List of publications. Appendix.

06. YADAV (Jyoti)
Some Aspects of Biomedical Signal Monitoring and Control.
Supervisor: Prof. Vijander Singh
Th 23605

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1. Introduction 2. Literature Review 3. Non – Invasive blood glucose sensing system 4. Modeling and simulation of blood glucose control 5. Results and discussion 6.Conclusion and future scope.List of Publication. Bibliography Biodata of author.