Abstract Book

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Mahdia, Tunisia

IEEE

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12th International Multi-Conference on Systems, Signals and Devices SSD'15

March 16–19, 2015

Mahdia – Tunisia

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Organized by:

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Preface

Following the success of SSD'01 held in Hammamet-Tunisia, SSD'03 and SSD'05 held in Sousse-Tunisia, SSD'07 held in Hammamet-Tunisia, SSD'08 held in Amman-Jordan, SSD'09 held in Djerba-Tunisia, SSD'10 held in Amman-Jordan, SSD'11 held in Sousse-Tunisia, SSD'12 held in Chemnitz-Germany, SSD'13 held in Hammamet-Tunisia, and SSD'14 held in Casteldefels-Barcelona-Spain, the twelfth International Multi-Conference on Systems, Signals and Devices - SSD'15 to be held at Mahdia-Tunisia, from 16^{th} to the 19^{th} of March 2015. The conference program consists of 3 plenary sessions, 10 Keynote Lectures and 39 oral sessions. SSD'15 multi-conference is organized to include 5 conferences covering different fundamental and applied aspects:

1 "Int. Conf. on Systems Analysis and Automatic Control".. (SAC)

2 "Int. Conf. on Power Electrical Systems" ..... (PES)

3 "Int. Conf. on Communication and Signal Processing" ... (CSP)

4 "Int. Conf. on Sensors, Circuits and Instrumentation Sys.".. (SCI)

5 "Int. Conf. on Computers and Information Technology" .. (CIT)

SSD'15 secretariat has received 288 submissions from 20 countries: Algeria, Canada, Egypt, France, Germany, India, Italy, Japan, Jordan, Libya, Malaysia, Morocco, Oman, P.R. China, Qatar, Saudi Arabia, Spain, Tunisia, Ukraine and USA. Each paper has been reviewed by at least two reviewers of the program committee which consisted of more than 100 scientists from more than 30 countries. Only 195 papers have been accepted.

We would like to express our deep gratitude to all chairs and members of the program committee for their substantial reviews. Special thanks are due to all members of the organizing committees for their determination to make this event a promising success.

Finally, we would like to extend our deep gratitude to all those who have contributed to the financial support of SSD'15 financially.

Professors Jawhar Ghommam and Faouzi Derbel

Mahdia, Tunisia

March, 2015

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Topics:

Advances in linear control theory
System optimization
Multivariable control
Large scale systems
Infinite dimension systems
Nonlinear control
Distributed control
Predictive control
Geometric control
Adaptive control
Optimal and stochastic control
Variable Structure Control
Robust control
Hierarchical and man-machine systems
Intelligent control systems
Robotics and mechatronics
System identification
Biological and economical models & control
Neural networks and neural control
Fuzzy systems and fuzzy control

Conference on Power Electrical Systems

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Topics:

Electric machines modeling and control
Electric machine design
Special machines
Power electronic converters
Variable speed drives
Automotive electrical systems
Monitoring and diagnostics
Power systems
Renewable energy generation
Electromagnetic compatibility
Variable speed generating systems
Transformers

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Signal processing
Communication systems
Digital signal processing
Image and video compression algorithms
Speech recognition
Person authentication
Biometry and medical imaging
Data fusion
Pattern recognition
Modulation and signal design
Communication theory and techniques
Communication protocols and standards
Telecommunication systems
Coding compression
Information theory
Communication networks
Wireless communication
Optical communication
Wireless sensor networks
MIMO communications
Artificial intelligence
Information retrieval
Adaptive antennas
Smart antennas

Conference on Sensors, Circuits & Instrumentation Systems

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Topics:

Fundamentals and physics
Self test
Fault tolerance system & diagnosis
Simulation and design
Calibration and quality insurance
Sensors and actuators
Transducer design
Optical sensors and applications
Biomedical instrumentation systems
Circuits and systems
Full and semi-custom integrated circuits:
- Design concepts
- architectures and high-performances
- low-power circuits

Analog and digital signal processing
Neural networks implementation
Pulse mode neural networks
Genetic algorithm implementation
Sigma delta converters
Design for testability
Low-voltage design
Low-power VLSI design
RF circuit design
Smart home
Life sciences
Environmental applications
Opto-electronics
Micro-machines

Conference on Computers & Information Technologies

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Topics:

Computer technology
Hardware design
Software design
Operating systems
Knowledge-based systems
Fuzzy logic algorithms
Neural networks algorithms
Genetic algorithms
Intelligent systems
Embedded systems
Parallel processing
Cloud computing
Distributed systems
Real time systems
Computer networks
Wireless sensor networks technology protocoles
Smart systems
Virtual reality systems
Mixed reality systems

SSD'15 : Multi–Conference Program

	08 h 30 – 09 h 15	**09 h 15 – 10 h 00**	**10 h 00 – 10 h 45**	**10 h 45 – 11 h 15**	**11 h 15 – 12 h 00**	**12 h 00 – 13 h 20**	**13 h 20 – 14 h 30**	**15 h 00 – 17 h 00**	**17h 00 – 19 h 00**	**19 h 00**
Sunday March, 15								**Registration for foreign attendees**		
Monday March, 16	**Registration**		**Official Opening**	Coffee Break	Plenary Session 1	Oral Sessions SAC 1 & PES 1 CSP1 & SCI 1 CIT 1	Lunch	Oral Sessions SAC 2 & SAC 3 PES 2 & SCI 2 CIT 2	**SSD Meeting**	
Tuesday March, 17	Plenary Session 2	Oral Sessions SAC 4 & SAC 5 PES 3 & CSP 2 SCI 3		Coffee Break	Keynote Lectures L1	Oral Sessions SAC 6 & PES 4 CSP 3 & SCI 4 CIT 3	Lunch	**SSD'15, Social Program**		
Wednesday March, 18	Plenary Session 3	Oral Sessions SAC 7 & PES 5 CSP 4 & SCI5 CIT 4		Coffee Break	Keynote Lectures L2	Oral Sessions SAC 8 & PES 6 CSP 5 & SCI 6 Keynote Lecture CIT	Lunch	Oral Session SAC 9 & SAC 10 PES 7 & CSP 6 SCI 7	**Workshop Organized by ISBS Sfax**	**Conference Dinner at 21h00**
Thursday March, 19	Oral Session SAC 11 & PES 8 CSP 7 & SCI 8 CIT 5			**Closure**		**Post Conference Program**				

Contents

Plenaries

SAC Papers

SCI Papers

International Multi-Conference
on Systems, Signals & Devices
March 16–19, 2015

Paper reference
SSD'15-PL-1

Stabilization of Time-Varying and Nonlinear Systems with Pointwise and Distributed Delays Through the Reduction Model Approach

Frederic Mazenc
(CR at INRIA EPI DISCO, France)

Abstract

The reduction model approach is a well-known stabilization technique for systems with input delays. It is effective for stabilizing continuous-time linear time-invariant systems with arbitrarily long pointwise or distributed input time-invariant delays. Recent extensions of this technique have been developed. We will present three extensions: we will show how (i) several families of time-varying systems can be handled (ii) local stabilization results for nonlinear systems with estimates of the basins of attraction (iii) the sampled control can be used when a limitation on the size of the sampling interval is imposed. Lyapunov-Krasovskii functionals are key tools of the proofs of our results.

International Multi-Conference
on Systems, Signals & Devices
March 16–19, 2015

Paper reference
SSD'15-PL-2

From Challenges to Control Solutions in Underwater Robotics: Beyond the Lab Experiments

Ahmed Chemori,
(LIRMM CNRS/University Montpellier 2, France)

Abstract

Underwater vehicles have gained an increased interest in the last decades given the multiple tasks they can accomplish in various fields such as dams' inspection, oil and gas industry, and environmental investigations. One of the potential applications of these systems deals with underwater inspection of facilities such as bridges, hydraulic dams, boat hulls, aquatic environments, etc. When we are interested in autonomous control of Remotely Operated Vehicles (ROVs), different challenges may arise. These challenges are mainly due to the inherent high nonlinearities and time varying behavior of the vehicle's dynamics subject to hydrodynamic effects and external disturbances.

In order to avoid the degradation in the performance of the controlled system during a specific mission, the vehicle is expected to possess a self tuning ability and robustness to compensate for different kinds of uncertainties, parameters variation and external disturbances. That is why adaptive and robust controllers are very popular for such systems.

The heart of this talk is organized in four main parts. The first one deals with an overview of the context of underwater inspection and its related control problems and challenges. The second part introduces our three underwater vehicles, namely the AC-ROV, the LIRMIA2 and the L2ROV. In the third part, the proposed adaptive and robust control solutions will be presented as well as their real-time implementation on the above underwater vehicles. The obtained results are illustrated through different experimental results in different conditions in a swimming pool environment. The last part shows the application of some of the proposed control strategies in challenging real operating conditions in the Mediterranean sea.

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Paper reference
SSD'15-PL-3

Recent Results in Optical Wireless Communications

Mohamed-Slim Alouini,
(Computer, Electrical, and Mathematical Science and Engineering (CEMSE), Division King Abdullah University of Science and Technology (KAUST), Saudi Arabia)

Abstract

Rapid increase in the use of wireless services over the last two decades has lead the problem of the radio-frequency (RF) spectrum exhaustion. More specifically, due to this RF spectrum scarcity, additional RF bandwidth allocation, as utilized in the recent past, is not anymore a viable solution to fulfill the demand for more wireless applications and higher data rates. Among the many proposed solutions, optical wireless communication (OWC) systems have gained an increasing interest due to their advantages including higher bandwidth and higher capacity compared to the traditional RF communication systems. This promising technology offers full-duplex Gigabit throughput in certain applications and environment while benefiting from a huge license-free spectrum, immunity to interference, and high security. These features of OWC communication systems potentially enable solving the issues that the RF communication systems face due to the expensive and scarce RF spectrum. The first part of the talk will give an overview of OWC systems by offering examples of advantages and application areas of this emerging technology. In the second part of talk, we will focus on some recent results and on-going research directions in the accurate characterization of the performance of OWC systems in the presence of inevitable impairments due to atmospheric turbulence and misalignment between transmitter and receiver.

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Paper reference
SSD'15-KL-SAC-1

From Hamiltonian Hopf-bifurcation to the control of limit cycles in underactuated mechanical systems

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University of Carthage, Tunisia)

Abstract

Mechatronic systems need the integration of mechanical, information, electronics, management, intelligence, and other interdisciplinary studies, which lead to complex applications. This complexity does not only appear in the system identification and modeling, but also it has a repercussion in signal processing and controller design. When the system complexity increases, it is difficult for researchers to describe its dynamic behavior. Therefore, the traditional methods used to analyze and control of such systems, have difficulties to respond to the requirements of this complexity. Bifurcation and chaos theory can be employed to classify different dynamical behavior arising in a mechatronic system. The main focus of this special session will be on the bifurcation and chaos theory and their applications in mathematical modeling, signal processing, and control of complex mechatronic systems.

This presentation is divided into four parts:

- What's generalized Hamltonian systems
- Hopf-bifurcation analysis
- The control of non-linear Oscillations
- Application to the Inertia Wheel Inverted Pendulum (IWIP)

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Paper reference
SSD'15-KL-SAC-2

Control and Optimization of Distributed Generation Systems

Magdi S. Mahmoud
(King Fahd University of Petroleum and Minerals, Saudi Arabia)

Abstract

The existing electricity grid has small number of producers, long distribution ways and high maintenance cost. It is also difficult to achieve load balancing. Moreover, the depleting fossil fuels and the adverse effect on environment by its consumption has gain multi-national interest in reducing the excess use of nonrenewable energy resources and many nations are keeping tap on Co2 emissions.

The main concerns with the existing centralized power system grid have led to Increasing demand and lack of high reliability and security threats with power quality, to name a few.

This in turn urges the need to incorporate distributed generating (DG) units into the existing power systems consumers. DG units are the emerging micro-generating technologies such as micro-turbines, fuel cells, Internal Combustion (IC) engines. It also make use of renewable energy sources such as Photo Voltaic (PV) arrays and wind turbines. The DG units have low emission rates, environment friendly and are economical. The introduction of DG units should reduce the pressure on central power grid principally but in technically speaking, penetration of distributed generation into the power grid creates a new class of issues different from those found in traditional power sources.

In this presentation, motivation towards development of DG and an overview will be presented on the two key aspects, modeling and control, of DG. Recent developments in these two key aspects will be presented. A better control strategy, by viewing DG as a special case of system of systems (SoS), will be discussed.

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Paper reference
SSD'15-KL-PES-1

Computational Intelligence Applications in Power Systems Operation and Control

Mohamed Boudour
(University of Sciences & Technology Houari Boumediene, Algiers, Algeria)

Abstract

Increased growing of load demand and interconnections of power systems along with deregulation and environmental concerns has brought new challenges for electric power system operation and control.

Computational intelligence techniques are new modern tools used to solve very complex problems that are difficult to solve with conventional algorithms. Artificial intelligence methods (Artificial Neural Networks, Expert Systems and Fuzzy Logic), Heuristic optimization and/or bio-inspired algorithms (Genetic Algorithms, Evolutionary Computation, Ant Colony Tabu Search and Particle Swarm) have emerged to give very interesting solutions to the decision maker, giving advantages over conventional methods in terms of computational time and robustness against system parameters variation. The faced problems could be treated with multi-objective functions and all the intelligent algorithms have been adapted to deal with.

This presentation lists some applications of computational intelligence algorithms to different areas in power systems operation and control, carried out with real large interconnected power systems and validated with commercial tools and ISO Data.

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Paper reference
SSD'15-KL-PES-2

Renewable Energy and Water Systems Designed and Managed as an Integrated Efficient System

Jamel Belhadj
(University of Tunis, Scientific Research and Technology, Tunisia)

Abstract

Water and energy availability is a global concern, most in particular in regions as the ones around the Mediterranean Sea not connected to the electricity grid. In parallel with the energetic problem, water is a major challenge not only for regions with a warm climate or semi-arid and arid regions.

The integration of multi-source renewable, such as stand-alone hybrid photovoltaic-wind system with or without electrochemical storage, has acquired a relative maturity in recent years, both from a scientific or technological point of view.The same for water systems when they are studied separately.

Actually, we develop original systemic methods to design and study, water and energy as an integrated system. The results are not the same when we design each part separately.The principal interests of such a system are the clean production on the place of consumption, the mutualisation of resources, energy and/or water storage, and the security of supply. The design method is based on a systemic view of point for the architecture, the sizing and energy management strategies, with experimental validation. An interest application of hybrid system dealing with water pumping and/or desalination is presented; witch represent an original problem when the problem of water and energy are related together especially for the electrical and hydraulic remote area. A particularly interest is dedicated for the development of a real time supervision and the energy and water management of the integrated system.

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Paper reference
SSD'15-KL-CSP-CIT-1

Possibilistic Scene Interpretation

Basel Solaiman
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Abstract

Scene interpretation is defined as the process, based on expert's fixed goals, and allowing the automatic extraction of meaningful semantic information content by the application of image analysis and image understanding approaches as well as the use knowledge representation and reasoning techniques. Several approaches of scene interpretation have been proposed. Most of these approaches use hierarchical interpretation strategy using different semantic levels of detail. Two major scene interpretation strategies are already proposed: Image-driven and model-driven scene interpretation strategies. In image-driven scene interpretation, also referred to as bottom-up strategy, processing proceeds from digital images to features components extraction (partitioning the observed image into meaningful features such as segments, lines, regions, objects...) to features description and characterization, and finally to features recognition (assigning semantic labels to each feature component based on its intrinsic attributes or its context with respect its neighboring features). On the other hand, model-driven, or top-down strategy, consists on the use of a set of assumptions/properties/models of expected scene contents, i.e. feature components such as regions, objects... The properties of these feature components are tested against a set of feature component prior models, or representations, of ever decreasing levels of abstraction. Through a series of test/validate processes, one eventually reaches an interpretation at the parent image semantic level.

Major difficulties in scene interpretation are related to: the knowledge representation of different elements constituting the scene (pixels, regions and objects) as well as the relationships between these elements; the interpretation strategy; and, the management of different forms of information imperfections related to the used data, sensors as well as the knowledge injected by the experts.

Main challenges in the field of scene interpretation are:

- Knowledge representation, i.e. how to model prior knowledge about possible scene description?
- Hypotheses matching, i.e. how to match possible scene descriptions against incomplete and erroneous detections of objects in an image?
- Inference, i.e. how to derive inferences from prior knowledge in order to improve and complete the scene description?

Two types of knowledge can be exploited in scene interpretation approaches:

- Descriptive knowledge related to the used sensors as well as the expert's knowledge. This knowledge may be given/expressed through different forms (symbolic or numeric), and may suffer from different forms of imperfection (uncertainty, ambiguity, missing data, reliability...);
- Operational knowledge related to the proposed methods and algorithms allowing to extract meaningful information from the observed image analyzing;

It is worthwhile to notice that human knowledge is generally expressed using epistemic terms not only because they are the most common form for the representation of human knowledge but because our knowledge about many aspects is ambiguous. Keeping this observation in mind, the presented research work proposes a possibilistic-based scene interpretation approach that can embrace human-like intelligence in image understanding and scene interpretation as we humans do.

This presentation is organized as follows. After the presentation of the scene interpretation concepts, a brief introduction to the possibility theory is given. The application of possibilistic knowledge representation and reasoning mechanisms into the major scene semantic levels (i.e. sub-pixel, pixel, region, object and global scene) is detailed using two real-world scene cases: environmental scene observed using multispectral remote sensing imaging, and a medical scene concerning mammographic median imaging. Results and research openings are detailed and discussed.

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SSD'15-KL-CSP-CIT-2

POPS-OFDM: Ping-pong Optimized Pulse Shaping OFDM for 5G Cellular Systems and Beyond

Mohamed Siala
(Sup'Com, Tunis, Tunisia)

Abstract

Next generation mobile communication systems will face stringent propagation conditions ranging from large Doppler spreads in frequency to excessive multipath spreads in time, both of which can be of natural or artificial origins. First of all, natural severe Doppler dispersions are to be experienced in next generation mobile communications because of expected high speed mobility as well as the use of new frequency bands beyond those used today. Secondly, slower loops for time advance and frequency control, needed to alleviate the synchronization overhead burden for very small packet communications, needed in low latency applications of tactile internet, will incur severe synchronization errors especially in the time domain. Last but not least, the use of the CoMP (Coordinated Multi-Point) technique, in its JP (Joint Processing) version, and the MBMS (Multimedia Broadcast Multicast Service) services in LTE, and its SFN (Single Frequency Network) counterpart in DVB-T, will cause severe artificial time dispersions that cannot be tackled by today cyclic prefix OFDM systems.

Unfortunately, conventional OFDM with CP (Cyclic Prefix) can no longer cope with these severe and challenging impairments, which will for sure be faced by 5G systems and beyond. The proposed solution, subject of the keynote speech, is to have recourse to pulse shaped (PS) OFDM. The idea behind PS-OFDM is to use non-perfectly orthogonal waveforms, unlike those of conventional OFDM, which can however better stand against time and frequency channel distortions.

After presenting an overview of conventional OFDM with guard interval insertion, with both its PC and ZP (Zero Padding) versions, and OFDM/OQAM, we present a new paradigm for simple and systematic pulse shape optimization for any given channel impairments: POPS-

OFDM (Ping-pong Optimized Pulse Shaping OFDM). We show how the new waveforms can withstand these impairments, how we benefit from an increased robustness to unexpected time and frequency synchronization errors, and how we can dramatically reduce out of band spurious emissions for a peaceful coexistence of adjacent frequency and power uncoordinated transmissions.

We finish this speech by presenting several perspectives for pulse shaping, pertaining to partially equalized OFDM, multi-pulse OFDM and single- and multi-pulse OFDM/OQAM.

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Paper reference
SSD'15-KL-SCI-1

Technologies and Applications of Photovoltaic Solar Cells

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(Electronic Research Group, Philadelphia University, Jordan)

Abstract

There are four main types of renewable energies; solar energy, wind energy, hydro and geothermal energy and biomass energy. Solar energy, in one form or another is the source of nearly all energy on the earth. Photovoltaics (PV) are a simple, practical and elegant method of harnessing the sun's energy. PV devices (solar cells) are unique in that they directly convert the incident solar radiation into electrical power, with no noise, pollution or moving parts, making them robust, reliable and long lasting. Solar cells are based on the same principles and materials behind the communications and computer revolutions. This presentation covers the operation, use and applications of photovoltaic devices and systems. Mainly there are two types of photovoltaic devices; crystalline silicon (monocrystalline and polycrystalline) and thin-film solar cell devices.

Unlike monocrystalline-based solar panels, polycrystalline solar panels do not require the Czochralski process. Raw silicon is melted and poured into a square mold, which is cooled and cut into perfectly square wafers. The process used to make polycrystalline silicon is simpler and cheaper. The amount of waste silicon is less compared to monocrystalline. On the other hand the efficiency of polycrystalline-based solar panels (typically 13–16%) is lower than monocrystalline because of lower silicon purity. It is generally needed to cover a larger surface to output the same electrical power as compared with a solar panel made of monocrystalline silicon.

Depositing one or several thin layers of photovoltaic material onto a substrate is the basic gist of how thin-film solar cells are manufactured. The different types of thin-film solar cells can be categorized by which photovoltaic material is deposited onto the substrate, namely: Amorphous silicon (a-Si), Cadmium telluride (CdTe), Copper indium gallium selenide (CIS/CIGS) and Organic photovoltaic cells (OPC). Depending

on the technology, thin-film module prototypes have reached efficiencies between 7–13% and production modules can operate at about 9%. Future module efficiencies are expected to climb close to the about 10–16%. The advantage of thin film solar cells that mass-production is simple. This makes them potentially cheaper to manufacture than crystalline-based solar cells. Also high temperatures and shading have less impact on solar panel performance. The main disadvantages of these systems although they are cheap, but they also require a lot of space as compared with crystalline devices. Also thin-film solar panels tend to degrade faster than mono- and polycrystalline solar panels, which is why they typically come with a shorter warranty.

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Paper reference
SSD'15-KL-SCI-2

Monitoring of Land Degradation From Space: an Integrated Approach of Remote Sensing and In-Situ Measurements

Moncef Bouaziz
(Technical University of Dresden, Germany)

Abstract

Soil degradation limits plant growth, reduces crop productivity and degrades soil. We conducted a remote sensing analysis to discern features and patterns of degraded soils. Hyper- and multi-spectral data are used within different spatial and spectral resolution. A remote sensing classification of the degraded soilsand Land use was made using Maximum likelihood, Support Vector Machine, and Minimum Distance. Computed accuracy from the classification varied between 46% and 75%. Support Vector Machine gave the best results in extracting the patterns and features of eroded and saline soil classes (kappa coefficient of 63% and overall accuracy of 75%). To generate a predicted salinity map, a multiple linear regression, based on the best-correlated indices is conducted. Spectral indices were also used to characterize degraded soils. The Linear Spectral Unmixing technique (LSU) is applied in this research work to improve the prediction models of degraded soils. The developed remote sensing models enable us to highlight areas in immediate need of conservation strategies and control further soil degradation.

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Paper reference
SSD'15-SAC-1-1

The compass-like biped robot revisited

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Ahmed Chemori (LIRMM-CNRS / University Montpellier 2, France),
Moez Feki (University of Sfax, CEMLab, ENIS, Sfax, Tunisia)

Abstract

When dealing with passive walking, it has been proved in the literature that the compass-like biped robot can walk down without actuation and with a stable gait. However, the stability of gait is very sensitive to disturbances such as ground irregularity, default in manufacturing, etc. Thus, in this paper, we propose an approach to control the biped robot gait when it has disturbance. This approach benefits from the characteristics of the undisturbed passive gait, in the aim of stabilizing the disturbed one. Indeed, initially, the proposed approach considers the state variables of the passive gait as references. Next, it predicts them for every walking step. After that, the predicted model is considered by the controller to compute the joint torque. As result, The robot would generate an active dynamic walking (ADW) identical to the passive dynamic walking (PDW) and the error between the current state trajectories and the reference trajectories will be canceled. The prediction was performed by two mathematical functions which are set of Fourier series and polynomial functions. The proposed approach is based on an inverse dynamics controller, evaluated through numerical simulations and compared with another approach based on energetic control.

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Paper reference
SSD'15-SAC-1-2

Tensor-based methods for Wiener and Hammerstein channels identification

Zouhour Ben Ahmed (University of Sfax, CEMLab, ENIS, Sfax, Tunisia),
Gérard Favier (Université de Nice Sophia-Antipolis France),
Nabil Derbel (University of Sfax, CEMLab, ENIS, Sfax, Tunisia)

Abstract

In this paper, we propose tensor-based methods for identifying nonlinear communication channels of Wiener and Hammerstein. For a Wiener channel, the parameters of linear subchannel are estimated using two different approaches based on the PARAFAC decomposition of the associated fifth-order Volterra kernel. The first approach is to apply the iterative ALS algorithm, while the second approach uses the SVD of the fifth-order Volterra kernel. For Hammerstein channel, we propose an approach based, also, on the fifth-order Volterra kernel. Then, the coefficients of nonlinear subchannels modeled as a polynomial, of both channels, are estimated by means of the RLS algorithm. The proposed identification methods is illustrated by means of simulation results.

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Paper reference
SSD'15-SAC-1-3

Master-Slave Controlled Synchronization to Control Chaos in an Impact Mechanical Oscillator

Hassène Gritli (Ecole National d'Ingénieurs de Tunis, Tunisia),
Safya Belghith (SYSCOM Laboratory/ ENIT, Tunisia)

Abstract

This work aims at controlling chaos exhibited in the impulse hybrid dynamics of a 1DOF impact mechanical oscillator by achieving a master-slave controlled synchronization. Our objective is to synchronize the motion of a chaotic slave impact oscillator with that of a periodic master impact oscillator via an external control input. The master-slave synchronization problem is reformulated as the stabilization of the synchronization error by means of a state-feedback controller. For the design of the control input, we deal only with the linear dynamics of the two systems during their oscillation phase. Our fundamental approach hinges mainly on the use of the S-procedure in order to reduce the conservatism of the classical Lyapunov approach. We employ also the Schur complement and the Matrix Inversion Lemma in order to transform a BMI into a LMI. We show the effectiveness of the proposed method for the control of chaos by applying the designed control input to the chaotic impact oscillator.

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Paper reference
SSD'15-SAC-1-4

Synchronization of chaotically behaving two permanent magnet synchronous motors using adaptive controller

Sana Ben Jemaâ, Moez Feki
(University of Sfax, CEMLab, ENIS, Sfax, Tunisia)

Abstract

This paper proposes a novel adaptive feedback controller to synchronize two identical chaotic Permanent Magnet Synchronous Motors (PMSM) starting from different initial conditions. The controller consists in determining an adaptation law to tune the controller gain vector in order to track a predetermined linearizing feedback control. Convergence of the closed-loop system responses is proved based on Lyapunov approach. The proposed scheme does not require knowledge of exact model of PMSM. Simulation results demonstrate that the constructed controller can ensure perfect synchronization even under parameters variation and disturbances.

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Paper reference
SSD'15-SAC-2-1

Identification of an Irrigation Station Using Hybrid Fuzzy Clustering Algorithms Based on Particle Swarm Optimization

Jaouher Chrouta
(C3S/ENSIT, University of Tunis, Tunisia)

Abstract

Fuzzy c-means (FCM) and Gustafson-Kessel (GK) algorithms are the best popular fuzzy clustering techniques in terms of efficient, straightforward, and easy to implement. However, these algorithms are sensitive to initialization and easy to trap in the local minimum. The important issue is how to avoid getting a bad local minimum value to improve the cluster accuracy. In fact, the particle swarm algorithm is strong global searching ability which is based on swarm operation, it doesn't easily get into the local minimum and has a fast convergence speed. In order to overcome the weakness of traditional clustering algorithms and takes advantage of PSO, we integrate FCM and GK algorithms with fuzzy particle swarm algorithm (FCM-PSO and GK-PSO algorithms). In this paper, hybrid fuzzy clustering algorithms based on FCM, GK and PSO called FCM-PSO and GK-PSO are presented. A comparative study between the clustering algorithms is investigated to identify the parameter of irrigation station. Experimental results applied to the irrigation station show that the GK-PSO algorithm is more effective and robust compared to the other algorithms.

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Paper reference
SSD'15-SAC-2-2

Parameter Identification for Nonlinear Biological Phenomena Modeled by S-systems

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Onur Avci (Qatar University, Qatar),
Hazem N. Nounou and Mohamed Nounou
(Texas A&M University at Qatar, Qatar)

Abstract

For computational modeling of biological systems, one of the major challenges is the identification of the model parameters. It is very beneficial to use easily obtained measurements and estimate variables and/or parameters in such systems. For instance, time-series dynamic genomic data can be used to develop models representing dynamic genetic regulatory networks. These models can be used to design intervention strategies such as understanding the biological system behavior and curing major illnesses. The study shown in this paper focuses on the parameter identification of biological phenomena modeled by S-systems using Particle Filter (PF). While the nonlinear observed system is assumed to progress according to a probabilistic state space model, the results show that the PF has good convergence properties. It is concluded that the good convergence is due to PF's ability to deal with highly nonlinear process models.

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Paper reference
SSD'15-SAC-2-3

Modeling and Identification of a Ship Propelled by Two Water Jets

Samir Nejim (Académie Navale & Unité de Recherche en Automatique et Robotique Marine, Tunisia),
Hassène Rebhi (U.R. Automatique et Robotique Marine, Tunisia)

Abstract

This paper deals with a simplified approach to modeling and parameters identification of the dynamics of a ship propelled by two water jets.The inputs are the commands to apply to the water jets including the two engines, the steering and reversing unit for each jet. The outputs of the studied system are variables that characterize the kinematics and the motion of the boat such as the speed, the heading, the course and the position in the horizontal plan. First a nonlinear model is found, then the parameters are identified based on sea trials data. Finally the model is validated by simulation using Matlab and Simulink in order to perform some control methods in a future work.

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Paper reference
SSD'15-SAC-2-4

Sliding Window Identification with Linear-Equality Constraints

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Mounir Ayadi (National Engineering School of Tunis, Tunisia),
Frederic Rotella (National Engineering School of Tarbes, France)

Abstract

In this paper, we present a new algorithm of sliding window identification with linear-equality constraints. This algorithm consists in firstly deleting the oldest set of data and in secondly adding the last set of data. The method developed in this paper allows to consider at every step a set of new data by an extension of their result. The proposed algorithm is based on the recursive calculus of the pseudo-inverse matrix from the forms of Albert and Sittler. A simple and easily implementable initialization of the constrained algorithm is proposed. An improvement is obtained by removing the influence of oldest set of data and by satisfying the linear-equality constraints. It is shown that the solutions of the sliding window identification algorithm converge to the true parameter that satisfies the equality constraints. Numerical example is provided to show the effectiveness of the proposed method.

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Paper reference
SSD'15-SAC-2-5

Bi-Axis Control Algorithm to Generate Manuscript Shapes from Mathematical Handwriting Model

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Afef Abdelkrim (Ecole Supérieure de Technologie et d'Informatique & Ecole Nationale d'Ingénieurs de Tunis, Tunisia),
Mohamed Benrejeb (ENIT, University of Tunis, Tunisia)

Abstract

The study of the human handwriting process shows that bell-shaped velocity profiles are generally observed in the handwriting motion. In this paper, a mathematical model using input and output data relative to two forearm muscles activities, named, ElectroMyoGraphic signals (EMG) and velocities of a pen tip moving on (x, y) plan is proposed. Using the outputs of this model, we also propose a novel bi-axis control algorithm to generate handwritten graphic traces obtained from the mathematical velocity model. The cascading validation between these approaches allows to control the handwriting process and to generate graphic traces only from the forearm activities. The effectiveness of this approach should be observed on predicting different cursive Arabic letters and geometric shapes constituting the recorded experimental basis.

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Paper reference
SSD'15-SAC-2-6

Identification of Hammerstein Nonlinear Systems with Delayed Input

Asma Atitallah (ENIG, Tunisia),
Kamel Abderrahim (ISSIG, University of Gabès, Tunisia),
Saida Bedoui (ENIG, Tunisia)

Abstract

This paper focuses on the identification problem of Hammerstein nonlinear systems with delayed input. This problem involves both the estimation of the time delay and the parameters by applying respectively the Variable Regression Estimation technique (VRE) and the gradient approach. Simulation results are presented to illustrate the the performance of the proposed method.

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Paper reference
SSD'15-SAC-3-1

Attitude Observers for Accelerated Vehicles Using IMU and GPS Measurements

Saliha Bencheikh (SAAD DAHLEB University, Algeria),
Salim Ibrir (King Fahd University of Petroleum and Minerals, Saudi Arabia),
Salah Boukraa (Saad Dahleb University, Algeria)

Abstract

In this paper, we present two new nonlinear attitude observers for accelerated vehicles moving in $3-D$ space using GPS velocity and IMU measures. These observers are developed based on the idea that for highly dynamic motions, the acceleration or the error affecting acceleration can be strongly related to dynamic changes of velocity errors. The two observers have ensured the convergence to zero of error in very short time and for any almost initial conditions. Conditions are given to guarantee the asymptotic stability of the system. Simulation results have proven the better performance of these observers compared to results obtained by other observers recently developed in the literature.

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Paper reference
SSD'15-SAC-3-2

High Gain Observer Based Higher Order Sliding Mode Control: Application to an Induction Motor

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Faouzi M'Sahli (University of Monastir & National School of Engineers of Monastir, Tunisia)

Abstract

In this paper, a novel Higher Order Sliding Mode Control (HOSMC) for uncertain nonlinear systems is presented. The proposed controller allows obtaining an exponential stability as well a finite time convergence to the sliding surface and guarantees robustness against uncertainties and external matched disturbances. Furthermore, the synthesis of the control law depends explicitly on the states of the system. But, in practice, most of systems admit one or more unknown states. Such problem represents a serious drawback when implementing the controller in real time. To solve this problem we incorporate a High Gain Observer (HGO) into the controller to estimate the missing states. These techniques of control and observation are applied to an induction motor system. Numerical simulations are developed to show the effectiveness of the resulting controller.

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Paper reference
SSD'15-SAC-3-3

Design of Unknown Inputs and Multiple Integral Observers for Takagi-Sugeno Multiple Model

Wafa Jamel (LARATSI, Tunisia),
Atef Khedher (ENIT, Tunisia),
Nasreddine Bouguila (LARATSI, Tunisia),
Kamel Benothman (LARA Automatic, Tunisia)

Abstract

In this paper, a proportional multiple integral observer (PMI) and a proportional integral observer with unknown inputs (PIUI) are proposed in order to estimate the state, the actuator and the sensor faults of nonlinear systems described by a Takagi-Sugeno multiple model. The convergence of the estimation errors between the system and each observer are studied using the Lyapunov theory. Academic examples are provided in order to illustrate the proposed methods. A comparaison between the two observers is made through mobile robot.

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Paper reference
SSD'15-SAC-3-4

Design of an ARX-Laguerre Based Proportional Observer

Hassene Bedoui (LARATSI-ENIM, Tunisia),
Anis Khouaja (ISSAT SOUSSE, Tunisia),
Kamel Benothman (LARA Automatic, Tunisia),
Hassani Messaoud (ENIM, Tunisia)

Abstract

A new ARX-Laguerre representation is recently built to model the dynamics of complex physical processes. The ARX-Laguerre models have proven their ability to accurately suit the behavior of systems. In this work, the model is exploited to diagnose the system by detecting its defaults. In this paper we build a proportional observer based on the ARX-Laguerre model. Therefore, the designed observer exploits the inputs and outputs of the Laguerre-ARX model to reconstruct the Laguerre filter outputs. The observer gain is calculated to ensure a fast asymptotic convergence of the estimation error. A simulation example is achieved to illustrate the ability of the proposed approach to estimate the Laguerre filter outputs.

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Paper reference
SSD'15-SAC-3-5

Nonlinear High Gain Observers for a Semi Continuous Stirred Tank Reactor

Amira Abdelkader
(ENIG, Tunisia)

Abstract

In this paper, two versions of nonlinear high gain observer are developed to reconstruct the full state of an olive oil waste esterification process. This operation is taking place in a Semi Continuous Stirred Tank Reactor (SCSTR). The plant model, is one of the most important plant in chemical processes, presents a high level of non linearities and interconnections between states. We will show the necessary steps required to move from differential algebraic model to a differential model. We show in this work that it is possible to synthesis a two versions of high gain observer for a multi input multi output system and ensure good applicability of a such observer. The results are validated on a real measurements of the plant. A performances' comparison between the two proposed observers is given.

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Paper reference
SSD'15-SAC-3-6

Robustness Enhancement of Proportional *Q*-Integral Multiobserver in the Case of Non-Stationary Sinusoidal Unknown Inputs

Mouhib Allaoui (National Engineering School of Gabes, Tunisia),
Anis Messaoud (Research group CONPRI-ENIG, Tunisia),
Ridha Ben Abdennour (University of Gabes, Tunisia)

Abstract

This paper deals with the robustness enhancement of proportional Q-integral multiobserver in the case of non-stationary sinusoidal unknown inputs. The multimodel approach is proposed in order to overcome the complexity problems of nonlinear systems. The proposed multiobserver uses the multi-integral strategy in order to provide a simultaneous estimation of the state and unknown inputs. A new robust strategy allowing the minimization of the non-stationary sinusoidal unknown inputs impact on the estimation error is developed. The significance of the proposed study is illustrated via a simulation example.

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Paper reference
SSD'15-SAC-3-7

State Estimation for Switched linear systems

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Kamel Abderrahim (ISSIG, University of Gabès, Tunisia)

Abstract

In this paper, we address the problem of state estimation of linear switched discrete time models from a finite set of input-output data. This is a challenging problem since it requires estimating the active discrete state and its continuous observer. In fact, we propose a hybrid state observer design which consists of two stages. The first allows to determine the active discrete state using a classification algorithm that associated the current data to its appropriate submodel. The second stage is used to estimate the corresponding continuous observer. Simulation results are presented to illustrate the performance of the proposed method.

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Paper reference
SSD'15-SAC-4-1

Control of Nonholonomic Mobile Robot Based on Immersion and Invariance Adaptive Control

Sami El Ferik and Imil Hamda Imran
(King Fahd University of Petroleum and Minerals, Saudi Arabia)

Abstract

This paper deals with control of nonholonomic mobile robot using Immersion and Invariance (I&I) adaptive control. I&I is a framework for adaptive stabilization of nonlinear systems with uncertainties parameter. We investigated the tracking control of nonholonomic mobile robot with uncertainties in dynamic and kinematics. We applied I&I adaptive control to control the angular and linear velocity of nonholonomic mobile robot. In this paper, we showed the integration of kinematic controller and torque controller for nonholonomic mobile robot. We investigated the control performance of nonholonomic mobile robot using I&I adaptive control. The results demonstrate the ability of I&I adaptive control as system velocity control of nonholonomic mobile robot.

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Paper reference
SSD'15-SAC-4-2

Improved Peg-in-Hole (5-Pin Plug) Task: Intended for Charging Electric Vehicles by Robot System Automatically

Mohamad Bdiwi (Fraunhofer Institute for Machine Tools and Forming Technology IWU, Germany),
Alexander Winkler, Michael Jokesch and Jozef Suchý
(Chemnitz University of Technology, Germany)

Abstract

This paper deals with establishing of the electrical connection between a plug and a receptacle by a robot manipulator for the purpose of charging electrical vehicles. In general, the task of the robot for automatic charging of vehicles consists of two phases. In the first phase, the robot system de

fines the position of the charging receptacle of the vehicle using vision or infrared system. After that in the next phase, it starts to interact with the environment by connecting the charger plug to the charging receptacle (socket) of the vehicle. However, this phase is not always performed successfully, especially when the socket has complicated shape or consists of multi cores with different sizes. In this paper we will use robot force control to build up the connection. Additionally, an algorithm will proposed which improves the peg-in-hole task by generating spiral motion. The proposed algorithm has shown promising results performed on 5-pin industrial charger plug which is very hard to peg in the socket, even for the human, because it is secure and weatherproof (the plug should cover the whole socket cavity), moreover it has multi cores (5-pins) and it is provided with multiple notches to avoid mismatching between similar pins. In addition to that, the proposed algorithm has assumed that a small vision error could be occurred during estimating the initial position of vehicle's receptacle.

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Paper reference
SSD'15-SAC-4-3

The Sigma-Point Central Difference Smooth Variable Structure Filter Application Into a Robotic Arm

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Mohammed Bani Younis (Philadelphia University Jordan, Jordan),
Khaled Hatamleh (Jordan University of Science & Technology, Jordan)

Abstract

Recent Mobile-robots/Robotic-manipulators based industrial applications require accurate control over sinusoidal trajectory functions, under blurry and noisy feedback signals. As a result, there is an increasing demand for new estimation techniques and filters to overcome accompanying system nonlinearities. Industrial applications control quality will improve if a robust filter is used to reduce the effect of noise and to improve the quality of feedback signals. In this work, a new filter that combines the Smooth Variable Structure Filter (SVSF) with the Central Difference Kalman Filter (CDKF) is proposed. The presented method results in robust, stable and accurate estimation algorithm for motion states and feedback signals. Results are demonstrated by applying the proposed filter to estimate the states of a PRRR industrial robotic arm.

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Paper reference
SSD'15-SAC-4-4

PSO-CF2: A new method for the path planning of a mobile robot

Safa Ziadi, Mohamed Njah (ENIS, Tunisia) and Mohamed Chtourou
(University of Sfax, CEMLab, ENIS, Sfax, Tunisia)

Abstract

The PSO based-Canonical Force Field (PSO-CF^2) method is a novel approach of mobile robot path planning with collision avoidance. The variation of CF^2 parameters is however vital to its performance. In this paper, we used the multi-objective Particle Swarm Optimization Canonical Force Field (PSO-CF^2) technique to search for the best combination of these parameters that minimize the robot path length and maximize the safe distance between the robot and the obstacles. Simulations are carried out in various environments (one obstacle, two obstacles and multi-obstacles). The results of these simulations show the feasibility of this approach in the path planning of a Mobile Robot.

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Paper reference
SSD'15-SAC-4-5

A Local Obstacle Avoidance Control Law for Mobile Robot Navigation Based on Beam Curvature Method

Faten Cherni, Yassine Bouteraa, Chokri Rekik and Nabil Derbel
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Abstract

This paper focuses on the based Beam Curvature Method for two wheeled mobile robot navigation in partially known environments. Local obstacle avoidance problem by indoor mobile robots has been a well-researched subject by several robotics researchers. There are various reactive strategies which operate in the velocity space such as the Dynamic Windows Approach (DWA), the Curvature Velocity Method (CVM), the Lane Curvature Method (LCM) and the Beam Curvature Method (BCM).These approaches formulate the local obstacle avoidance problem and take into account the robot dynamics and environment physical constraints. In this paper we present a comparison between two methods based on the Beam Curvature Method and the Dynamic Window Approach.

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Paper reference
SSD'15-SAC-5-1

Performances Compared to the Sliding Mode and Gain Scheduling Control Methods of a CSTR Chemical Reactor

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Abstract

For many years, the sliding mode control has been deemed as one amongst the most studied control domains. Indeed, the power and simplicity that characterize such a control are the essential coerces which often push us to search for this technique thoroughly.When synthesizing the sliding mode control law, the sliding surface is usually defined as an autonomous and stable nonlinear system. Nevertheless, the dynamics imposed by such a system is slower than that imposed by a nonlinear system. Therefore, the use of this type of systems to synthesize the sliding surface in certain applications hase becomes increasingly important. This type of system is also utilized for the gain scheduling control. The very control is combined with the feedback linearizing. Indeed, the synthesized control is mainly based on the reverse trajectory method which allows estimating the domains of attraction around the operating points. In this work, as a matter of fact, we are inclined to the synthesis of control laws of a chemical reactor. In this respective, an approach to the sliding mode control is applied. Another approach to the gain scheduling control is also proposed and is, successful, applied to the considered system. The performances of both control laws are, then, compared in terms of trajectory tracking.

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Paper reference
SSD'15-SAC-5-2

High Gain Observer for Nonlinear System: Application to System of Waste Water Treatment

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Abstract

In this paper, observers design for a class of nonlinear systems has been investigated. Over the last decades, tremendous research activities focus on observer design for nonlinear systems can be shown through the vast literature in this field. Also, waste water treatment process models have become a major tool to design control schemes. So, a model of waste water treatment plants was developed to describe the concentration's behavior. And the nonlinear observer is applied to estimate the states in system of waste water treatment plants whose substrate concentration and biomass concentration.

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Paper reference
SSD'15-SAC-5-3

Single-Input T-S Fuzzy Logic Controller for the MPPT of Photovoltaic System

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Abstract

The aim of this paper is to design an intelligent control such as a Takagi-Sugeno fuzzy logic controller (T-S FLC) for the Maximum Power Point Tracking (MPPT) of a photovoltaic system under variable temperature and irradiance and load change. In order to accelerate the time of calculation we used single input at the fuzzy controller which reduces the number of fuzzy rules to the number of the used membership functions. Moreover to expand or shrink the division of the membership functions; we introduced three modified parameters, this lets us have a good precision in the MPP. Finally the effectiveness of the proposed approach of single input T-S FLC is demonstrated by simulation results for the PV system consists of a PV generator, BOOST chopper and a resistive load.

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Paper reference
SSD'15-SAC-5-4

Explicit Model-Predictive Control of Hybrid Dynamical Systems: Application to a Two-Tank System

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Yosra Hammi (Automatic, Tunisia),
Ali Douik (National Engineering School of Sousse, Tunisia)

Abstract

In this paper, we consider the solution of explicit model predictive control problem for piecewise affine systems in order to compare the results for the quadratic criterion and the linear one. Two issues are addressed: First, we start by computing the solution of the considered problem and determine the structure of the control law. Thereafter, we aim to reduce the complexity of the obtained control law to improve system performance in terms of number of polyhedral regions and computation time.

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Paper reference
SSD'15-SAC-5-5

Cascade Unknown Input Observers Applied to a Quadruple Tank Process

Feten Smida and Salim Hadj Said (ENIM, Tunisia),
Faouzi M'Sahli (University of Monastir & National School of Engineers of Monastir, Tunisia)

Abstract

A technique of nonlinear unknown input observer (UIO) is developed for a large class of MIMO nonlinear systems in order to simultaneously estimate the whole state as well as the unknown inputs. In fact, for every unknown input a high gain observer (HGO) is created, these observers put on cascade to simultaneous estimation the non measured states and the unknown inputs. The process investigated herein is the quadruple tank process (QTP) that has been introduced in the laboratories of many schools as a didactically multivariable system. It is a benchmark for testing advanced algorithm of control and observation. In this work, the flow rates of moto-pump conjointly with a liquid level are estimated using UIO.

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Paper reference
SSD'15-SAC-6-1

Stiction Compensation Using PI-Sliding Mode Control for Pneumatic Valve

Sami El Ferik, Tri B. Susilo,
Muhammad Fahrudin Muna and Imil Hamda Imran
(King Fahd University of Petroleum and Minerals, Saudi Arabia)

Abstract

Oscillations in process control loops greatly affects the performance of the controller and lead to a waste of energy, an increase of process variability, and a severe degradation of product quality. Such oscillations are either the result of badly tuned controller or produced by the undesirable presence of a nonlinear element. Stiction valve due to wear and tear or due to mishandling of the actuator is an example of malfunction control loop component that leads to such situation. Stiction problem is by far the most frequent anomaly in process and control. In this paper, we propose a new method to compensate for valve stiction, reduce the variability of the process, and increase the life cycle of the valve. Therefore, a new approach based on sliding mode control is applied to compensate for an unknown valve stiction degree. The performance of the new approach is presented through various simulation results which demonstrate the strength of the approach when compared to recent published methods.

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SSD'15-SAC-6-2

Second Order Sliding Mode Control for Inverted Pendulum

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(National Engineering School of Monastir, Tunisia),
Ali Douik
(Ecole Nationale d'Ingénieurs de Monastir, Tunisia)

Abstract

This paper presents a second order sliding mode control for an inverted pendulum which is a nonlinear and unstable system. Two second order sliding mode algorithms are presented: Twisting algorithm and super-twisting algorithm. They are used to ensure not only a better robustness against parametric uncertainties, modeling errors and external disturbances, by the attenuation of chattering, but also a finite time convergence of state variables. Simulations results are shown to manifest the efficiency of these approaches.

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Discrete Input-Output Second Order Sliding Mode Control Using LMIs Approach

Khadija Dehri (ENIG, Tunisia),
Houda Romdhane (National Engineering School of Gabes, Tunisia),
Ahmed Said Nouri (University of Gabès, Tunisia)

Abstract

During the reachability phase, the sliding mode control is sensitive to external disturbances and uncertainties. In this paper, we propose to determine the coefficients of the sliding function using the technique of Linear Matrix Inequalities. This technique leads to an optimal choice of sliding function. Using the proposed sliding function, a discrete second order sliding mode control is presented. The control law is based on an input-output model. Simulation results demonstrate that the proposed strategy leads to an optimal performances in terms of the reduction of the reachability phase and the chattering phenomenon.

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Paper reference
SSD'15-SAC-6-4

On the High Order Sliding Mode Control of a R/W Head Track Following in Hard-Disc-Drives

Manel Taktak-Meziou and Nabil Derbel
(University of Sfax, ENIS, CEMLab, Tunisia)

Abstract

In this paper, a Sliding Model Control (SMC) is proposed to deal with a track following problem of a single stage-Voice-Coil (VCM) Motor of a Hard-Disc-Drive (HDD). As to offer a chattering free motion of the HDD due to the presence of hysteresis, the SMC can be improved using a higher order version to enhance the accuracy, the speed and the robustness of the closed-loop system. The two control approaches were tested and compared in nominal conditions as well as situations including external punctual and persistent disturbances. Such a comparative study, as never been conducted before on such a system, aims to highlight the efficiency of the Higher Order Sliding Mode Control (HOSM) controller to achieve good tracking performances.

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Modified DTC Control Using Fuzzy Logic Control for Dual Three Phase Induction Machine With Open Phases

Abir Belgacem, Yemna Bensalem and Mohamed Naceur Abdelkrim
(Ecole Nationale d'Ingénieurs de Gabès (ENIG), Gabes University, Tunisia)

Abstract

The aim of this paper is to control a dual three induction motor drives under open phases. The DTC is a variable structure control strategy with simplicity, fast response, and tolerance to motor parameter variation, which provides direct control of stator flux and electromagnetic torque by optimally selecting the inverter states in each sampling period. Conventional DTC of dual three induction motor has the limitations of constant duty ratio for every switching period and high torque and flux ripples. To solve these problems and ameliorate the performances of this control method, a fuzzy logic controller is used instead of the hysteresis torque and flux controller to minimizing the torque and flux ripple. The faulted mode of the six phase induction machine leads to torque oscillations and poor tracking behavior. In this way, this paper presents a new modified fuzzy DTC for dual three phase induction motor under open phase. The performance of the modified fuzzy DTC is evaluated through simulation and it is shown to be superior to the conventional DTC in term of minimization the torque and flux ripple under open phase.

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Paper reference
SSD'15-SAC-7-2

New Condition of Stabilization for Non Linear Takagi-Sugeno Discrete Time Uncertain System

Ali Bouyahya
(University of Tunis El Manar, Tunisia)

Abstract

This paper deals with the control law design with state feedback, and give a new approach of stabilization of discrete time Takagi-Sugeno uncertain fuzzy system. Using non quadratic Lyapunov function, the new condition of stabilization is used in terms of linear matrix inequalities LMIs. By using the simulation we verify the robustness of this approach.

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Paper reference
SSD'15-SAC-7-3

Driving Style Assessment Based On the GPS Data and Fuzzy Inference Systems

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Abstract

Car insurance can be computed according to the client's driving behaviour. This option is based on algorithms which use data from the black box. To carry out the monitoring function, the black box integrates an Inertial Navigation System (INS) sensors, a Global Positioning System (GPS), which are Micro Electromechanical Systems (MEMS) based and a flash memory. Researchers were interested in driver behaviour modeling by means of Kalman Filtering (KF) and Hidden Markov Modeling (HMM) and most of them are based only on the driver's acceleration profile during a period of time. This research paper expands the number of parameters, by adding the jerk, to estimate the driver aggressiveness. It proposes two approaches for driving behaviour supervision based on the vehicle velocity signal which is acquired from the Global Positioning System (GPS). The first approach presents three driving behaviour indicators based on the vehicle acceleration and jerk. Simulation results show some weaknesses in terms of driver aggressiveness estimation. For this purpose, the second approach is based on a developed Fuzzy Inference System (FIS) model. The inputs of the FIS model are the vehicle acceleration and jerk and the output remains the aggressiveness score. Experimental results show that the driver aggressiveness is better estimated by the proposed FIS model since the two input parameters are taken into account simultaneously. Furthermore, it will be shown that the defuzzification techniques and the GPS signal noise have an impact on the driver behaviour estimation.

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Paper reference
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Real Time Fixed Order Robust H_∞ Orientation Control for 3-DOF Helicopter

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Moussa Boukhnifer (ESTACA Paris, France),
Yassine Bouteraa (University of SFAX, Tunisia),
Ahmed Chaibet (ESTACA Paris, France),
Jawhar Ghommam (INSAT, Tunis, Tunisia)

Abstract

Helicopter dynamics are generally non linear, unstable with inter-axis coupling as well. Moreover, disturbance and parametric uncertainties make traditional control structure, as PID controller, usually not effective to stabilize this system. This paper focuses on modeling and real time robust control of 3-DOF Helicopter. This study presents an improved H_∞ controller for this aerial vehicle. The model of 3-DOF Helicopter is developed as a differential equations and in order to reduce the complexity of the standard H_∞ structure, a fixed order control design is proposed. Simulation and experimental results are given to demonstrate the consistency of the suggested control, through a comparative study with a classical PID and standard H_∞ controllers. Simulation and experimental results in the presence of the noise disturbance prove the effectiveness of the proposed control strategy.

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Paper reference
SSD'15-SAC-7-5

Indirect Fuzzy Sliding Adaptive Control law For Nonlinear Systems

Hafedh Abid and Ahmed Toumi
(University of Sfax, ENIS, Tunisia)

Abstract

In this paper we are interested to indirect adaptive fuzzy control of nonlinear SISO systems. The plant model is represented by a Takagi-Sugeno (T-S) type fuzzy system. The indirect adaptive fuzzy controller is basis of model reference. The adaptive algorithm exploits the lyapunov matrix and the sliding surface to adjust online the state matrices parameters of all local models. The Lyapunov ap-proach has been used to analysis and check the stability of the global closed loop system.. The plant state tracks asymptotically the state of the reference model for any bounded reference input signal. A mechanical system has been used to check the performances of the proposed controller.

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Paper reference
SSD'15-SAC-8-1

Stabilizing Fractional Order Controller Design for First and Second Order Systems

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Messaoud Amairi (National Engineering School of Gabes, Tunisia),
Mohamed Aoun (The National Engineering School of Gabes, Tunisia)

Abstract

The paper deals with the stabilization problem of the Linear Time Invariant system. In this work, we present a new method of stabilization addressed to the first and second order unstable system in order to guarantee the stability and the time domain performances. Analytic expressions are developed in the purpose of setting the stabilizing parameters of the controller by describing the stability region. Moreover, the time domain-curves of the desired closed-loop system are used to show time domain specifications. Finally, some numerical examples and a control of DC motor are proposed in order to show the benefits and the reliability of the new technique.

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Paper reference
SSD'15-SAC-8-2

Multi-Objective Optimization Based Design of Fractional PID Controller

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Slaheddine Najar (Associate Professsor, Tunisia),
Mohamed Aoun (The National Engineering School of Gabes, Tunisia)

Abstract

This paper deals with robust fractional order PID controller design via numerical multi-objective optimization. The proposed interval-based design scheme uses frequency-domain specifications to ensure a desired closed-loop behavior. By maintaining the desired phase margin quasi-constant in a pre-specified frequency band, it guarantees more robustness to gain uncertainties. This leads to a closed-loop system with an interesting iso-damping property in a more large frequency band than other design methods. A numerical example is presented to show the efficiency of the proposed method and to discuss about the obtained results.

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Paper reference
SSD'15-SAC-8-3

A Direct Fractional Order Bias Eliminated Least Squares Method for the Fractional Closed-Loop System Identification

Zaineb Yakub (University of Gabes, Tunisia),
Manel Chetoui and Messaoud Amairi
(National Engineering School of Gabes, Tunisia),
Mohamed Aoun (The National Engineering School of Gabes, Tunisia)

Abstract

The paper deals with the continuous-time fractional closed-loop system identification in a noisy output context. Both coefficients and fractional orders of the process are estimated using the direct approach. The proposed method is based on the least squares technique and the state variable filter. It is an extension of the bias eliminated least squares method to the fractional systems. It is combined to a nonlinear optimization algorithm in order to estimate both coefficients and fractional orders of the fractional process. A numerical example is presented to illustrate the performances of the proposed methods.

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Paper reference
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Analytic Approach to Design PID Controller for Stabilizing Fractional Systems with Time Delay

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Mohamed Aoun (The National Engineering School of Gabes, Tunisia)

Abstract

The paper considers the problem of PID controller design for stabilizing fractional systems with time delay. An analytic approach developed for rational systems with time delay is extended for fractional systems with time delay. It consists in determining the stability regions in the PID controller parameters planes and choosing the optimal controller by analyzing the stability of the closed-loop corrected system using a graphical criterion, like the dual-locus diagram. The performances of the proposed approach are illustrated using two numerical examples.

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Paper reference
SSD'15-SAC-9-1

Robust Fault Tolerant Control for T-S Fuzzy System With Unmeasurable Premise Variables: LMI Approach

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(National School of Engineering of Sfax, University of Sfax, Tunisia),
Maha Bouattour (University of Sfax, Tunisia),
Driss Mehdi (University of Poitiers, France),
Mohamed Chaabane (Université de Sfax, Tunisia)

Abstract

This paper addresses the problem of robust fault tolerant control (FTC) for Takagi-Sugeno (T-S) fuzzy nonlinear systems with unmeasurable premise variables. A fuzzy-augmented descriptor observer design is proposed to achieve a simultaneous estimation of the system states and of the occurring sensor faults. Sufficient conditions for the existence of the controller based observer are established with Lyapunov theory and H_∞ performance and given in terms of linear matrix inequalities (LMI). Numerical simulation example is given to illustrate the effectiveness of the proposed FTC scheme.

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Paper reference
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Modeling, Intelligent Diagnosis of Faults and Command with a Dspace: Application on a Pumping Station under Pressure

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Chaari Abdelkader (Tunis University & ESSTT-C3S, Tunisia)

Abstract

The problem of managing water sources and distribution systems is becoming more important. The objective of this paper can be integrated in this theme that we tried to model a station pumping of water under pressure, taking into account the possibility of the occurrence of leaks and we seek to design a supervisor fuzzy that role as the Intelligent leak detection and gives order to adapt to the PI controller to reduce leakage by controlling the pressure. Practical validation was done to the structure of proposed order and the diagnosis module, whose was used DSpace card.

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Paper reference
SSD'15-SAC-9-3

Robust Diagnosis for Hybrid Dynamical Systems

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Labidi Islem and Nadia Zanzouri (ENIT, Tunisia),
Mekki Ksouri (National Engineering School of Tunis, Tunisia)

Abstract

The aim of this paper is to propose a hybrid observer design for linear Hybrid Dynamical systems (HDS) modeled via hybrid automata. In addition, the structure of the proposed observers is based on a discrete observer and a continuous observer on interaction. The discrete observer reconstructs the discrete mode and detects discrete faults. Once, the active mode is obtained, the continuous observer which is synthesized around a DOS (Dedicated Observer) Scheme to generate structured residuals which locate sensor faults. The observer based method is designing with LMI (linear Matrix Inequalities) formulation technique. A robust evaluation method based on the residuals norm (errors estimation) is used to detect the noisy active mode.

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Paper reference
SSD'15-SAC-9-4

Fault Detection in Wind Turbine System Using Wavelet Transform: Multi-Resolution Analysis

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Rim Hamdaoui (MACS Research Unit, ENIG, Tunisia),
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(Ecole Nationale d'Ingénieurs de Gabès (ENIG) & Gabes University, Tunisia),
Christophe Aubrun (University of Lorraine & CRAN, France)

Abstract

In this paper, the wavelet transform theory is used to fault diagnosis for wind turbine benchmark model, considering its characteristics of multi-resolution and thresholds. The paper emphasizes de-noising based on wavelet transform in signal of generated residue in order to detect faults. Executing wavelet transformation, faults in the wind turbine can be detected. We have attempted to show how wavelet transform can be used to detect faults.

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Paper reference
SSD'15-SAC-9-5

On Fault Tolerant Control of Mobile Robot based on Fast Adaptive Fault Estimation

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Ahmed Zouinkhi (ENIG, Tunisia),
Mohamed Naceur Abdelkrim
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Abstract

This paper introduces a procedure for the design of reconfigurable linear quadratic (LQ) state-feedback control tolerant to actuator fault. In fact,this work is based on a previous one which use as a fault estimator bloc the Fast Adaptive Fault Estimation (FAFE) algorithm. Therefore, thanks to this novel estimation design, the process performances will be improved. As an example of simulation, a linear model describing an unicycle robot is proposed to illustrate the theoretical results.

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Paper reference
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H_∞ Fault Tolerant Control for Uncertain State Time-delay Systems

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Rafika Elharabi (National school of Engineers de Gabès, Tunisia)

Abstract

H_∞ formulation of the robust fault tolerant control problem for uncertain systems with state time-delays is studied in this paper. A robust control law is then designed in order to automatically compensate actuator and sensor faults, based on a performance index as H_∞ model-matching problem. Where, the gain is obtained via Linear Matrix Inequality (LMI) feasibility conditions. Indeed, a new condition is developed to show that the system can be guaranteed to be asymptotically stable in the presence of uncertainties, faults and disturbances based on the Lyapunov-Krasovskii theory. The effectiveness of the design methodology is verified based on a two-stage chemical reactor train with delay recycle streams.

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Paper reference
SSD'15-SAC-9-7

Fault Detection and Estimation Based on Full Order Unknown Input Hamiltonian Observers

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Abstract

This paper deals with a novel diagnosis framework for robust fault detection and estimation purposes by combining an ordinary Unknown Input Observer (UIO) with the port-Hamiltonian formalism. Based on energy aspect, the full order Unknown Input Hamiltonian Observer (UIHO) design scheme guarantees robust residual generation through decoupling the disturbances effects from the fault ones. The fault estimation is, then, allowed by an algebraic transformation taking into account co-energy variables. Finally, simulation tests on ladder networks illustrate the effectiveness of the theoretical development.

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Paper reference
SSD'15-SAC-10-1

Automatic Model Predictive Control Implementation in a High-Performance Microcontroller

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(Institut Supérieur des Sciences Appliquées et de Technologie de Mateur, Tunisia),
Faouzi Bouani
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Abstract

In this paper, a framework for embedding Model Predictive Control (MPC) for Systems-on-a-Chip applications is presented. This contribution is especially interesting when dealing with high performances devices since it increases the number of addressable control applications in the industrial field and particularly in fast systems. Aiming to allow the implementation of such a computationally expensive controller on chip, we propose optimization hints satisfying trade-offs between code size and computation speed versus digital precision and effectiveness of the computed control action. The illustration of the proposed implementation is tested on a high performance STM32F407 microcontroller. Analysis of the accuracy of the digital implementation of MPC algorithm are given, and it shows that the proposed framework controls successfully the process with a good set-point tracking and a low computational burden with a high speed.

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Paper reference
SSD'15-SAC-10-2

Global Optimization Method for Model Predictive Control Based on Wiener Model

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Chagra Wassila
(Analysis, Conception and Control of Systems Laboratory, IPEIEM, Tunisia)

Abstract

This paper deals with model predictive control based on Wiener model. The nonlinear block of the considered model is represented by a polynomial relation and the model's parameters are determined using the neural networks. A global optimization method, i.e. the generalized geometric programming method, is used to solve the nonconvex optimization control problem. The efficiency of the proposed controller is illustrated through a simulation example.

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Paper reference
SSD'15-SAC-10-3

Robust Predictive Controller Based on an Uncertain Fractional Order Model

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Abstract

This paper focuses on Fractional Robust Predictive Control (FRPC) for fractional order dynamic systems with real parametric uncertainties to take into account the uncertain behavior of physical process. Based on worst case strategy, the control law is obtained by resolution of a non convex min-max optimization problem which takes into account the uncertain-ties on the fractional order model parameters. The performance of the proposed predictive controller are illustrated by a simulation example.

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Paper reference
SSD'15-SAC-10-4

Impulse Fuzzy Model Based Predictive Control For Nonlinear Systems

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Abstract

Fuzzy and predictive control methods are two modern control strategies that have been accepted by the industry to describe and solve complex problems. The present paper introduces a fuzzy control technique, which belongs to the popular family of control algorithms, called model predictive control (MPC). This method is based on the use of a Takagi-Sugeno fuzzy model which is considered as a powerful structure for representing nonlinear dynamic systems. So, an impulse fuzzy model predictive control is used for predicting the future behavior of the output variable. A local optimization problem is formulated, which minimize the difference between the model predictions and the desired trajectory for each subsystem. Simulation results are given to illustrate the tracking performance of the proposed method.

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Paper reference
SSD'15-SAC-10-5

Decoupled Multimodel Predictive Control Based on Multi-Observer for Discrete-Time Uncertain Nonlinear Systems

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Anis Messaoud (Research group CONPRI - ENIG, Tunisia),
Ridha Ben Abdennour (University of Gabes, Tunisia)

Abstract

This paper deals with a decoupled multimodel predictive control for discrete-time uncertain nonlinear systems. The control scheme is based on a multi-observer for the state estimation of uncertain nonlinear systems described by decoupled multimodel. A partial controller and observer is synthesized for each local model. In order to ensure the closed-loop performances, a supervisor is proposed to select the appropriate controller. Simulation example is carried out to exhibit the effectiveness of the proposed control strategy.

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Paper reference
SSD'15-SAC-10-6

Multi-Objective Predictive Control Using Discrete TS Fuzzy Systems and a Modified Dynamic Neighborhood PSO

Ali Thamallah (National Engineering School of Monastir, Tunisia),
Sakly Anis (ENIM, Tunisia),
Faouzi M'Sahli
(University of Monastir & National School of Engineers of Monastir, Tunisia)

Abstract

In this paper, various efforts to develop multi-objective predictive controller strategy of Multi Inputs Multi Outputs Nonlinear system are presented. The proposed strategy integrates a modified Dynamic Neighborhood PSO algorithm to solve optimization problems for multiple constrained objectives and TS Fuzzy modeling approach to determine process model. Simulations results of applying the proposed strategy to quadruple tank process confirm its capability to track the objective.

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Paper reference
SSD'15-SAC-11-1

Minimum Variance Control based on an Uncertain Neural Networks and Global Optimization Method

Ahmed Mnasser (Tunis El Manar University & FST, Tunisia),
Faouzi Bouani (University of Tunis, National School of Engineering, Tunisia)

Abstract

In this paper, we propose a robust minimum variance controller for nonlinear systems based on feedforward neural networks. Based on input-output system measurements, a neural network model with uncertain parameters is trained to approximate the unknown dynamic behavior of the system. The control law is formulated as a min-max optimization problem which minimizes the worst case of the quadratic objective function subject to the uncertain parameters of the model and the control signal constraints. When classic optimization methods are used to optimize this kind of problem, a local solution is then obtained. In order to reach the global solution of the control problem which corresponds to the optimal control actions, the Generalized Geometric Programming technique is used to reduce the constrained non-convex problem to a convex one. The performances of the proposed neural controller are illustrated by a simulation example.

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Paper reference
SSD'15-SAC-11-2

Backstepping-based Output Feedback Control of an Electro-hydraulic Servo System

Sami El Ferik, Babajide Ayinde and Salim Ibrir
(King Fahd University of Petroleum and Minerals, Saudi Arabia),
Moez Feki (University of Sfax, Ecole Nationale d'Ingénieurs de Sfax (ENIS), CEMLab, Tunisia)

Abstract

This paper addresses the control of a hydraulic servo system rod subject to uncertainty in parameters and to an unknown but bounded disturbance. The proposed backstepping-based robust controller guaranties a uniformly ultimately bounded tracking error leading to practical stability of the closed loop system. State-Observer is also designed using backstepping approach to estimate the states. The controller assures robustness against perturbations and uncertainties in the dynamics of the system. Numerical simulations illustrate the efficacy of the proposed scheme.

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Paper reference
SSD'15-SAC-11-3

Neural Network-Based Adaptive Control For Induction Motors

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Boubakeur Zegnini
(Université Amar Telidji de Laghouat, Algeria)

Abstract

Neural network-based adaptive output feedback control scheme is developed to address the tracking problem of an induction motor (IM) based on a modified version of field oriented control (FOC). The control contains a flux observer that estimates the rotor flux from the stator currents. An single hidden layer neural network (SHL NN) is used to adaptively compensate for the unmodelled dynamics, estimation errors and unknown or varying system parameters. The network weights are adapted using a Lyapunov-based design. The method uses a linear observer for the almost linear tracking error dynamics, the output of which is used as a teaching signal for the SHL NN. The NN operates over available input output history of the controlled system. The linear portion of the error dynamics is stabilized by a linear output feedback dynamic compensator. Ultimate boundedness of the tracking error and observation errors is proven through Lyapunov's direct method. The effectiveness of the proposed controller is demonstrated through computer simulation.

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Paper reference
SSD'15-SAC-11-4

Backstepping Control for a Quadruple Tank Process Based on Adaptive Observer

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(National Engineering School, Tunisia),
Salim Hadj Said (ENIM, Tunisia),
Faouzi M'Sahli
(University of Monastir & National School of Engineers of Monastir, Tunisia)

Abstract

This paper is about control of hydrographic process. A new output control scheme is developed, which combine a nonlinear backstepping control with an adaptive high gain observer. We consider the nonlinear MIMO class of systems, which include the model of our hydrographic process. The main objective is to automate the control of pumps for a successful and safe manner in order to keeps the levels of the bottoms tanks to specific references. Only two sensors are available to measure the liquid level in the two bottom tank and the other process's states and some parameters are assumed unavailable. For this case, an adaptive high gain observer for a class of nonlinear system which is constructed using Lyapunov stability technology. Thereafter, simultaneous online estimations of system states and parameters are performed for the system during the control operation.

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Paper reference
SSD'15-SAC-11-5

Robust Pole Assignment for the Control of Uncertain Nonlinear Discrete-time Systems

Amira Aydi, Mohamed Djemel and Mohamed Chtourou
(University of Sfax, CEMLAb, ENIS, Tunisia)

Abstract

This paper concerns a robust pole assignment for the control of uncertain discrete-time nonlinear systems. A composed model of two parts is used to describe the dynamic of the considered system. The first part is linear affected by bounded uncertainties. It is obtained by the nominal system linearization. The second part is nonlinear. A robust pole assignment called 'pole colouring' is employed for the system control. It is synthesized basing only to the linear uncertain part of the model. Finally, two simulation examples are presented to illustrate the effectiveness of the proposed design method.

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Paper reference
SSD'15-SAC-11-6

Asymptotical Stability Criterion for a Class of Nonlinear Neutral Systems with Mixed Time-Varying Delays

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(University of Tunis El Manar, Tunisia)

Abstract

This paper investigates the asymptotical stability analysis problem for a class of nonlinear neutral systems with mixed time-varying delays. In order to reduce the conservatism, a new delay-dependent asymptotic stability criterion is proposed based on the Lyapunov-Krasovskii functional. Finally, a numerical simulation is presented to illustrate the effectiveness of the proposed approach using the Linear Matrix Inequalities (LMIs).

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Paper reference
SSD'15-SAC-11-7

Tracking Control of Nonlinear Systems via Backstepping Design

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Abstract

This article treats the tracking control problem of nonlinear continuous system. A backstepping design technique is used here for being a powerful, robust nonlinear strategy and for its ability to ensure a asymptotic stability of the controlled system without canceling useful nonlinearities. The basic idea of backstepping design is that a complex nonlinear system is decomposed into the subsystems, and the degree of each subsystem doesn't exceed that of the whole system. Accordingly, the Lyapunov function and medial-fictitious control are designed respectively, and the whole system is obtained through backstepping. Thus the control rule is designed thoroughly. The backstepping method is called as back-deduce method, and the desired dynamic indexes are satisfied.

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Paper reference
SSD'15-SAC-11-8

Strong Stablization of The Non-Linear Pendubot System

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(King Fahd University of Petroleum & Minerals, Saudi Arabia)

Abstract

This paper concerns with the strong stabilization for a typical example of MIMO under-actuated robots called the Pendubot, which is a two-link under-actuated planar robot with a single actuator at the first joint. First, a study of the existing of blocking zeros is presented to check for strong stabilization condition. Then the paper presents a design method for observer-based dynamic stable controller for the upright equilibrium point of the Pendubot. Simulation results are presented to validate the theoretical results.

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Paper reference
SSD'15-PES-1-1

A WT Based DSP Algorithm to Calculate SAPC Compensating Current in Accordance to IEEE STD 1459-2010

Gad Mohamed, Medhat El Geneidy and Nabil Abbasy
(Alexandria University, Egypt)

Abstract

This paper presents a new digital signal processing (DSP) algorithm based on wavelet transform (WT) in order to calculate compensating current of shunt active power compensator (SAPC). The proposed algorithm depends on the highly resolution approach which has been presented previously by the authors to calculate the electrical power components defined in IEEE STD 1459-2010 in case of non-sinusoidal and un-balanced voltage and current waveforms. The presented algorithm relies on the advantage of discrete wavelet transform (DWT) in order to calculate the phasors (magnitude and phase angle) of fundamental frequency component of voltage and current waveforms. Also it is using the advantage of discrete wavelet packet transform (DWPT) in harmonic analysis of non-sinusoidal waveforms in order to calculate RMS values of integer harmonics. The developed algorithm is tested with the synthesised waveforms and obtained

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Paper reference
SSD'15-PES-1-2

Improvement of transient stability in an AC/DC system with synchronverter based HVDC

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Abstract

The HVDC emulation by the synchronverter concept is investigated in a realistic power system. A specific tuning method for the parameters of the regulators based on the sensitivity of the poles of the neighbor zone of the HVDC with the respect to the latter parameters is used. As consequence, not only the local performances of the HVDC link, but also overall transient stability of the AC zone in which the HVDC is inserted are improved. Extensive tests are provided using Matlab/Simulink implementation of the IEEE 9 bus/3 machines test system.

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Paper reference
SSD'15-PES-1-3

Linking the Results of Key and Supplementary Comparisons of Regional Metrology Organization for Electrical Power

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Abstract

The paper describes the proposed procedure of linking the results of key and supplementary comparisons of regional metrology organization (RMO) for electrical power. It is realized for linking EURAMET.EM-K5.1 key comparison and COOMET.EM-S2 supplementary comparison. The results of RMO SCs are used for confirming calibration and measurement capabilities NMIs.For each of the joint participants in key and supplementary comparisons for equal nominal of electrical quantity can be calculated degrees of equivalence national standards and it uncertainty in term key comparison reference value.

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Paper reference
SSD'15-PES-2-1

Modeling and Control of Parallel Inverters-Based Dual-Stage Grid-Connected PV System

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Barkat Said (University of M'sila, Algeria),
Mohammed Belkheiri (Université Amar Telidji de Laghouat
& Laboratoire de Télécommunications, Signaux et Systèmes, Algeria),
Assam Zorig (Université of M'sial, Algeria)

Abstract

Parallel operation of multi-inverters is an effective way to increase the power capacity and the reliability of distributed power systems. In this paper, a photovoltaic system based on dual-stage topology of boost converter and parallel three-phase inverters connected in distribution systems is presented. Also, a decoupling control strategy of parallel inverters system is proposed to control the current injected into the grid, active and reactive power demand, and DC-link voltage. The resulting system is able to extract the maximum power from photovoltaic unit, to achieve sinusoidal grid currents, and to ensure reactive power compensation. The proposed system performance is investigated at different operating conditions.

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Paper reference
SSD'15-PES-2-2

PWM Modulation Strategy of Three-phase AC-AC Power Converters Based on Sparse Indirect Matrix Converter

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Abstract

This paper presents a Sparse Indirect Matrix Converter (SIMC) topology, which can be proposed as an alternative to the direct matrix converter. This double stage converter configuration consists of a combination of two conventional converters through a fictitious intermediate floor without capacitive storage element. The first floor is a controlled rectifier directly connected to a second floor, which consists of a voltage source inverter traditionally used in many different industrial applications. PWM control strategy of matrix converters is aimed to generate the gate signals that guarantee the control of the semi-conductors in good conditions. It provides balanced output voltages with RMS and controllable frequency, a maximum value of the ratio and a displacement factor near unity regardless the load.

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Paper reference
SSD'15-PES-2-3

Power Quality Improvement Using VF-DPC-SVM Controlled Three-Phase Shunt Active Filter

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University of Tunis, Tunisia)

Abstract

The main focus of this paper is to present a novel and simple direct power control of shunt active power filter with constant switching frequency using space-vector modulation (DPC-SVM). Also, the AC line voltage sensors with a virtual flux (VF) estimator are replaced. This control method is applied to eliminate harmonic pollution and compensate the reactive power in the presence of nonlinear loads and unbalanced sources. The control system is resistant to the majority of line voltage disturbances using by the idea of virtual flux and phase locked loop (PLL) approach. The superior advantages of this method are simple algorithm, good dynamic response, constant switching frequency and resistant to the majority of line voltage disturbances. The simulation results, using Matlab/Simulink, are presented to show the validity of the proposed model, and to evaluate the performance of the control strategy.

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Paper reference
SSD'15-PES-2-4

Performance Analysis of DPC for Grid Side Converter Dedicated to Wind Energy Conversion System-Based DFIG

Aicha Daoud, Fatma Ben Salem and Nabil Derbel
(University of Sfax, National School of Engineering, Tunisia)

Abstract

This paper investigates and studies the use of direct power control (DPC) approach for controlling three-phase AC/DC converter included in a wind conversion system based DFIG. Instantaneous active and reactive powers are directly controlled by selecting the optimum state of the converter. The DC-bus voltage is maintained at the required level by imposing the active power to be constant and equal to its reference value. The unity power factor (UPF) operation of the converter is achieved by maintaining the reactive power zero during all sectors. Simulation results highlight the performances as well as the lacks of such a strategy.

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Paper reference
SSD'15-PES-2-5

Analysis of Bifurcation Behavior in a Current-fed Boost Converter for PV Systems

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Abdelali El Aroudi (Research group GAEI, Technical Engineering School of the Rovira i Virgili, Spain),
Safya Belghith (Ecole Nationale d'Ingnieurs de Tunis, Tunisia)

Abstract

In most power electronics applications, the input is a voltage source and it is required to control the output voltage to a desired value. In photovoltaic (PV) applications, the control of the input voltage of the converter is frequently required to extract the maximum power from the PV panel. Moreover, unlike the conventional case, the output voltage is constant. This paper presents an analysis of nonlinear dynamics and bifurcation behavior of a current-fed boost converter for PV applications. First, a discrete-time model of the converter is derived. Simulation results using this model show that the system can exhibit period doubling bifurcation when some design parameters are varied. Then, the monodromy matrix obtained from Floquet theory and Filippov method is used to perform a stability analysis of the system periodic orbits and to explain the mechanism of losing their stability.

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Paper reference
SSD'15-PES-2-6

Validation of a New Structural Health Monitoring Technique of a Wind Turbine Prototype

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Slim Choura (University of Sfax, ENIS, Tunisia),
Fathi Ghorbel (Rice University, USA)

Abstract

The aim of this paper is to validate a new proposed technique for Structural Health Monitoring (SHM) of Wind Turbine (WT). This technique, recently published in Ben Hassena et al. [1], is an identification model-based technique derived from a mathematical modeling. The damage identification is based on dynamic analysis, i.e. especially based on time domain responses of the WT. For validation purpose, a new Finite Element Method (FEM) model of a Horizontal Axis Wind Turbine (HAWT) prototype is developed and a modal and steady state transient dynamic analysis are performed. The dynamic behaviors resulting from numerical and analytical models are compared, and thus, we notice good agreements of the results. By presenting modal analysis and time response of a cracked HAWT structure, we demonstrate efficiency of the identification model-base technique to detect damages in WT blades

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Paper reference
SSD'15-PES-3-1

Performance Comparison of PI, SMC and PI-Sliding Mode Controller for EV

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(ENIS, Tunisia)

Abstract

This paper presents three different control strategies for controlling an induction motor "IM" in an electric vehicle (EV) application. The control techniques analyzed and compared are: the proportion-integral regulator (PI), the sliding mode control (SMC) and the PI-Sliding Mode Control (PI-SMC). Simulation results show the comparison performance in term of robustness.

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Paper reference
SSD'15-PES-3-2

Sliding Mode Control of Ship Electric Propulsion System

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(Naval academy, Tunisia)

Abstract

The electrical propulsion vessels are complex, multi variable and highly nonlinear. They require advanced controls ensuring good robustness in stability and performance. This paper focuses on modeling and sliding mode control of electric propulsion system of a ship insured by a double star synchronous motor. We propose a structure of sliding mode control performance which well be applied it to ship electric propulsion system. A numerical study simulation of the proposed control is presented. The simulation results have allowed us to analyze the behavior of the loop for various operating conditions of the system.

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Paper reference
SSD'15-PES-3-3

Design of PMSMs Topologies Based on FEA for In-Wheel Motor Hybrid Propulsion Application

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Hafedh Trabelsi (Engineering school of Sfax, Tunisia)

Abstract

Permanent Magnets Synchronous Machine(PMSMs) are considered as the promising electromagnetic structure, especially for In-Wheel motor electric and hybrid propulsion applications. For determining the design requirements, a simple vehicle-dynamics model that evaluates vehicle performance through the typical cruising trip of an automobile was considered. This work classifies the PMSMs in two topologies such the surface mounted and the flux concentrating machine. A Finite Element Analysis (FEA) based investigation and a study of the different PMSM topologies with different magnet material for performance improvement of the machines is presented.

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Paper reference
SSD'15-PES-3-4

Energy Management of a FC/UC Hybrid Power Source

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(ENIS, Tunisia)

Abstract

The studied system in this paper is a hybrid power source with a Fuel Cell (FC) as a main energy source and an Ultra-Capacitor (UC) as an energy storage system for an electric vehicle. The energy management problem as well as the charge sustaining, which is an optimal control problem are fulfilled by Ant Colony Optimization algorithm while respecting the energetic and dynamic constraints of the hybrid energy source. Two standard driving cycles (ECE 15) and (EUDS) are utilized for the simulation work.

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Paper reference
SSD'15-PES-3-5

Cost Optimization of Fuel Cell / Ultracapacitor Powertrain

Intissar Darwich, Islem Lachhab and Lotfi Krichen
(University of Sfax, ENIS, CEMLab, Sfax, Tunisia)

Abstract

This work focuses on applying a Particle Swarm Optimization (PSO) on Fuel Cell/Ultra-Capacitor (FC/UC) Electrical Vehicle. This method is dedicated to minimize the energy sources cost. Indeed, the PSO algorithm allows finding the optimal size of each energy sources by identifying FC and UC cells numbers. A relationship is developed between FC/UC sizing parameters and vehicle requirements. The sources sizes ought to guarantee the drive performances. Simulation results show the sufficiency of optimal sizes and the effectiveness of the proposed optimization method.

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Paper reference
SSD'15-PES-4-1

Complex Dynamics in a Two-cell DC/DC Buck Converter using a Dynamic Feedback Controller

Karama Koubaâ
(CEMLab, University of Sfax, (ENIS), Tunisia)

Abstract

Power converters are known to exhibit border collision bifurcation and chaos. In this paper, we consider the example of a two-cell DC/DC buck converter controlled with a dynamic feedback controller. We use a simplified discrete model to analyze the complex dynamics in the converter. Then, we give theoretical conditions of stability according to the values of the parameters. Toggling between different modes in the circuit influences the appearance of switching-sliding bifurcation and undesirable saturating regimes. Numerical simulations confirm the analytical results and explain the complex dynamics and the strange phenomena encountered in the two-cell converter.

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Paper reference
SSD'15-PES-4-2

Study of the Radiated Emissions of an Electric Vehicle Battery Charger during the Charge Cycle

Hanen Shall, Moncef Kadi
(IRSEEM/ESIGELEC, France)

Abstract

The development of hybrid/electric vehicles for land transport brings up new constraints in terms of electromagnetic compatibility and particularly low frequencies magnetic field radiations. This paper presents a study of an electric vehicle charger magnetic emissions during the different charge cycle phases. In fact, the electric vehicle battery charger under test is placed beneath the passenger seat; therefore its radiated emissions might affect not only the passengers but also the other electronic devices placed in its vicinity. This study gives designer clearer idea toward an optimized components' arrangement inside the limited space of the vehicle to scale down the possible electromagnetic interference phenomena.

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Paper reference
SSD'15-PES-4-3

The Advantage of Silicon Carbide Material in Designing of Power Bipolar Junction Transistors

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Kamel Besbes
(University of Monastir & Faculty of Sciences of Monastir, Tunisia)

Abstract

The use of Silicon Carbide in designing of power components made exceptional improvements by their high breakdown voltage in the off state, ultra-fast switching with a minimum loss during their turn-On and turn-Off transitions especially at high operating temperatures where silicon power devices reaching their limits of operations. This paper presents a comparative study, through numerical simulation using the finite element method, between a 4H-SiC power bipolar junction transistor and a Silicon power bipolar junction transistor having the same breakdown voltage, 3KV, to highlight the benefits of Silicon Carbide material in their designing.

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Paper reference
SSD'15-PES-5-1

Modeling and Backword / Forword Power Flow Analysis of Unbalanced Radial Distribution System

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Adel Kheder (University of Sousse, Tunisia)

Abstract

A distribution system has to be modeled accurately so that analysis techniques for steady state and short circuit conditions can be developed [1]. In this work, a contribution for a modeling of a three phased unbalanced radial distribution system components, is given. A decoupled approach has been adopted so that each phase can be studied independently of the others. Some important components of a simple radial feeder has been described such as the line segment, the voltage regulator, and different models of loads have been presented and discussed. And the model has been tested for an IEEE 69 bus radial distribution system.

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Paper reference
SSD'15-PES-5-2

Study of Dielectric Behavior of PEN (Polyethylene - Naphtalate) by Dielectric Spectroscopy

Fadila Benabed, Taher Segheir (Laghouat University, Algeria),
Saliha Boudraa (University of laghouat Laghouat, Algeria),
Mohammed Belkheiri (Université Amar Telidji de Laghouat,
Laboratoire de Télécommunications, Signaux et Systèmes, Algeria)

Abstract

The method of dielectric spectroscopy is an instrument of choice for the diagnosis of insulation used in high voltage and also to assess the quality of the insulation of HV equipment such as transformers, cables, capacitors, etc.. This method allows to estimating the state and the quality of the insulation using the dielectric response of the frequency range. In this article, we have presented results of dielectric studies in polyethylene naphtalate by means of dielectric relaxation spectroscopy (DRS) in frequency range 10-2 - 106 Hz and temperature between -60 and 140 °C, we will invest this method on solid insulation PEN "Polyethylene Naphtalate" to measure the dielectric properties and evaluate the performance of this insulator.

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Paper reference
SSD'15-PES-5-3

Degradation Analysis of the Lead Acid Battery Plates in the Manufacturing Process

Raja Yahmadi, Kais Brik, Faouzi Ben Ammar
(INSAT, Tunisia)

Abstract

This paper presents a degradation analysis of the lead acid battery plate during the manufacturing process. The different steps of the manufacturing process of plate such as manufacturing of lead oxide, paste mixing and manufacturing of grid, pasting, curing and drying are described by Structured Analysis and Design Technique (SADT). The general analysis of all the causes and potential factors causing a low quality of the plate during the manufacturing process is created by the Ishikawa diagram. This description is completed by the Causal Tree Analysis in order to seek the various possible combinations of events leading to the low quality of lead acid battery plate during the pasting, curing and drying process.

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Paper reference
SSD'15-PES-5-4

Steady State Stability in Power Systems Including Nonlinear Voltage Dependent Loads

Yosra Welhazi, Tawfik Guesmi, Hsan Hadj Abdallah
(University of Sfax, ENIS, CEMLab, Tunisia)

Abstract

In this paper, we propose a detailed flexible approach for incorporating static loads into the small signal analysis framework of a power system. In particular, constant power, constant current and constant impedance loads are illustrated. The incorporation of nonlinear voltage dependent loads into multimachine power system requires the development of the mathematical model of the power system with static loads. The differential algebraic equation (DAE) model of multimachine power system including nonlinear voltage dependent loads has been developed in this paper. Thus, the objective of this paper is to develop a general methodology of DAE model of power system with taking into account voltage dependency of static loads. The Western System Coordinating Council (WSCC) 3-machine, 9-bus system and the IEEE 14-bus test system are used to illustrate the application of all proposed models and techniques for different loading conditions. Results demonstrate that both constant power and constant current load models give poor results as far as network loadability is concerned, whereas constant impedance type load is more stable.

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Paper reference
SSD'15-PES-5-5

Performance Evaluation of Box-Jenkins and Linear-Regressions Methods versus the Study-Period's Variations: Tunisian Grid Case

Adel Bouallegue (ENISo, Tunisia),
Sirine Sallah (SAGE, Tunisia),
Adel Kheder (University of Sousse, Tunisia)

Abstract

In the aim of forecasting the electricity demand in Tunisia, we have attempted in this paper to evaluate the performances of two traditional methods namely the univariate Box-Jenkins analysis (ARIMA models) and the multiple linear regressions based on economic and demographic variables (gross domestic product per capita and population). Forecasting algorithms are based on historical data period and provide results for a given future period. The evaluation of forecasting errors is calculated regarding the variation of historical data period and the future one. Forecasted results are calculated by means of the ARIMA (Autoregressive Integrated Moving Average) univariate models and their performances are compared to those of regressions models. The influence of historical data and prediction periods on forecasting performance is investigated to evaluate the minimum period that gives acceptable forecasting errors.

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Paper reference
SSD'15-PES-6-1

Design and Optimization of PMSM With Outer Rotor For Electric Vehicle

Ali Mansouri, Hejra Msadek (Engineering School of Sfax, Tunisia),
Hafedh Trabelsi (Engineering school of Sfax, Tunisia),
Stéphane Brisset (L2EP, EC Lille, France)

Abstract

In this paper, the importance of electrical machine was involved. So researches are oriented to make a progress in this domain. Permanent magnet synchronous machine (PMSM) is selected to be studied in this work. Two optimization methods are used in the design of the PMSM for the application of in wheel motor of electric cars. The first one is sequential quadratic programming (SQP) algorithm using the interface Sophemis developed in L2EP laboratory which is a deterministic method and the second is NSGAII algorithm which is a stochastic method. Finally, a comparison between the two methods, using pareto front, is discussed and the appropriate one is then choosed.

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Paper reference
SSD'15-PES-6-2

Co-Simulation of Induction Motor Fed by PWM Inverter Under a Broken Bar Fault

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Wiem Zaabi (National Engineering School of Gabes (ENIG), Tunisia),
Yemna Bensalem (University of Sfax, Tunisia)

Abstract

The paper presents a finite element (FE) based efficient analysis procedure for induction machine (IM). The study based on finite element models (FEM) offers much more information on the phenomena characterizing the operation of electrical machines than the classical analytical models. This explains the increase of the interest for the finite element investigations in electrical machines. This paper attempts to present a dynamic model involving Finite Element Analysis and equivalent circuit simulation together for PWM inverter fed induction motor assisted based on Maxwell 2D and Simplorer. The nonlinear magnetization characteristics have been considered and calculated by FE software Maxwell. The circuits of the inverter are built by using the circuit components in Simplorer environnement. Based on finite element models, this paper studies the influence of the rotor broken bar fault on the IM behavior under various conditions and severity. The comparison of the results obtained by simulation tests allowed verifying the precision of the proposed FEM model. Using the simulated model, this paper presents a technical method based on Fast Fourier Transform (FFT) analysis of stator current and electromagnetic torque to detect the faults of broken rotor bar. The technique used and the obtained results show clearly the possibility of extracting signatures to detect and locate faults.

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Paper reference
SSD'15-PES-6-3

Reluctance Network Model for Linear Switched Reluctance Motor

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Chillet Christian (G2ELAB, Tunisia),
Boujemaâ Ben Salah (National Engineering School of Tunis, University of Tunis El Manar, Tunisia)

Abstract

This paper presents a new reluctance network model developed in aim to design and optimize the linear switched reluctance motor. The developed reluctance network model is verified using finite element method. This reluctance network model takes an account the saturation of the ferromagnetic parts of the actuator. Also, the dispersion flux is modeled with a particular reluctance. Consequently, the reluctance network model gives precise results of the flux and the force. On the other hand, the important interests of the proposed reluctance network model is that this model can be coupled with other tools in aim to optimize the linear machine.

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Paper reference
SSD'15-PES-7-1

SVPWM Control Strategy to Minimize Circulation Harmonic Currents for VSI Fed Double Star Induction Machine

Hajer Kouki, Mouldi Benfredj, Habib Rehaoulia
(ESSTT, Tunis, Tunisia)

Abstract

The aim of the present paper is to show the impact of the fed of multi-phase induction machines by a voltage inverter that produce circulating harmonic currents. In order to eliminate this extra harmonic currents of stator windings that cause losses, a space vector PWM control strategy is employed and developed, based on the vector space decomposition for double star induction machine modeling, while taking into account the mutual leakage between two stars. The simulation results illustrate the validity and efficiency of the proposed model.

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Paper reference
SSD'15-PES-7-2

Performance Comparison For Loss Optimization Techniques Of FOC Induction Motor Drive

Wahiba Khemiri (Research Unit: ESIER Monastir, Tunisia),
Anis Sakly, Mohamed Faouzi Mimouni (ENIM, Tunisia)

Abstract

This paper present a comparative study of an analytical method and particle swarm optimization (PSO) method for minimum-energy loss for a field oriented control (FOC) induction motor (IM) in transient regime. Those suggested strategies are based on the optimization of the input active power to determine the optimal flux which optimizes the IM efficiency. Comparing with the conventional field oriented control (FOC) it has been observed that the PSO-based algorithm is much more efficient than the other methods.

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Paper reference
SSD'15-PES-7-3

FPGA Implementation of the Direct Torque Control with Constant Switching Frequency of Induction Motor

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Saber Krim
(The National Engineering School of Monastir, Laboratory of EμE, Tunisia),
Abdellatif Mtibaa, Mohamed Faouzi Mimouni (ENIM, Tunisia)

Abstract

The aim of this paper is to present a digital implementation of the direct torque control (DTC) of an induction motor with a constant switching frequency using the field programmable gate array (FPGA) component. The FPGA is used in order to overcome the digital Signal Processing And Control Engineering (dSPACE) limitations such as the sequential processing which increase the sampling time. The Conventional Direct Torque Control (CDTC) presents some disadvantages, such as the torque and stator flux ripples, and stator current distortions due to the variable commutation frequency of the inverter. To overcome the conventional DTC limitations the switching frequency is imposed by using space vector modulation (SVM). The hardware implementation is proposed to take advantages of the FPGA in digital control field of electrical machines in real time, such as the reduction of the execution time by adopting a parallel processing, the possibility of implementing more complex and more efficient algorithms by exploiting the parallel computing. The performances of the direct torque control with space vector modulation are evaluated by digital simulation using the toolbox Xilinx System Generator (XSG) and implementation results on the FPGA. It has been found that the proposed control yields high performances in term of ripples and execution time.

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Paper reference
SSD'15-PES-7-4

Multi-Model Modeling Methods Based on Novel Clustering Strategy and Comparative Study: Application to Induction Machines

Aicha Abid (High Engineering School of Gabes, Tunisia),
Mouna Ben Hamed (National Engineering School of Gabes Tunisia, Tunisia),
Lassâad Sbita (High Engineering School of Gabes, Tunisia)

Abstract

This paper is a comparative study of three doubly fed induction motor (DFIM) speed modeling strategies through multi-model approach based on three clustering algorithms; subtractive, C-means and K-means clustering. The comparison leads to a novel clustering strategy compound of the three clustering algorithms. The novel clustering strategy is applied to modeling the speed of the doubly fed induction motor then validated experimentally on a 1kw induction motor. The experimental study is held with the help of MATLAB/SIMULINK and a dSpace system with DS1104 controller board based on digital signal processor (DSP) TMS320F240. Simulation and experimental results approve the efficiency of the proposed approach.

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Paper reference
SSD'15-PES-7-5

High Order Sliding Mode Observer for Inter-Turn Short-Circuit Fault Detection in Induction Machine

Amal Guezmil (ENIM, Tunisia),
Hanen Berriri (ENIT, Tunisia),
Anis Sakly, Mohamed Faouzi Mimouni (ENIM, Tunisia)

Abstract

This paper explores the design of high order sliding mode observer for induction machine fault detection. Inter-turn short-circuit is one of the most common fault occurring in induction machine. Healthy machine behavior and effects of such fault on the induction machine behavior are evaluated. This motivates the necessity of early fault detection. A high order sliding mode observer is developed and confirmed for different operating conditions. Detection method is based on calculating the difference between the actual behavior of induction machine and the expected behavior given by high order sliding mode observer. That produces a set of residual sensitive to fault. Numerous simulations results are given to illustrate the effectiveness and performance of the proposed approach.

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Paper reference
SSD'15-PES-7-6

Open-End Stator Winding Permanent Magnet Synchronous Machine with Salient-poles

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Sami Guizani (IPEIEM, Tunisia),
Faouzi Ben Ammar (Université 7 Novembre, Carthage, INSAT, Tunisia)

Abstract

In this paper the authors propose the mathematical model in Park reference frame of the open-end stator winding salient poles permanent magnet synchronous machine, this machine by sinusoidal voltage is validated. Then the machine is supplied by two 2-level inverters and compared with classic permanent magnet synchronous machine. And feeding machine by two 2-levels cascaded inverters is presented. The authors present the analysis of this machine into consideration the THD voltage, THD current and the torque undulation.

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Paper reference
SSD'15-PES-8-1

Comparison of MPPT Algorithms for DC-DC Boost Converters Based PV Systems Using Robust Control Technique and Artificial Intelligence Algorithm

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(High Engineering School of Gabes, Tunisia)

Abstract

This paper proposes two methods of maximum power point tracking algorithm for photovoltaic systems, based on the first hand on fuzzy logic control and on the other hand on the first order sliding mode control. According to the non-linear characteristic of photovoltaic array, it's necessary to find a solution to track the maximum power of the PV system in order to improve its efficiency. The fuzzy logic controller was presented in many works. It provides fast response and good performance against the climatic and load change and uses directly the DC/DC converter duty cycle as a control parameter. Moreover, the sliding mode control approach is recognized as one of the efficient tools to design robust controllers it has been receiving much more attention within the last two decades and many research are dealing with this type of robust controllers. A detailed comparison between the fuzzy logic and slinging mode controllers was presented in this work. Simulation results show that the proposed algorithms can effectively improve the efficiency of a photovoltaic array output.

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Paper reference
SSD'15-PES-8-2

Decentralized Charging Infrastructure for the E-Mobility

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(HTWK Leipzig, Germany)

Abstract

Electromobility offers the opportunity to achieve individual mass mobility in a conscious efficient, climate friendly and environmentally manner. Therefor new technologies in energy distribution grids are needed with the integration of decentralized intelligently networked charging infrastructure. The paper is focused is on interprocess communication and demand side management especially for e-mobility.

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Paper reference
SSD'15-PES-8-3

A New Power Management Algorithm for a Stand - Alone Hybrid System Supplying a Desalination Unit

Mariem Smaoui, Lotfi Krichen
(University of Sfax, ENIS, CEMLab, Sfax, Tunisia)

Abstract

A renewable hybrid system coupled to a reverse osmosis desalination unit in southern Tunisia is studied. The hybrid system includes a photovoltaic generator, a wind turbine, a fuel cell and an electrolyzer. To allow a real penetration of intermittent energy sources and to satisfy the fresh water needs, a new power management algorithm allowing the control of the energy flow between the system components is developed. Two sub-algorithms are incorporated in this algorithm. These two sub-algorithms determine the production lines number operating at a pre-defined time interval and adjust the consumed power by the desalination unit. Simulation results are carried out over one year and present the different parameters describing the behavior of the system. These results demonstrate the feasibility and the efficiency of the used control strategy and the performance of the hybrid system.

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Paper reference
SSD'15-PES-8-4

Design Verification Based on Hardware-in-the-Loop Simulation for Photovoltaic System

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Mohamed Abid (CES-ENIS, Tunisia),
Hafedh Abid (ENIS, Tunisia)

Abstract

Due to the increasing complexity of photovoltaic systems and problems linked to development and design, verification of the entire system operation is essential before real implementation. Besides, high requirements of a real-time simulation and control circuit prototyping before application increases safeness, and can reduce time and costs of implementation. For this end, the purpose of this work is to achieve photovoltaic system development and its design verification through system simulation using FPGA device. The verification method used in this study is the "Hardware-In-the-Loop" (HIL) simulation method. It provides an effective platform for developing and testing real time embedded systems. In this paper, we design the power circuit and we develop the open-circuit voltage controller which tracks the maximum power point. Then, the HIL simulation process is performed for the photovoltaic system. The efficiency of the photovoltaic system is validated by the simulation results.

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Paper reference
SSD'15-PES-8-5

Small Signal Modeling and Stability Analysis of Wind Turbine with PMSG Connected to the Grid

Maryam Chouket
(ENIS, Tunisia)

Abstract

In this paper, a detailed mathematical model of wind turbine with direct drive permanent magnet generator (DDPMSG) and its associated controllers connected to the grid is presented to derive a small signal stability model. DDPMSG is used with and without PI controller and tested for both cases to improve the system stability. Therefore, eigenvalues analysis based approaches have been studied to evaluate the stability problem. Afterward, the impact of the controller parameters variation on the trace of eigenvalues is investigated to improve the system stability under small disturbances of a wind velocity. The simulation analysis study was done using MATLAB/SIMULINK.

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Paper reference
SSD'15-PES-8-6

Action on the Dynamic Behavior of a Washing Machine in a Renewable Multi-Agent System

Randa Kallel, Ghada Boukettaya and Lotfi Krichen
(University of Sfax, ENIS, CEMLab, Sfax, Tunisia)

Abstract

This paper investigates the action on the dynamic behavior of a domestic washing machine in a multi-agent system. The purpose of this work is to develop a demand side management control strategy by modifying the washer power profile. This strategy leads to increase the renewable energy usage and to reduce peak demands by modifying the electrical profile of the consumer.

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Paper reference
SSD'15-CSP-1-1

An Efficient Hardware Architecture for Interpolation Filter of HEVC Decoder

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Ahmed Ben Atitallah (ISECS, Tunisia),
Nouri Masmoudi (Ecole Nationale d'Ingénieurs de Sfax, Tunisia)

Abstract

In most video coding standard, motion compensation MC is applied to remove temporal redundancy and reduce the size of bit stream significantly. In the decoder, the reconstructed MV (Motion Vector) is generated from the prediction error and neighboring information. However, due to the finite sampling the motion of blocks does not match exactly in the integer positions of samples grid. The High efficiency video coding standard HEVC introduced 7 taps filter and 8 taps filter for the interpolation of 1/4 and 1/2 luminance sub positions respectively which can give a better precision in the inter prediction process. Furthermore, the profiling of the HM reference software proves that the interpolation filter consume more than 50% of the complexity of Motion Compensation block in the HEVC decoder with random access configuration. Therefore, a new flexible hardware architecture for half and quarter fractional pixels used in the interpolation filter is proposed in this paper. This architecture can process the whole fractional positions of 4×4 PU (prediction unit) in only 30 clock cycles and support a maximal throughput of QFHD@30fps at 185 MHZ. The implementation is performed with the technology TSMC 0.18μm.

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Paper reference
SSD'15-CSP-1-2

Digital images watermarking and partial encryption based on DWT transformation and chaotic maps

Oussama Benrhouma, Olfa Mannai, Houcemeddine Hermassi
and Safya Belghith
(Ecole Nationale d'Ingnieurs de Tunis, Tunisia)

Abstract

In this paper we present a commutative watermarking and partial encryption techniques based on wavelet transformation and chaotic maps. The commutative property of the proposed scheme allows us to cipher a watermarked image without interfering with the embedded signal or to watermark an encrypted image still allowing perfect deciphering. Both operations are performed in a transform domain given by the DWT transform. Level 1 DWT transformation gives four coefficients: One approximation coefficient which contains the most important information of the image , and three details coefficients. The main idea of Our scheme in to hide the approximation coefficient in the details and to encrypt that coefficient considering that it contains the most information of the image, so the encryption of the approximation coefficient leads to the encryption of the whole image.

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Paper reference
SSD'15-CSP-1-3

Prototype Arabic Sign Language Recognition using Multi-Sensor Data Fusion of Two Leap Motion Controllers

Mohamed Mohandes
(King Fahd University of Petroleum & Minerals, Saudi Arabia)

Abstract

Sign language is important for facilitating communication between hearing impaired and the rest of society. However, most vocal people do not understand sign language, hence, the need to develop system capable of translating sign language. Two approaches have traditionally been used in the literature: image-based and glove-based systems. Glove-based systems require the user to wear electronic gloves while performing the signs. The glove includes a number of sensors detecting different hand and finger articulations. Image-based systems use camera(s) to acquire a sequence of images of the hand. Each of the two approaches has its own disadvantages. The glove-based method is not natural as the user must wear a cumbersome instrument while the camera-based system requires specific background and environmental conditions to achieve high accuracy. In this paper, we propose a new approach for Arabic Sign Language Recognition (ArSLR) which involves the use of two Leap Motion Controllers (LMC) to prevent the case of one finger being occluded by another finger or hand. This device detects and tracks the hand and fingers to provide position and motion information. We propose to use the two LMCs as a backbone of the ArSLR system. In addition to data acquisition, the system includes a preprocessing stage, a feature extraction stage, and a classification stage. Fusion of evidences from the two LMCs at the feature extraction and classification stage was also investigated using Dempster-Shafer theory of evidence. Features fusion from the two LMCs gives 97.7% classification accuracy with Linear Discriminant Analysis (LDA) classifier and 97.1% with classifier level fusion. This gives better recognition over the use of a single LMC.

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Paper reference
SSD'15-CSP-2-1

Estimating the K-Distribution Parameters Based on Fractional Negative Moments

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Amar Mezache
(Département Electronique, Laboratoire Signaux et Systèmes de Communications & Département Electronique, Faculté de Technologie, Université de M'sila, Algeria)

Abstract

Estimation quality of the K-distribution parameters can be improved using a low fractional moments. For noiseless situations and a single pulse processing, we resort in this communication to the fractional positive moments and the fractional negative moments of the received data to derive a new estimation method whose non linear estimates of the shape parameter are achieved using numerical computations. Regardless of these computational requirements, simulation comparison with the existing higher order moment estimator (HOME), fractional order moment estimator (FOME) and z[log(z)] based estimator, show that the new estimator yields asymptotically a lower mean square error (MSE) estimates of the characteristic parameters.

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Paper reference
SSD'15-CSP-2-2

Planar Multi-Classifier Modelling-NN/NN for face recognition

Imen Abroug (SAGE ENISo, Tunisia),
Najoua Essoukri Ben Amara (ENISo, Tunisia)

Abstract

We present in this paper a new approach to modeling an image in a pattern recognition context. It relates to a generalization of the planar Markov modeling, which we call Planar Multi-Classifier Modeling (PMCM). These models allow exploring various classifier types, among others, Markov ones, to model delimited bands of an image associated with a given pattern. Determining the different parameters of the proposed planar model is made explicit. Various PMCM architectures are proposed, we present in this paper the PMCM-NN/NN architecture. The validation has been performed in the case of face recognition. The different experiments, carried out on the public FERET database, have led to promising results.

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Paper reference
SSD'15-CSP-2-3

Image Matching Based on LBP and SIFT Descriptor

Leila Kabbai, Aymen Azaza and Ali Douik
(Ecole Nationale d'Ingénieurs de Monastir, Tunisia)

Abstract

In this paper, we propose a new approach for extracting invariant feature from interest region. The new descriptor is inspired from the original descriptor SIFT (Scale Invariant Feature Transform) which is widely used in image matching by extracting interest points (IPs). However, this descriptor performs badly when the background is complex or corrupted with noise. Then, we adopt the local binary Pattern (LBP) descriptor with uniform pattern and the center symmetric local binary pattern (CSLBP) instead of a gradient feature used in the SIFT algorithm. To do so, we present new descriptors based on different combinations of SIFT, LBP and CSLBP descriptors to improve matching results. Thus, we compute different evaluation measures such as repeatability, recall and precision for various images transformations (blur attack, rotation and affine transformation). Experiments, which are achieved on two different databases, show that the descriptors leads to better results.

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Paper reference
SSD'15-CSP-2-4

Statistical Performance Analysis of a Cryptosystem Based on the Discretized Ikeda System

Olfa Mannai, Rabei Becheikh, Houcemeddine Hermassi, Safya Belghith
(Ecole Nationale d'Ingnieurs de Tunis, Tunisia)

Abstract

In this paper, we exploit the topological features of nonlinear delay differential systems (NDDS) to study the statistical performance analysis of a cryptosystem based on the discretized version of a simple first order time-delay system with appropriate non-linearity. Numerical results have shown optimal statistical properties making the cryptosystem robust against most common attacks.

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Paper reference
SSD'15-CSP-2-5

Sea Clutter Modeling in Presence of Thermal Noise Using Beta-Prime Texture Distribution

Chalabi Izzeddine (University of M'sila, Algeria),
Amar Mezache
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Abstract

Modeling of high resolution sea radar clutter using compound-Gaussian model with additive thermal noise is proposed in this communication. To do this, the Beta-Prime distribution is selected as a texture component. Then, the overall PDF (probability distributed function) is given in integral form in terms of three parameters. As the closed form methods to estimate these parameters can not be achieved, we resort in this work to use the parametric curve fitting estimation approach based on the Nelder-Mead (N-M) algorithm to get the optimal estimates of the parameters. It is shown, with reference to real IPIX high resolution radar clutter that the compound Beta-Prime distribution can yield tighter fits compared to the K-plus-noise and the Pareto-plus-noise models in most case.

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Paper reference
SSD'15-CSP-2-6

Adaptive Filter for Perceptual Speech Enhancement

Sana Alaya
(ENIT, Tunisia))

Abstract

In this paper, we present a new perceptual speech enhancement method. It is based on an improved spectral subtraction filter and a spectral attenuation filter. In the classic noise reduction techniques, both musical noise and distortions are introduced in the enhanced speech signal. Consequently, the perceptual appearance is affected. Within this context, our method consists in making the musical noise, produced by the classical methods, inaudible. Objective and subjective tests prove the effectiveness of the proposed method in reducing noise and also in minimizing distortions in the proceeded speech signal.

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Paper reference
SSD'15-CSP-3-1

Towards Unsupervised Learning and Graphical Representation for on-Line Handwriting Script

Mariem Gargouri (University of Sfax, Tunisia),
Sameh Masmoudi Touj (ISI, Tunisia),
Najoua Essoukri Ben Amara (ENISo, Tunisia)

Abstract

To train cursive script recognition system, a large labeled database at different levels (grapheme, character or word) is required. Nevertheless, manual segmentation and labeling are tedious tasks. To reduce the human workload, we are motivated to automate the annotation process. Considering online handwriting problems and the Arabic script characteristics, we discuss the implementation of word recognition system based on unsupervised approaches. Word segmentation is performed into strokes as written by the writers. Then, Agglomerative Hierarchical Clustering is used to produce a codebook with one stroke per class. This codebook is labeled manually. Using spatial relations, we introduce a new representation for online Arabic handwriting which is graphical representation.

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Paper reference
SSD'15-CSP-3-2

Restoration of Ancient Colored Documents Foreground/Background Separation

Amal Ghomrassi (SAGE-ENISo, Tunisia),
Mohamed Aymen Charrada (University of Sousse, Tunisia),
Najoua Essoukri Ben Amara (SAGE-ENISo, Tunisia)

Abstract

In this paper, we propose a new approach for foreground/background separation to restore degraded ancient documents suffering from recto/verso transparency. This approach is used to process single-sided documents and proceeds in three steps: The first step aims to separate between the background and foreground of the image by a contrast enhancement using gamma correction and histogram stretching. The second step consists in separating the final foreground and the remaining noised pixels. This step is based on the pixel-level characterization of the initial foreground followed by a Principal Component Analysis. Then, the results are ameliorated using a Fuzzy C-Means classification with two classes followed by a maximum likelihood algorithm to refine the results and to correct the misclassified pixels. Finally, the third step allows the reconstruction of the final restored image using the obtained foreground and background. The new approach presents the advantage of the accuracy of its results.

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Paper reference
SSD'15-CSP-3-3

Arabic Handwritten Characters Recognition Using Deep Belief Neural Networks

Mohamed Elleuch
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Najiba Tagougui and Monji Kherallah (University of Sfax, Tunisia)

Abstract

In the handwriting recognition field, the deep learning is becoming the new trend thanks to their ability to deal with unlabeled raw data especially with the huge size of raw data available nowadays. In this paper, we investigate Deep Belief Neural Network (DBNN) for Arabic handwritten character/word recognition. The proposed system takes the raw data as input and proceeds with a grasping layer-wise unsupervised learning algorithm. The approach was tested on two different databases. For the character level one, the results were promising with an error classification rate of 2.1% on the HACDB database. Unlike, the character level, the evaluation on the ADAB database to deal with word level shows an error rate which exceeds the 40%. Hence, the proposed DBNN structure is not already able to deal with high-level dimensional data and thus has to be improved.

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Paper reference
SSD'15-CSP-4-1

Optimized Node Classification and Channel Pairing Scheme for RF Energy Harvesting Based Cognitive Radio Sensor Networks

Saleem Aslam and Mohamed Ibnkahla
(Queen's University, Canada)

Abstract

Cognitive radio networks (CRNs) has appeared as a promising solution to solve the problem of spectrum scarcity and improve spectrum utilization. Furthermore, the RF energy harvesting is predicted as novel solution to counter the issue of limited network energy and support green communication paradigm. In this paper, we knot both solution together to achieve spectral and power efficiency and introduce residual energy aware channel allocation scheme for cognitive radio sensor network. The multiband EH mechanism is introduced to self-empower the censor nodes. In addition, we incorporate a secondary transmission index (STI) in the channel selection which forecast the length for the idle state of the channel. Simulation results prove that the proposed scheme show significantly higher performance gain in terms of throughput, idle time, collision with primary users and life time of the network compared to the existing approaches.

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Paper reference
SSD'15-CSP-4-2

OFDM Systems Performance Enhancement

Omar Daoud, Qadri Hamarsheh and Ahlam Damati
(Philadelphia University, Jordan)

Abstract

In this work a comparison among different proposed algorithms has been done to check the performance improvements for current wireless technologies. Orthogonal Frequency Division Multiplexing (OFDM) technique is one of the main techniques that are uses to enhance the quality of service (QoS) for beyond third generation (B3G) systems. This is in order to meet the rapidly increased of multimedia users demand. This comparison includes three previous propositions that were made to enhance the OFDM performance; work based on linear coding techniques, work based on wavelet transform and work based on PWM. All these propositions have been made to combat the effect of high Peak-to-Average Power Ratio (PAPR).

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Paper reference
SSD'15-CSP-4-3

A Real-Time Indoor Localization Platform based on Wireless Sensor Networks

Amir Guidara (ENIS, Tunisia, Tunisia),
Faouzi Derbel (Leipzig University of Applied Sciences, Germany)

Abstract

The localization services are growing sharply after the evolution of the mobile devices which are almost equipped by the GPS technology (Global Positioning System). There is diversity in the positioning services but the majority of them are provided for outdoor purposes. These outdoor positioning systems include Car Assist Navigation, Outdoor Person Tracking, Mapping Services... However, there are no available widespread indoor localization systems since now. Some recent statistics show that people spends from 80 to 90 percent of their time indoor at home, in the office or even in the supermarkets. The indoor positioning systems and services can be very beneficial in our daily life. Often, many people are projected in different situations where they need someone that can answer to questions like: Where can I find an ATM in a commercial center? Where I have parked my car? How to go to the corresponding airport's terminals and gates? These situations can face anyone who is not very familiar with the place where he is. Therefore the Indoor Navigation system can be a solution to guide humans or robots inside buildings in order to reach their desired destination. Also the indoor localization can be useful for Asset Tracking purposes. For example it can be helpful inside hospitals to track medical staffs and to assign qualified personnel for specific tasks. In addition Asset Tracking is very benefic in warehouses and supermarkets because it helps to improve the logistics services inside these enterprises. Moreover the indoor localization technology can be used for advertising. Sometimes providers need to send targeted ads or new products info to their customers inside a mall center. Also Indoor localization can be used for entertainment like developing interactive video games. The mentioned cases push researchers to think seriously about providing sophisticated and accurate indoor positioning systems in order to make our life easier. The satellite-based

technology, like the GPS, is very limited for indoor localization because it is hard to pick up the signals emitted by the satellites in buildings or huge structures. For this reason new indoor localization technologies are revealed such us the vision based and the wireless communication based. The vision technology is mainly based on the computer vision and image processing techniques. This method requires powerful computational units which are greedy in term of energy consumption. In addition it is hard to process the data in Real Time especially that image processing tasks could take a considerable time to be achieved. After the evolution of the wireless communication in the last decade, researchers come to present an alternative in the indoor positioning technologies which is the localization based on the Wireless Sensor Networks (WSN). Despite the low computational load and the flexibility in terms of communication protocols, it stills some challenges when using WSN for indoor localization goals. The indoor environments have different characteristics like; open or close area, static or dynamic rooms, high or low ceiling, metal surfaces and crowded or empty zones. These characteristics could influence on the quality of radio communication because obstacles can effect on the physical properties of the wave like direction, transmission power, wavelength... Therefore, to reach high indoor localization accuracy, it is recommended to take into consideration reflection, refraction, shadowing, diffraction and scattering phenomena. In addition the WSN technology is based on battery-powered sensing nodes, so it is recommended to concept an indoor localization system with low energy cost in order to increase the batteries life time. In this paper we present a localization system for indoor applications based on wireless sensor networks. With improvements in terms of signal processing we realized an accuracy of 1m which is very useful for many applications.

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Paper reference
SSD'15-CSP-4-4

Performance Enhancement of Adaptive Beamforming Algorithms Based on a Combination Method

Thamer Jamel
(Philadelphia University, Jordan)

Abstract

This paper proposes new two adaptive beamforming algorithms based on a combined method. The first proposal combination method includes merging pure Conjugate Gradient Method (CGM) with pure Normalized Least Mean Square (NLMS) algorithms, so that the first a new algorithm is called as CGM-NLMS. While the second proposed algorithm merges pure CGM with a Modified NLMS algorithm (MNLMS). The MNLMS algorithm is regarded as a variable regularization parameter that is fixed in the conventional NLMS algorithm. Then the new combination algorithm is called as CGM-MNLMS algorithm. Through simulation results of adaptive beamforming system using an Additive White Gaussian Noise (AWGN) channel model, the two new proposed algorithms provides fast convergence time, higher interference suppression capability and low level of MSD, and MSE at steady state compared with the pure CGM and pure NLMS algorithms.

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Paper reference
SSD'15-CSP-4-5

Algebraic Constructions of Quasi-Cyclic LDPC Codes Based on Generators

Rui Zhang, Guixia Kang and Ningbo Zhang
(Beijing University of Posts and Telecommunications, P.R. China)

Abstract

This paper puts forward two novel algebraic constructions of quasi-cyclic low-density parity-check (QC-LDPC) codes. The two constructions are achieved on multiplicative and additive matrix dispersions of two specified base matrices, which are constructed base on multiplicative and cyclic groups, respectively. In addition, masking, as a powerful technique in code construction, can also be applied to the two constructions, inducing new QC-LDPC codes. Simulation results show that codes generated in this paper performs well with iterative decoding over AWGN channel. The codes have advantages over MayKay codes in some aspects of code performances. Meanwhile, two codes constructed in this paper converge fast in iterative decoding, which is an important property in high throughput communication system.

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Paper reference
SSD'15-CSP-4-6

Rigorous Analysis Of A High Tc Circular Superconducting Microstrip Patch in a Substrate-Superstrate Configuration

Fadila Benmeddour, Ouarda Assas
(Universite of M'sila, Algeria)

Abstract

In this paper, the effects of both the anisotropic substrate and isotropic protecting dielectric superstrate loading on the resonance and bandwidth of a high Tc superconducting circular microstrip in a substrate-superstrate configuration are investigated. The problem is rigorously formulated using integral equation, the kernel of which is the full-wave spectral domain dyadic Green's function for multilayer dielectric substrates. Using Galerkin's moment method to solve the integral equation, the complex resonance frequencies are studied with basis functions involving Chebyshev polynomials in conjunction with the complex resistive boundary condition.

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Paper reference
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An Ultra Low Power Wake up Receiver with Flip Flops Based Address Decoder

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Sadok Bdiri, Faouzi Derbel (Leipzig University of Applied Sciences, Germany)

Abstract

Energy-Efficient Communication is one of the main requirements in the development of wireless sensor networks especially for event-triggered applications. These applications present low data rate and the real time behavior is an issue. Duty-cycling scheme is proposed where the node's transceiver is turned off and on regularly in order to listen to the radio channel for possible incoming communication during its on-state. Nonetheless, such a paradigm performs poorly for scenarios of low or bursty traffic because of unnecessary activations of the radio transceiver. As an alternative technology, Wake-up Radio (WuR) systems present a promising energy-efficient network operation, where target devices are only activated in an on-demand way by means of a special RF signal. The wakeup receiver is ultra-low power receivers which always on for a continuous idle listening of the channel. It detects the wakeup signal, identifies it, and if the wake-up packet corresponds to the requirements, an interruption signal will be sent to the main transceiver to activate it. In this work, we present a novel wake-up receiver operating in the 868 MHz Industrial, Scientific and Medical (ISM) frequency band. The proposed wake-up receiver consists of an RF front end circuit and a digital code detector for the identification. The RF front end circuit is implemented with passive elements and is triggered by radio energy to minimize power dissipation. It is simulated using Advanced Design Software (ADS) by Agilent. A prototype of the RF front end wakeup receiver is implemented into two layers PCB. Meanwhile, the code detector generates an interrupt signal to the main transceiver based on the received information. Thus, it enables the main transceiver to react to the events instantly. The code detector is based on logic flip flops. It is simulated using ISIS proteus. Detailed descriptions of each block and performance evaluation in term of power consumption and latency have being carried out.

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Paper reference
SSD'15-CSP-5-2

Synthesis of Total Harmonic Distortion and Interference Between Stereo Spectrum and RDS Process

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Fahmi Ghozzi (ENET'Com, Sfax, Tunisia),
Lassaad Sbita (ENIG, Tunisia)

Abstract

By reference to our recent paper [1] and in order to elaborate a new telemetry network destined to supervise a photovoltaic (PV) fields, using RDS subscriber (Radio Data System) we continue to study various aspects of the transmission. So, in this paper, we gathered all eventualities of distortion and interference between different components of signals in order to draw conclusions about our telemetry process transmission. Total harmonic distortion THD and inter-modulation between signals are the main parameters considered in this simulation.

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Paper reference
SSD'15-CSP-5-3

Method of Auxiliary Sources for the Electromagnetic Scattering Problem From an Array of Different Cylinders

Sami Hidouri
(National Engineering School of Tunis, Tunisia)

Abstract

A rigorous solution is presented for electromagnetic scattering from an arrangement of long, axially parallel cylinders. The arrangement is constituted of dielectric and perfectly conductive cylinders illuminated by plane TMz wave.. The solution is obtained using the standard method of auxiliary sources. Then an optimization of the solution is introduced to minimize the computational cost of the resolution of the scattering problem. In order to check the validity of this method in the case of inhomogeneous cylinders, the radar-cross section of some examples of linear array of inhomogeneous structure are calculated and compared with available data in the literature.

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Paper reference
SSD'15-CSP-5-4

An Empirical Model of the SBX Daughter Board Output Power Driven by USRP N210 and GNU Radio Based Software Defined Radio

Rafik Zitouni (ECE Paris, Université de Paris Est, France),
Stefan Ataman (ECE, France)

Abstract

In this paper, we propose an empirical model based on Radio Frequency (RF) measurements. The output power is measured sweeping a frequency band from 350 MHz to 4400 MHz of four SBX daughter boards. These daughter boards are connected to a Universal Software Radio Peripheral (USRP) N210. For each carrier frequency, a narrowband sinusoidal signal is generated by a GNU Radio Software Defined Radio (SDR). The output power at each carrier frequency is measured through a spectrum analyzer. Hence, an empirical model has been obtained to predict the output power in the analyzed frequency band.

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Paper reference
SSD'15-CSP-6-1

Low Complexity and Efficient Architecture of 1D-DCT based Cordic-Loeffler for Wireless Endoscopy Capsule

Nedra Jarray, Abdelkrim Zitouni and Majdi Elhaji
(Faculty of Science of Monastir, Tunisia)

Abstract

Due to the power limitation and the small size condition of the wireless capsule endoscopy, therefore the principal defiance is to reduce the area and the power consumption. The aim is to preserve acceptable image reconstruction and coding. In this paper, we present a Low complexity and efficient architecture of 1D-DCT based Cordic-Loeffler technique for wireless capsule endoscopy. Our improvement over the original algorithm is performed in CORDIC part. This brings us to reduce the number of addition operations from 18 to 10. As a result, the number of addition is reduced from 38 to 30 operations in the main algorithm. Also, to more ameliorate our results, we used Modified Carry look Ahead adder (MCLA) and Carry Save Adder (CSA) adder which are characterized by low power and high speed compared to classical Carry Look Ahead adder (CLA). Our aim is to provide an optimized architecture in terms of area and power consumption. The proposed design has been implemented on FPGA. Compared to other architectures, the proposed architecture has not only reduced the computation complexity, but also the area and the power consumption. It should be noted that the proposed DCT architecture is very suitable for low-power and high-quality codecs, especially for battery-based systems.

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Paper reference
SSD'15-CSP-6-2

Skin Lesion Segmentation Using the D-S Evidence Theory Based on the FCM Using Feature Parameters

Olfa Trabelsi (ENSIT, Tunisia),
Mounir Sayadi (High School of Science and Technology of Tunisia, Tunisia)

Abstract

Lesion segmentation is an important step in diagnostic of skin lesion images. In this paper, to improve the segmentation of the skin color image (RGB), we apply the Fuzzy-C-Means method based on feature parameters in each color component (R, G and B) and we use the Dempster -Shafer evidence theory method to merge the results and to have the final segmentation result. In this work, the proposed technique was compared with the FCM based on feature applying in gray level skin image and the experiments show the performance of the proposed technique.

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Paper reference
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A New Approach Based on the Serological Tests for the Diagnosis of Tuberculosis in Cattle

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Lotfi Tlig (Esstt SICISI Unit, Tunisia),
Makram Essafi (Institut Pasteur de Tunis, Tunisia),
Mounir Sayadi (ENSIT, Tunisia)

Abstract

The diagnosis of bovine tuberculosis (TB) is still a challenge for a better control of the disease. Here we report the use of a simple ELISA test combined with a multilayer neuronal network analyzing method in order to diagnose TB in cattle from the north part of Tunisia. The subjects were first divided into two groups of TB+ and TB- based on their response to the standard gold tuberculin skin test (TST). Sera of all subjects were simultaneously collected and assessed, by ELISA, for interaction with a panel of Mycobacterium bovis (Mbv)-specific recombinant proteins, namely the recombinant 10 kDa culture filtrate antigen (CFP-10), the 6 kD Early Secretory Antigenic Target (ESAT-6), the recombinant ESAT-6/CFP-10 heterodimer along with the crud BCG proteins and Tuberculin purified protein derivative (PPD). We then described a new approach to select the most discriminative antigen and/or the antigens combination to be used to diagnose TB using the simple ELISA test. The classification of subjects into two groups, TB+ (TST+) and TB- (TST-) subjects, was affected by an artificial multilayer neural network and the statistical study to estimate the diagnosis of bovine tuberculosis and the construction of an optimal partition of the results were detailed. This method may prove helpful to develop an efficient simple way for the diagnosis of bovine tuberculosis.

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Paper reference
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Features Selection for an Optimization of EEG Classification

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Nouredine Ellouze (ENIT, Tunisia)

Abstract

Brain computer interface represents a way for severely disabled persons to communicate via EEG signals . The classification of EEG signals can be improved using features selection ,allowing to find relevant features for EEG description. In this paper, The features selection is performed using successively t-test and entropy criteria in the proposed classification scheme. EEG Features extraction is accomplished using Symmelt5 wavelet function, then features are ranked using t-test and entropy criteria. Classification results accomplished via Linear Discriminate Analysis LDA classifier illustrate an improvement of 7% is in the classification accuracy.

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Paper reference
SSD'15-CSP-7-1

Implementation of Speech Synthesis Based on HMM using PADAS Database

Mohamed khalil Krichi (FST-Faculty of Sciences de Tunis, Tunisia),
Adnan Cherif (Communication and Signal Processing, Tunisia)

Abstract

This paper describes the Arabic system synthesis on hidden Markov models (HTS). The main objective of Text-to-Speech (TTS) synthesis is to convert arbitrary input text to intelligible and natural sounding speech. Our developed synthesis system uses phonemes as HMM synthesis unit. In this work, the Phonetic Arabic Database Automatically Segmented "PADAS" based on rich phonetic and balanced speech corpus is used. Prosody is applied which makes the synthesized speech sound more like human speech. In order to reduce the synthetic quality, STRAIGHT system used into the system. Besides that basic setup, a high-quality analysis/ synthesis system STRAIGHT was employed for more sophisticated speech representation. This method has several advantages. As it is parametric, it is possible to play on the HMM parameters, change the producer voice characteristics. The developed model improves the speech synthesis, naturalness and intelligibility quality in the Arabic language environment.

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Paper reference
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A Novel Approach for Auditory Spectrum Enhancement to Improve Speech Recognition's Robustness

Khaireddine Salhi
(ENIT, Tunisia)

Abstract

The success of acoustic features derived from MFCC and PLP turned them into a standard choice in specific conditions but their performances degrade with additive noise. Recently, we have proposed an auditory feature extractor based on gammachirp wavelet transform, they are obtained by replacement of the filter bank used in above methods by a gammachirp wavelet transform. We found that proposed feature give a significant improvement in robust speech recognition than conventional acoustic feature.

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Paper reference
SSD'15-CSP-7-3

Using Single Log-Gabor Filter and Reassignment Method for Audio Classification Applications

Souli Sameh
(ENIT, Tunisia)

Abstract

We present a robust environmental sound classification approach, based on reassigned spectrogram and log-Gabor filters. In this method, reassigned spectrograms are passed through an appropriate log-Gabor filter and the outputs are underwent an optimal feature selection procedure based on mutual information criteria. The evaluation of this classification system is performed on a corpus of 6 environmental sounds classes. The best performance was obtained using multi-class support vector machines (SVM's), producing an average classification accuracy of the order 91.77%.

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Paper reference
SSD'15-CSP-7-4

Comparison Between GMM-SVM Sequence Kernel and GMM: Application to Speech Emotion Recognition

Imen Trabelsi
(ENIT, Tunisia)

Abstract

Speech emotion recognition aims at automatically identifying the emotional or physical state of a human being from his or her voice. The emotional state is an important factor in human communication, because it provides feedback information in many applications. This paper make a comparison of two standard methods used for speaker recognition and verification: Gaussian Mixture Models (GMM) and Support Vector Machines (SVM) for emotion recognition. The gaussian components of the GMM statically represent the spectral characteristics of the emotion. The main goal here is to analyze and compare influence of initial setting of parameters such as number of mixture components, used number of iterations and volume of training data for GMM training process. Experimental studies are performed over the Berlin Emotional Database, expressing different emotions, in German language. The emotions used in this study are anger, fear, happy, neutral, disgust, and sadness. Experimental results show the effectiveness of the combination of GMM and SVM in order to classify sound data sequences when compared to systems based on GMM.

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Paper reference
SSD'15-SCI-1-1

An Energy Efficient Convergecast Generic Algorithm for Wireless Sensors Network

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Abstract

The aim of the present work is to develop a new Convergecast routing technique which allows to connect many source nodes to a single sink node via a wireless sensor network (WSN). The synthesized method overcame the problem of energy consumption resulting from the repetition of the course of the edges during a transmission period. The proposed technique, based on intelligent routing algorithm to transmit the collected data to the base station, ensured a reduction of the routing paths length. This new approach was applied to a WSN, designed to control the temperature and volume of propane and butane in the tanks of the British Gas Group, for minimizing the energy consumed and increasing the life cycle of the network.

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Paper reference
SSD'15-SCI-1-2

A Novel Implantable Planar Inverted-F Antenna for Biomedical Applications

Amal Bouazizi, Nejah Nasri, Ghada Zaibi, Mounir Samet and Abdennaceur Kachouri

(University of Sfax, ENIS, Laboratoire d'Electronique et des Technologies de l'Information, Tunisia)

Abstract

In recent years, the Wireless Body Area Network WBAN has emerged over the world as a new technology for medical applications. The advent of technology and concern for the patient's comfort lead to extreme miniaturization of medical devices. This miniaturization is not done without the degradation of the antenna's performance. This paper presents a novel design of rectangular Planar Inverted-F Antenna (PIFA) for biomedical application in Medical Implantable Communications Service band MICS (402-405) MHz. The use of MICS band is of great importance. It is dedicated just for implantable medical applications thus the risk of interference is minimal. Different miniaturization techniques are combined with the use of high dielectric (substrate/superstrate) to fulfill a tradeoff between size and performances. The proposed antenna is characterized by a good performances and a small size $11.9 \times 14.7 \times 1.2\text{mm}^3$ compared to other implantable antennas in the literature.

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Paper reference
SSD'15-SCI-1-3

Power Saving Solution For WSN Cases Studies based on Interrupt handler versus DMA

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Abstract

In Almost wireless sensor network (WSN), nodes are usually powered with non-reloadable battery. Hence, power consumption reduction is the main challenge for longer nodes lifetime. Direct memory access (DMA) is recommended for data transfer as best power saving solution. In this paper we contradict this thesis. We demonstrate experimentally and theoretically that for some cases of typical WSN data transfers using interrupt (IT) handler is better than DMA. We calculated and measured the power needed for each transfer mode (DMA and IT) based on different parameters acting in data transfer and we prove that IT handler saves an amount about 14% of power

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Paper reference
SSD'15-SCI-1-4

Extending the Network Lifetime of Wireless Sensor Networks Using Fuzzy Logic

Oussama Ben Belghith and Lassaad Sbita
(National Engineering School of Gabes ENIG, Tunisia)

Abstract

Wireless Sensor Networks (WSNs) present a real-time embedded system with limited energy, computation and memory resources that are being used in a wide variety of applications. In designing WSN routing protocol, the enhancing energy efficiency and extending the lifetime of WSNs are the most important challenges for researchers. In LEACH protocol each sensor node elects itself as a cluster head based on a probability model. Selected cluster heads may be located near to each others or even near to the edge of the networks which leads to inefficient energy distribution. Almost researches are to conserve energy at its maximum level. In this paper, a fuzzy logic approach to cluster-head election is proposed based on three descriptors - energy, distance to coordinator and density. Simulation shows that depending upon network configuration, a substantial increase in network lifetime can be accomplished as compared to probabilistically selecting the nodes as cluster-heads using only local informations.

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Paper reference
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Analytical modeling of a multi-coil system for inductive powering of movable low-power wireless devices

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Koushik Sasmal (TU Chemnitz, Germany),
Olfa Kanoun (Chemnitz University of Technology, Germany),
Hafedh Trabelsi (Engineering school of Sfax, Tunisia)

Abstract

Inductive power transfer provides interesting possibilities for supplying movable devices. In this paper, an analysis of the inductive link for a multi coil system consisting of an array of air-core transmitter coils connected in series is carried out. An analytic model for the system is proposed and the corresponding equations are solved numerically. These equations are verified then by simulation. The good fitting between analytic and simulation results implies the validity of the proposed model. The theoretical analysis is first highlighted to extract the critical parameters in order to achieve a large powering range and relative good efficiency. For the same reason, a series-series resonant tank is considered for both sending and receiving sides. A method to improve both link and power efficiencies is also proposed by setting an optimal load at the receiving side. The investigation shows that the system is capable to send 239milliwatts over 30 mm coil to coil distance and reaching 71.42% coil to coil efficiency and 14% as total efficiency.

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Paper reference
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Investigation of the magneto-mechanical coupling in a magnetoelectric vibration energy converter

Slim Naifar and Sonia Bradai (University of Sfax, Tunisia),
Christian Viehweger and Olfa Kanoun
(Chemnitz University of Technology, Germany)

Abstract

Magnetoelectric (ME) transducers have recently been used in vibration energy harvesting. The magneto-mechanical coupling between the magnetic circuit and the magnetostrictive layers can highly affect the output power of the converter. In this paper, a new vibration energy harvester has been designed and fabricated, which consists of a magnetic spring, two magnetoelectric transducers and a magnetic circuit. The magneto-mechanical coupling has been studied in detail in order to ensure the transmission of higher stress to the magnetostrictive layer.

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Paper reference
SSD'15-SCI-2-3

Novel electronic approach for efficient energy harvesting from Cu2S/CdS solar cell

Wagah Mohammed
(Pheladelphia University, Jordan)

Abstract

Remarkable progress has been made in the development of high efficiency Copper-Sulfide/Cadmium-Sulphide (Cu2S/CdS) solar cells. The stability degradation mechanisms of these devices are of utmost importance. Cu2S/CdS solar cell is fabricated of four main layers and deposited on a glass substrate. CdS film exhibited high degree of transmittance in the infrared region and showed sharp absorption edge at nearly 0.5 μm wavelength. Transmittance curves of Cu2S films diminished transmission in the near infrared region and have maximum transmittance value at 0.7 μm wavelength. The spectral response measurements for the Cu2S/CdS films prove that the light is absorbed mainly by the Cu2S layer. The sample exposed to 100 oC annealing (20 min.) yielded maximum photogenerated current. The annealing improves the open circuit voltage (Voc) of the samples, and Voc increases considerably with time while the degradation of the sample under illumination becomes smaller. The load characteristics of the cell washed for five minutes and heated at 200oC is improved by enhancement of the exchange reaction and formation of Cu2S/CdS layer. Another achievement of the cell efficiency is to deposit of a very thin layer of copper followed by additional heat treatment at 200oC for 5 minutes to ensure the formation of chalcocite phase. Improvements have been made by varying the thickness of Cu2S layer. More than 80% efficiency has been detected at 5 μm thicknesses with the highest efficiency in the gradual transition between 0.5 and 0.8 μm. This is the reason behind the choice of a few microns (2-5μm) thickness of the Cu2S layers. Creating a highly doped p++ layer at the surface of Cu2S can reduce the effects of the back contact potential barrier produces tunneling or thermally assisted tunneling carrier transport mechanism. The tunnel diode is formed by high doping thin layer of Cu2S to produce p++, then depositing another

highly doped CdS to produce n++. The tunnel diode is designed to be able to have a peak current that may exceed 50mA/cm2. Measured I -V characteristics of a Cu2S/CdS solar cell with Cu2S (p++) CdS (n++) tunnel diode at the short circuit current of the cell to be lower than the maximum tunneling current push the short circuit current up as long as the photogenerated current is increased, this consequently means that the maximum power output of solar cell is increased.

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Paper reference
SSD'15-SCI-2-4

Power Management Strategies In Self-Sufficient Sensor Nodes

Philipp Mehne (Albert Ludwig University of Freiburg, Germany),
Michael Kroener (University of Freiburg - IMTEK, Germany),
Peter Woias (University of Freiburg, Germany)

Abstract

Wireless sensor nodes, powered from energy harvesting generators using available ambient power sources, need a sophisticated power management to optimally budget the scarcely available energy. By that, the reliability, the functionality, and availability of these nodes are increased. The decisions of the power management can either be based on a simple energy income and storage level knowledge, or it additionally has empirical information about the past power income. In case the system comprises two energy storage units with different capacities for long and short term use, the commonly used power management algorithms do not offer satisfactory functionality. This report provides an overview over different concepts of power management strategies for . These offer an improved performance by better task management, storage organization, and power routing.

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Paper reference
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Novel Concept for a Wireless and Batteryless Brain Implant Array

Tobias Volk, Christian Bentler, Sebastian Stoecklin, Joan Albesa and Adnan Yousaf
(University of Freiburg, Germany), Thomas Stieglitz (Albert-Ludwigs-Universität Freiburg & Institut fur Mikrosystemtechnik, Germany),
Leonhard Reindl (IMTEK - Institute for Microsystem Technology, Germany)

Abstract

The treatment of several neuro-degenerative disorders require electrical closed-loop brain stimulation. Therefore, this paper presents several concepts, which help to improve this technology in the near future. The article shows concept and design of a multi-implant system, which is able to measure bio-signals from the cerebral cortex and to stimulate on the same electrode. More specific, architecture, concept, as well as theory of a novel wireless power / communication system is presented and demonstrated in case of an initial prototype. Finally, concepts and design of the used signal processing shows a prospect to the future implant.

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Paper reference
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Comparative Study of Resonant Circuit for Power Transmission via Inductive Link

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Olfa Kanoun (Chemnitz University of Technology, Germany),
Nabil Derbel (University of Sfax, ENIS, CEMLab, Tunisia)

Abstract

Wireless power transmission via inductive links has been more and more developed in the last years for low power applications. In this paper we will explore a solution to obtain a maximum output power and relative high efficiency for a Single input single output SISO coil system and for a multi-input single output MISO coil system using compensation capacitors in both sending and receiving sides. These compensation capacitors form four topologies: Series-Series, Series-Parallel, Parallel-Series and Parallel-Parallel. For the same reason a rectifier stage providing a DC output voltage is used. Investigation shows the dominance of the parallel-parallel topology for a maximum power and efficiency while using both single input single output and multi input single output coil system in case of fixed axial distance and variable lateral misalignment.

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Paper reference
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Combined Experimental and Theoretical Study of Structural and Optoelectronic Properties of Polyfuran With Its Oligomers

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Mohamed Bouachrine (Université Moulay Ismail, Meknes, Morocco)

Abstract

In this work, a combination of experimental and theoretical study of Polyfuran and its oligomers, in their neutral and doped states, was reported. The effect of chain length on optoelectronic properties was discussed using the Density Functional Theory (DFT). Since the optoelectronic properties of this kind of conducting polymers are governed by their band gap, a comparison among Highest Occupied Molecular Orbital, Last Unoccupied Molecular Orbital and band Gap energies of these compounds shall be presented.

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Paper reference
SSD'15-SCI-3-2

Low Cost Infrared Sensors Using Processed Single-Walled Carbon Nanotubes

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Abstract

The engineering of single-walled carbon nanotubes infrared sensors are presented. The technique employs two-electrode low-frequency dielectrophoretic technique to assemble the nanotube bundles which serve as the active component of the device. The devices were assembled using both processed and unprocessed carbon nanotube samples. The Raman spectrum for the SWNTs shows a slight increase in the defect density for the processed samples which improves the devices photocurrent and response time.

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Paper reference
SSD'15-SCI-3-3

Schottky Barrier Carbon Nanotube Transistors Op-Amp Circuit

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Wafa Makni (LETI Laboratory - ENIS, Tunisia),
Hekmet Samet (ENIS, Tunisia)

Abstract

This paper presents a computationally efficient Raychowdhury compact model for the Schottky barrier (SB) carbon nanotube field-effect transistor (CNTFET). In order to achieve an accurate compact model, shot noise sources is added. The simulation result of I-V characteristic is validated by a comparison with respect to Monte Carlo (MC) simulation. Good agreement is observed. Then, for the assessment of the SB on circuit performances, an operational amplifier (Amp Op) is designed using the SB-CNTFET compact model, and results are compared with a conventional CNTFET.

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Paper reference
SSD'15-SCI-3-4

The Piezoresistive Performance Investigation of Multifunctional Genuine Nanocomposites Thin Films

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Ayda Bouhamed
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Christian Müller (Technische Universität Chemnitz, Germany),
Olfa Kanoun (Chemnitz University of Technology, Germany)

Abstract

In this work, piezoresistive properties of thin films based on carbon nanomaterials dispersed in intrinsically conductive polymer were investigated. The high conductive multiwalled carbon nanotubes / graphene oxide and Poly (3,4-ethylenedioxythiophene) polymerized with poly (4-styrenesulfonate) (PEDOT:PSS) thin films were prepared and deposited on flexible polymer substrates (Kapton HN500, 125 μm) by solution drop casting. The influences of mixing ratio of MWCNT:GO to PEDOT:PSS and of the chemical reduction on the film properties such as electrical conductivity and strain sensitivity were investigated. For the non-treated thin films, a negative resistance coefficient was observed for the applied strain force. A low strain sensitivity around 0.9 was remarked independent on the mixing ratio between the MWCNT:GO to PEDOT:PSS. However, for the chemically reduced thin films, two strain regions were distinguished with sensitivity up to 48. In general, MWCNT:GO/PEDOT:PSS films have potential as a high sensitive, high linear strain sensitive material for advanced structural health monitoring and space application.

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Paper reference
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Piezoresistive Behavior of Epoxy/MWCNTs Nanocomposites Thin Films for Strain Sensing Application

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Abstract

In this present work, the influence of processing paremeters such as sonication time and curring time on the electromechanical properties of thin films based thermosetting polymer known as Epoxy filled with untreated multiwalled carbon nanotube (CNTs) were investigated systematically. For this reason, a predefined CNT content (0.3 wt.%) was directly mixed with epoxy at different sonication time i.e. (20, 30, 40 and 50 min) and differnt curring time i.e. (3 and 5 hours). Experimental results show that these processing parameters have an inversal effect on the electrical and mechanical behavior. It was found that, the films made based on nanocomposite sonicated for 30 min and curried for 5 hours had the highest conductivity. On the other side, samples sonicated at 30 min and curried for lower time i.e. 3 hours gave higher strain sensitivity (4.8), compared to the samples curried for 5 hours (1.22).

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Paper reference
SSD'15-SCI-3-6

Investigation of Physical Aging of Carbon Nanotube/ PEDOT:PSS nanocomposites by Electrochemical Impedance Spectroscopy

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(Technische Universität Chemnitz & Faculty of Electrical Engineering and Information Technology, Germany),
Christian Müller (Technische Universität Chemnitz, Germany),
Olfa Kanoun (Chemnitz University of Technology, Germany)

Abstract

In this work, thin films based on multi-walled carbon nanotubes (MWCNT) - poly(3,4-ethylenedioxythiophene) -poly (styrenesulfonate) (PEDOT:PSS) were prepared by solution mixing method. The dispersions were deposited on a flexible thin polyimide Kapton-HN 500 substrate by drop casting technique. The physical aging effect on the thin films as a function of MWCNT concentration ranging from 0.025 wt. % to 0.1 wt. % were investigated at room temperature by electrochemical impedance spectroscopy (EIS) over a wide range of frequency from 40 Hz to 110 MHz. It was found that the MWCNT concentration has a considerable influence not only on the conductivity but also on the aging rate of the nanocomposite films. It was also observed that the influence of aging on the electrical properties of the nanocomposites decreases with increasing amount of MWCNT concentration, due to the electron restriction mobility in the polymer chains at the vicinity of PEDOT:PSS/MWCNT interfaces. While the relative resistance change in the pure PEDOT:PSS polymer is 21.2 %, this change is found to be 6.8 % at 0.1 wt. % of MWCNT. Moreover, the aging effect on the MWCNT/PEDOT:PSS nanocomposites was considered within an equivalent complex R-C circuit model based on the obtained impedance data. This model was used to extract the electrical fitting parameters of the nanocomposites at different MWCNT concentrations.

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Paper reference
SSD'15-SCI-4-1

Iterated Square Root Unscented Kalman Filter for State Estimation– CSTR Model

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Abstract

In this paper, we propose to use an improved unscented Kalman filter algorithm based on iterated measurement update to estimate the nonlinear and non Gaussian state variables (the concentration and temperature) of the continuously stirred tank reactor (CSTR) process. The performances of various conventional and state-of-the-art state estimation techniques are compared when they are utilized to achieve this objective. These techniques include the unscented Kalman filter (UKF), the square-root unscented Kalman filter (SRUKF), the iterated unscented Kalman filter (IUKF) and the developed iterated square root unscented Kalman filter (ISRUKF). The results show that the ISRUKF has better convergence properties than the IUKF, and both of them can provide improved accuracy over the UKF and SRUKF. In addition, ISRUKF can provide accuracy related advantages over other estimation methods, this is because ISRUKF approach re-linearizes the measurement equation by iterating an approximate maximum a posteriori (MAP) estimate around the updated state, rather than relying on the predicted state.

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Paper reference
SSD'15-SCI-4-2

Modeling and Simulation of the Phosphoric Unit in Skhira Plant

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Charfeddine Tahri (Tunisian Chemical Group, Tunisia)

Abstract

This work deals with the physical modeling of the phosphoric unit in the Chemical Tunisian Group (CTG). The process is consisting of a continuous reactor and a rotary filter. This study focuses on the different physical laws involved in the filtration step and the attack step combined with differents actuators models in order to get a simulator of the global process. In control, this system is MIMO. Besides, many parameters rise in the system model and effect enormously the efficiency which should be modeled with precision such us permeability, porosity, specific resistance, ... The improved model developed in this study offer practical means of interpreting experimental data and optimizing the efficiency of the two steps: filtration and attack. The majority of the reported process studies have not made attempts at measuring a full set of measurable parameters. The phosphoric model presented in this study may provides some guidance for the types of parameters involved in such process. Moreover, we think of implementing a user interface on MATLAB to supervise and control the phosphoric unit process via simulink model.

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Paper reference
SSD'15-SCI-4-3

Bayesian Statistics for Conformity Assessment

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Abstract

This paper discusses the opportunity to use the Bayesian inference methods to evaluate the uncertainty of measurement in the conformity assessment. In a small practical example the approach is applied to the conductivity measurement of a rubber insulating. The adopted method is shown to produce a posterior estimates to test a hypothesis with a significance level.

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Paper reference
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Behavior Analysis of a 3-axis detection Push-Pull Piezoresistive MEMS Accelerometer

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Abstract

This paper reports a concept of 3-axis accelerometer design, fabrication and circuit readout configuration. In order to achieve a better performance in terms of induced output, the study focuses on the optimization of the structure dimensions and the optimal piezoresistor's location. The proposed model will be analyzed using Finite Element Modeling (FEM) to fully investigate the stress field in the structure based on the seismic mass movement and dimensions of attachment arms. Using finite element analysis results, the push-pull operation mode has been confirmed. Maximum magnitude of stress with appropriate profile has been studied in terms of various key geometric parameters. Symmetric stress magnitude with a value around 3MPa under an acceleration of 100g has been detected. This paper also discusses the structure of the built-in network of the piezoresistive Wheatstone bridge circuit and its position. We also show a flip-chip process flow for the fabrication of a polymer based accelerometer.

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Paper reference
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Mechanical Modeling and Sensitivity Evaluation of an Electrodynamic MEMS Microsensor

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Abstract

In this paper, we present the mechanical modeling and of a MEMS electrodynamic microphone using finite element analysis. This new model aims to study the mechanical design of a microphone to predict its dynamic range performance. Two coaxial planar inductors, one external and the other is internal, are used in this microphone design. When the external inductor is flown by a current, it will produce a magnetic field within the internal suspended one located on top of a suspended membrane above a micromachined cavity. In the present study, the membrane is attached around its edges, to avoid opening in the top membrane surface which leads usually to an acoustic short path in low frequencies that can affect the microphone performance. So, both membrane resonant frequency and displacement have been determined according to the used technology in IIT Bombay- India. The frequency was optimized around 1.6 KHz in the geometric mean of the acoustic band (20 Hz - 20 kHz) and the harmonic displacement was around 8μm for the main resonant frequency. Finally, the sensitivity was evaluated by coupling different transducer domains involved in the microsensor principle and by using the lumped element model of the microphone. The ultimate sensitivity was found around 0.1V/Pa, which is considered to be quite good compared to previously published sensitivities. However, the bandwidth was quite narrow for acting as a microphone.

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Paper reference
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Accurate Reduced-Order Modeling of MEMS and NEMS Microactuators Under Dynamic Electrostatic Loading and Large Strokes

Sarah Ben Sassi (Ecole Polytechnique de Tunisie, Tunisia),
Fehmi Najar (Ecole Polytechnique, Tunis, University of Carthage, Tunisia)

Abstract

This work investigates the static and dynamic behavior of microbeam when actuated by a DC load superimposed to an AC harmonic load. When modeling the micro electromechanical system, the use of nonlinear terms like third-order nonlinearities can be sometimes ambiguous. In this study we demonstrate that neglecting third-order nonlinearities and nonlinear inertia in the equation of motion leads to accurate results and low computational cost. We derive the governing equation of motion using both linear and nonlinear Euler Bernoulli beam theory with two possible configurations: cantilever and doubly-clamped. A Reduced Order Models (ROMs) based on Differential Quadratic Method (DQM) decomposition is utilized to simulate dynamic response of microbeam. Besides, we employ the Finite Difference Method (FDM) to discretize the orbits of motion and solve the resulting nonlinear algebraic equations. The stability of captured orbits is determined by combining the FDM discretization with Floquet theory. A comparison is then deduced between results found by applying the DQM-FDM decomposition and results found in the literature.

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Paper reference
SSD'15-SCI-5-4

Modeling and Design of Very Low-Voltage MEMS Microswitch Using Dynamic Pull-in

Majdi Naoui and Hatem Samaali (Ecole Polytechnique de Tunisie, Tunisia),
Fehmi Najar (Ecole Polytechnique, Tunis, University of Carthage, Tunisia)

Abstract

This study proposes the use of a new actuation technique to trigger ON/OFF states of a capacitive microswitch. The proposed technique is compatible with CMOS technology thanks to its low and simple actuation voltage. Using a reduced-order model based on the Differential Quadrature Method, which fully incorporate the electrostatic force nonlinearities, we solve for static, transient and limit-cycle solutions. We show that using only nine grid points give relatively accurate results when compared to those obtained using ANSYS. Then we examine the dynamic behavior of the MEMS switch under different electrical actuation waveforms and obtain results indicating that subsequent reduction can be obtained in actuation voltage and switching time compared to classical static pull-in actuation.

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Paper reference
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Electro-Thermal Interactions Modelling in Power MOSFET Transistor

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Amar H Kabashi (Umm Al-Qura University, Saudi Arabia),
Mohamed Ali Belaid (Tunisia)

Abstract

This paper presents a method of studying the temperature effects in power MOSFET transistors by the means of electro-thermal modelling, utilizing Advanced Design System techniques. The model incorporates the thermal effects and the temperature evolution in the device and captures the heat dissipation from the silicon chip to the ambient air. It enables a better estimation of the device's reliability and lifetime. Furthermore, it can be used to make a connection between the electrical parameter drifts and the existing failures types. The developed model reflects superior performance in terms of accuracy and flexibility and the results obtained indicate a good agreement with the operating conditions.

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Paper reference
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Design of Wide-Tuning High-Q Differential Active Inductor For Multistandard Applications

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Abstract

In this paper, a new tunable differential active inductor (DAI) architecture based on the use of two cascade-grounded active inductors is proposed. A negative resistance based cross-coupled pairs is added to improve the quality factor. The DAI has been implemented in 0.13μm CMOS process. The obtained simulation results show an inductance tuning range from 80 nH to 520 nH for circuit operating frequency range from 0.78 GHz to 3.25 GHz achieving 66% tuning range. A high quality factor of 2672 is obtained at the center frequency of 1.65 GHz. The power consumption is around 2.5 mW under 1V power supply. It occupies a small chip area of around 23.6×37.8μm^2.

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Paper reference
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Low-Cost Multifunctional Sensor System for Online Determination of Aqueous Solutions

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Olfa Kanoun (Chemnitz University of Technology, Germany)

Abstract

Online-determination of aqueous solutions can be used in many different applications e.g. for the monitoring and controlling of a complete washing process. During this process different water and suds parameters must be measured continuously and used to control and optimize the washing process. Current methods use complex or sensitive sensor elements or expensive bulk or surface materials to determine liquids. Different parameters in the liquid need different special sensors and make the complete system complex and expensive. The new smart low-cost sensor system was developed to measure online all necessary parameters of liquids. The hardware of this sensor system with the combination of the measurement methods impedance spectroscopy and cyclic voltammetry can be used for different applications. The software must be adapted individually and makes the system very flexible and keep the cost low.

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Paper reference
SSD'15-SCI-6-2

Temperature Effect on the Complex Conductivity of Adblue

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Olfa Kanoun (Chemnitz University of Technology, Germany)

Abstract

Diesel engines have a strong contribution to the NOx in air; this amount of NOx should be reduced because it's toxic and harmful to the environment. To enable this reduction, manufacturers of commercial vehicles developed the selective catalytic reduction (SCR) technology. This technology uses Adblue in order to reduce the NOx-content in the exhaust gas stream. Adblue is an Aqueous Urea Solution made with 32.5% urea and 67.5% de-ionized water. The quality of Adblue has a big influence on the efficiency of the SCR. A quality sensor was developed in order to determine the contamination or adulteration of Adblue solution by water or other additive using Impedance Spectroscopy. The temperature has an influence on the electrochemical behavior of the Adblue solution; in this work we study the effect of temperature on the measurement results. It was shown that at a constant concentration the impedance of the Adblue change with the temperature which is an important factor to be considered in the treatment of the measurement results.

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Paper reference
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Finite Element Simulation to Improve the Sensitivity of a MIT

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Olfa Kanoun (Technische Universität Chemnitz, Germany),
Joerg Himmel (university of applied sciences Ruhr West, Germany)

Abstract

In the field of magnetic inductance tomography, signal processing is a real challenge. This is due to the divergent nature of magnetic fields. The sensitivity, i.e. the change in the receiving signal by means of an electrically conductive sample in a measuring volume depends strongly on the positioning of the sample. Objects that are located near the transmitting or receiving coils are very well locatable, where objects in larger distance are hard to detect. In this paper an approach is presented that improves the topology of the magnetic fields in the magnetic induction tomography (MIT) by changing geometric constructions and current patterns of coils so far, as to allow a sharper localization of objects within the space. The aim is to level the distribution of the sensitivity in the measuring volume, so that electrically conductive objects with a larger distance between transmitting and receiving unit can be detected with almost the same signal intensity as objects close to the transmitting and receiving unit. The simulation tool Comsol is used for the geometric modeling making a finite element analysis (FEA). The subsequent signal processing and analysis of the simulation results are implemented in Matlab. Within this FEA the coil geometries and current patterns are changed numerically, so that the minimum object size, that is still detectable, is, compared to the known MIT, reduced and the sensitivity of the system is improved. To validate the simulation in Comsol, first simulation results are compared with analytical models and analyses.

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Paper reference
SSD'15-SCI-7-1

A Real Time Environmental Monitoring for Smart City Surveillance Based GUI on Android Platform

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Abstract

Android based Smartphone have recently been applied in a number of smart city surveillance applications. The related works make an emphasis on sensing and delivering of alert message over the Wireless sensors networks to an operator. Instead, in this paper, we propose a real time environmental monitoring system which aims at quick pollutants detection and sending value immediately to the supervisor. Each value is processed by the supervisor server and compared to a previously defined threshold. In the normal case, the sensed data will be sent to android terminal and when the pollution threshold is exceeded, the user is notified by receiving an alert message on its mobile. The experimental results demonstrate the efficacy of our project in terms of fast detection, real time response and capacity to notify user everywhere.

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Paper reference
SSD'15-SCI-7-2

Implementation of a Coulomb Counting Algorithm for SOC Estimation of Li-Ion Battery for Multimedia Applications

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Asma Mlayah (Sousse University, ENISo, Tunisia),
Sabeur Jemmali (ENISo, Tunisia),
Bilal Manai (IntelliBatteries, Tunisia),
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Abstract

Lithium-Ion based batteries are quite popular thanks to their good electrical characteristics but they risk to be damaged when they are overcharged or deeply discharged. In order to avoid these problems, Lithium-Ion batteries require an accurate state of charge determination to extend their lifetime and hence protect the equipment they supply. In this paper we propose a solution based on an enhanced Coulomb counting method which we have implemented on a hardware platform based on the PIC18F MCU Family. The results are promising. The proposed system is supported by IntelliBatteries and integrated on its products.

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Paper reference
SSD'15-SCI-7-3

Model Based Conductance Measurements Design for Thermally Modulated Sensor Arrays

Liwa Wu and Christian Langen
(Karlsruhe University of Applied Sciences, Germany)

Abstract

This paper describes a model-based conductance measurement design for a metal oxide gas sensor based on tin oxide. The model accounts a conductance measurement system and a corresponding temperature control system. It is demonstrated that the chemical analysis capability with metal oxide gas sensors based on tin oxide can be considerably enhanced when the sensors are under thermo-cyclic operation mode. The sensor response is expressed by the conductance-over-time profiles. Based on preliminary studies, the sensor has shown wide range variation of resistance values. In order to interface this kind of sensor, a direct conductance measurement circuit with gain-ranging signal processing as well as temperature control system is developed for multi metal oxide gas sensor arrays. The system is modeled and analyzed in Simulink and then implemented in an embedded system.

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Paper reference
SSD'15-SCI-7-4

New Design of 3-10 GHz Low Noise Amplifier for UWB Receivers

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Abstract

In the ultra-wideband (UWB) communication system receiver, the low noise amplifier (LNA) is the critical module. The LNA is used to amplify the received signal with sufficient gain and as little additional noise as possible. This paper presents a new 3.1-10.6 GHz LNA UWB receivers. The UWB LNA was formed by two stages. The first one uses the resistive current reuse and degenerative parallel LC to provide the input matching over a wideband. The proposed UWB LNA uses an inductive-series peaking technique with cascode common-source amplifier to improve the gain, fatness and consume lower power. This LNA is designed using 0.18 μm CMOS technology. Our finding show that, the low noise amplifier LNA using these techniques allowed us to achieve a maximum power gain of 20.62 dB, a good input/output impedance matching, S11 below -10 dB, S22 below -10dB and an excellent noise figure NF between 1.6-2.5 dB.

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Paper reference
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Digital Inclinometer for Joint Angles Measurements with a Real-time 3D-Animation

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(University of Science & Technology Houari Boumedienne, Algeria),
Nazim Ouadahi and Arezki Youyou
(University of Science and Technology Houari Boumediene, Algeria),
Amina Ababou and Noureddine Ababou
(University of Science and Technology Houari Boumediene USTHB, Algeria)

Abstract

Range of motion measurement using wearable sensors is an inexpensive, convenient, and efficient manner of providing useful information for joint disorder. Classical digital inclinometers can only measure joint angles in a vertical plane. This paper describes an embedded system that measures joint angles simultaneously in vertical and horizontal planes. It is based on gravitational acceleration and magnetic field sensors measurements. The method used in order to measure the correct angles for a given position of the device is described. A Graphical User Interface has been developed to display simultaneously the flexion-extension, abduction-adduction and internal-external rotations of the upper limb joint angles during a movement performed by a subject. This movement was reconstructed in a 3D real-time animation.

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Paper reference
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Air Pollution Monitoring System Using LabVIEW

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Abstract

Air pollution is one the most crucial factors affecting life and health of human, animals and plants. In this paper, a wireless solution is proposed for monitoring the level of hydrogen sulfide gas (H2S). The proposed system enables measurement of the levels of H2S, temperature, and humidity. The software part of the project has been developed under LabVIEW environment. The experimental results demonstrate the efficacy of our project in terms of fast detection and real time response.

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Paper reference
SSD'15-SCI-7-7

FPGA Pulse Mode Implementation of a Gaussian Fuzzy C-Means Algorithm

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Abstract

Fuzzy C-Means (FCM) is well known as a fuzzy clustering approach offering good performances in image processing applications. The use of the euclidian distance in the membership function causes a tremendous complexity in hardware implementation. For this reason, we propose a modified version of the FCM algorithm aiming at hardware resources minimization. In this paper, a pulse mode hardware architecture of this algorithm is proposed and implemented in a Virtex 6 FPGA platform. Such implementation offers many advantages over software solution, namely in speed.

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Paper reference
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Design of a Tri-Band Microstrip Filter for GPS Receiver

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Rim Barrak (SUP'Com, Tunisia),
Mohamed Mabrouk (GRESCOM (SUPCOM) and ISETCOM
Tunis, Tunisia)

Abstract

Global Navigation Satellite System (GNSS) receivers provide users with positioning, velocity and time. These receivers have to work with different standards and frequency bands in order to enhance the precision and the robustness. A multiband GNSS terminal with a single RF front-end would be a beneficial and cost-effective solution that allows the combination of more than two bands. The RF filter is an important component in the radio receiver. In this paper, we focus on the design of a tri-band filter operating at the three frequency bands (L5, L2, L1) of the GPS standard. The filter schematic is based on the half-wavelength bandpass topology with crossed open stubs. S parameters simulations show good agreement between the filter response and the standard specifications in terms of center frequencies and bandwidths.

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Paper reference
SSD'15-SCI-8-2

Low Power and High Gain Folded Cascode OTA

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Abstract

Low power is one of the key research areas in analog integrated circuits design. Need of low power has created a major pattern shift in the field of electronics where power dissipation is equally important as area, performance etc. Low power dissipation high gain low-voltage operational amplifiers are used for many applications. This paper presents a design of the Folded Cascode OTA using 0.35μm CMOS technology, which leads to high gain and low power consumption. Trying to combine an alternative technique of folded cascade transistor with an OTA design to improve gain and output voltage swing in that circuit by reducing its supply voltage and power consumption. The simulation of the folded cascade OTA circuit is done using Cadence Spectrum. A complete theory study, analysis and design of the used circuit is presented in this paper which shows how this circuit leads to a high gain and resistance at output, a low voltage and power dissipation. Performances parameters of the Folded-Cascode OTA circuit obtained by electrical simulation under Cadence are given. This paper provides a considerable insight into the overall operation and advantages of the folded-cascode OTA circuit. This design overcomes some limitations and drawbacks of the various architectures.

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Paper reference
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A 160-μW, Ring Digitally Controlled Oscillator for UHF/VHF Nano-satellites Broadcasting Tuners in 90nm CMOS Process

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Mongia Mhiri (University of Monastir, Spain),
Aymen Ben Hammadi (University of Monastir, Tunisia),
Kamel Besbes (University of Monastir, Faculty of Sciences, Tunisia)

Abstract

This paper presents a two-stages 5-bit digitally controlled oscillator designed mainly for Nano-Satellites (Amateur) applications. The structure based on a ring oscillator and implemented with Schmitt trigger inverters (Hysteresis Delay Cell) to lead the low frequencies, which has power and area efficiency better as compared with conventional delay cells. The proposed DCO offers the possibility to adjust the oscillation frequency digitally, without analog voltage tuning. Simulations of the proposed DCO achieve controllable frequency range of 118MHz∼462MHz with a wide linearity. Monte Carlo simulation demonstrates that the deviation offset frequency due to random process fluctuation is fewer than 7.4%. Phase noise at 436.5MHz carrier frequency and 1MHz offset is -100dBc/Hz. Figure of Merit (FoM) calculated is -174.78dBc/Hz. in 90-nm CMOS technology, the circuit occupies an area of 0.00297mm^2 and least significant bit (LSB) resolution of 5 kHz. With a supply voltage of 1.0V, the estimated average power values are 104 and 158μW at 145 and 436.5MHz, respectively.

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Paper reference
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A Novel Low-Voltage Low-Power CCII Based on Super Class AB CMOS OTA Cells and Filter Application

Thouraya Ettaghzouti and Nejib Hassen (University of Monastir, Tunisia),
Kamel Besbes (University of Monastir, Faculty of Sciences, Tunisia)

Abstract

A new high-performance second generation CMOS current conveyor CCII is presented. The input stage of this circuit is based on a super class AB CMOS OTA cells. The proposed CCII is operated at low-voltage of ± 0.75V with a reduced power consumption of 230μW. All simulations are performed by TSPICE based on BSIM3v3 transistor model (level 49) for the TSMC 0.18μm CMOS process available from MOSIS. This circuit showed a good linearity over the dynamic range and an excellent accuracy. It has a low parasitic resistor at terminal X (RX=8.26Ω) and a very high input impedance at terminal Y. This novel circuit offers a 2.96GHz current transfer bandwidth and 3GHz voltage transfer bandwidth. Based on the novel CCII, we have implemented a bi-quadratic voltage mode filter. The simulation results of this filter are in a good agreement with the theoretical calculations

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Paper reference
SSD'15-SCI-8-5

Low Voltage Low Power Analog Circuit Design OTA Using Signal Attenuation Technique in Universal Filter Application

Karima Garradhi and Nejib Hassen (University of Monastir, Tunisia),
Kamel Besbes (University of Monastir, Faculty of Sciences, Tunisia)

Abstract

This paper presents a new configuration for a linear operational transconductance amplifier (OTA) using a signal attenuation technique. The OTA is designed to operate with a ±0.8V supply voltage and consumes 0.45mW power. All simulations are performed by ELDO model BSIM3v3 technology CMOS TSMC 0.18μm. The simulation results of this circuit showed a high DC gain of 73.6dB with a unity frequency of 50.19MHz and a total harmonic distortion of −60.81dB at 100 kHz for an input voltage of 1Vpp. Based on this circuit, we have implemented a voltage mode universal filter whose simulation results are in good agreement with the theoretical calculations.

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Paper reference
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Two Stage CMOS Operational Transconductance Amplifier for Front-End Electronics Design using Multiobjective Genetic Algorithms

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Slimane Oussalah
(Centre de Développement des Technologies Avancées, Algeria)

Abstract

In this paper, we elaborate a program based on multi objective genetic algorithms (MOGAS) to allow automated optimization of analog circuits. The proposed methodology is used to find the optimal transistors sizes (length and width) in order to obtain operational amplifier performances for analog and mixed CMOS-based circuit applications. Eight performances are considered in this study, direct current (DC) gain, unity-gain bandwidth (GBW), phase margin (PM), power consumption (P), area (A), slew rate (SR), thermal noise and signal to noise ratio (SNR). We used the Matlab optimization toolbox to implement the program. Also by using variables obtained from genetic algorithms, the operational transconductance amplifier (OTA) is simulated by using Cadence Virtuoso Spectre circuit simulator in standard TSMC (Taiwan Semiconductor Manufacturing Company) RF 0.18μm CMOS technology. A good agreement is observed between the program optimization and electric simulation.

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Paper reference
SSD'15-SCI-8-7

Novel Second Generation Current Conveyor and Voltage Mode Universal Filter Application

Thouraya Ettaghzouti and Nejib Hassen (University of Monastir, Tunisia),
Kamel Besbes (University of Monastir, Faculty of Sciences, Tunisia)

Abstract

A novel topology low voltage low power second generation current conveyor circuit CCII is presented. This circuit provides a very high input impedance at Y port, low impedance at X port, good accurate current and voltage tracking and wide bandwidth. The performance of proposed CCII has been verified by TSPICE model BSIM3v3 technology CMOS TSMC 0.18μm with a supply voltage $\pm$0.75V. Based on this circuit, we have implemented a novel voltage mode universal filter with single input and five output terminal. The simulations results of this application are in a good agreement with the theoretical calculations.

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Paper reference
SSD'15-SCI-8-8

Improvement of the Linearity and Conversion Gain of an Ultra Wideband Up-Conversion Mixer in CMOS 0.18μm Technology

Amel Neifar, Ghazi Bouzid and Mohamed Masmoudi
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Abstract

This paper presents a fully differential, low power and low voltage UWB up-conversion mixer, operating in the third channel of the ultra wideband range frequency (3-5GHz). Designed on CMOS 0.18 μm technology and a voltage supply of 1.8, this circuit is based on a double balanced Gilbert topology, which uses a current injection method to increase the conversion gain and pi-inter-stage matching network formed of additional inductors to improve the linearity. Thus the mixer exhibits 10 dB conversion gain, 10 dBm IP3, a DC power in the range of 4.3 mW and can output an RF signal over the third channel of the low band (3-5) GHz frequency range.

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Paper reference
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Centralized KNN anomaly detector for WSN

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Abstract

This work suggests to detect abnormalities from spatial distribution of data using a numerical outlier data detector in a wireless sensor network (WSN). The detector is able to find anomalous from one or many events by using KNN technique and Euclidian distance. WSN uses a Low Energy Adaptive Clustering Hierarchy protocol (LEACH), where we compute the good impact of detection on energy. From this, a mean time to failure is computed. The evaluation is also with detection rates metrics in order to appreciate the detection accuracy and quality of data.

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Paper reference
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MAI Plus Noise-Constrained LMS-based Algorithm for MIMO-CDMA DFE Systems

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Abstract

In this work, a decision feedback equaliser (DFE) is implemented based on a constrained least mean square (LMS) algorithm for multiple input multiple output code division multiple access (MIMO-CDMA) systems. The proposed algorithm is equipped with the knowledge of the number of subscribers, the spreading sequence length, the noise variance as well as the variance of the multiple access interference (MAI) plus noise. Unlike previous works, here the MAI is introduced as a constraint as well. The introduction of these two constraints gives the proposed algorithm an excellent performance. Finally, simulation results conducted to support the theoretical findings show that the proposed algorithm outperforms various constrained implementations of the LMS algorithm.

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Paper reference
SSD'15-CIT-1-3

A Reputable Secure routing protocol for Wireless Sensor Networks

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Idris Umar (Universiti Putra Malaysia, Malaysia)

Abstract

For the last decade Wireless Sensor Networks (WSNs) have been gaining recognition due to the fact that they provide inexpensive solutions for a diversity of sensitive applications. However, these networks are highly at risk for many routing attacks due to the nature of their deployment as well as their device characteristics. They are usually deployed in a distributed manner, unattended for a long period of time with imperfect network resources such as memory, bandwidth, energy and computation power. Therefore, security plays an important role. In this paper, we propose a reputation based secure routing protocol that is sufficient to thwart the routing attacks in the neighborhood for WSN. The proposed protocol maintains neighbors reputations based on their n locations and packet transmission information to select the well-behaved forwarding node to transmit the data packet through multiple hops towards the destination. The protocol also proposes the use of the extension forwarding area to accommodate extra legitimate nodes when the number of routing attacks increases in a given forwarding area. Our performance results exhibit the enhancement of network performance in term of packet delivery as well as a reduced amount of attack selection in the process of transmitting packet to the destination.

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Paper reference
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A Hybrid Sampling Method for Imbalanced Data

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Najoua Essoukri Ben Amara (ENISo, Tunisia)

Abstract

With the diversification of applications and the emergence of new trends in challenging applications such as in the computer vision domain, classical machine learning systems usually perform poorly while confronting two common problems: the training data of negative examples, which outnumber the positive ones, and the large intra-class varia-tions. These problems lead to a drop in the system performances. In this work, we propose to improve the classification accuracy in the case of imbalanced training data by equally balancing a training data set using a hybrid ap-proach which consists in over-sampling the minority class using a "SMOTE star topology", and under-sampling the majority class by removing instances that are considered less relevant. The feature vector deletion has been performed with respect to intra-class variations, based on the distribution criterion. The experimental results, achieved in biometric data, show that the proposed approach significantly improves the overall performances measured in terms of true-positive rate.

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Paper reference
SSD'15-CIT-2-2

A MATLAB/Simulink-based environment for large-integer HDL designs verification

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Abstract

Large integers are integers with more than 64-bit as bit-width. They are mainly used in cryptography and computational algebra. Arithmetic of large integers is constantly changing resulting in continuous new hardware implementations. Their verification process should be then flexible enough to follow the design rate. One of the shortcomings of current hardware description languages (HDLs) libraries and tools used for testbench is their lack of support for large-integer's functions. This paper presents a MATLAB/Simulink environment intended to verify the operation of HDL circuits based on large integers.

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Paper reference
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Insights Into the Convergence and Steady-State Behaviors of the SLMF and its Variants

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Azzedine Zerguine (KFUPM, Saudi Arabia)

Abstract

In this paper, we provide some insights into the convergence and steady-state behaviors of the sign-error least mean fourth (SLMF), sign-sign least mean fourth (SSLMF), normalized sign-error least mean fourth (NSLMF), and normalized sign-sign least mean fourth (NSSLMF) algorithms for both cases of real- and complex-valued data. Moreover, we also report the equivalence algorithms of the block-based normalized sign-error least mean fourth (BBNSLMF) and block-based normalized sign-sign least mean fourth (BBNSSLMF) algorithms. Finally, simulations are conducted for both cases of real- and complex-valued data to provide us with more insights into the performance of the SLMF, SSLMF, NSLMF, and NSSLMF algorithms.

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Paper reference
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HLS based design of a mixed architecture for H.264/AVC CAVLD

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Sébastien Bilavarn (LEAT, France),
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Abstract

Mixed Hardware/Software architectures are often attractive solutions for Embedded System especially for real time applications. However, when the complexity of hardware functions grows, hand coding at Register-Transfer Level (RTL), which is already low and error prone, adds debugging and verification overheads that impact severely the time and costs of development. Therefore, High Level Synthesis (HLS) brings a solution to decrease the design time of dedicated hardware and keep the high abstraction level of software development. In this context we propose a HLS based design flow for Hardware/Software architecture on top of Catapult C Synthesis. We illustrate the effectiveness of this approach on the practical implementation example of a full $H264/AVC$ video compression decoder. The hardware accelerator is the CAVLD module that takes 14% from the decoder execution time. Three architectures are presented for this module. The best one offers 85% of gain compared to software execution. The proposed architectures are implemented on a Xilinx FPGA-embedded systems prototyping board considering the PowerPC processor and a PLB bus for data communications with the CAVLC accelerator.

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Paper reference
SSD'15-CIT-2-5

On the emulation of narrowband powerline communication noise scenario

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Chiheb Rebai
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Abstract

This paper presents an implementation of narrowband powerline channel (NB-PLC) noise model from $40kHz$ up to $500kHz$ on a digital signal processor (DSP). This implementation represents a major building block in a $NB-PLC$ channel emulator which incorporates channel attenuation and noise scenario. A complete noise model is proposed combining the cyclostationary noise model and a stochastic model for aperiodic noise. The spectral and temporal characteristics of cyclostationary component define a possible linear filters based implementation whereas; the aperiodic noise is established via statistical distributions of its parameters. The exponentially decayed waveform model is adopted for this type of noise. Proposed implementation is optimized and tuned to be embedded on a DSP platform with real timing constraint

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Paper reference
SSD'15-CIT-2-6

Multi-Robot Task Scheduling and Routing Using Neuro-Fuzzy Control

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Abstract

Multi-robot systems have been widely used in modern flexible manufacturing systems. It is not an easy task to achieve effective cooperation between these robots in a dynamic environment. Task planning is the most important issue to specify how to use mobile robots and other resource efficiently. An efficient task scheduling and routing algorithms together with intelligent real-time control is necessary for a multi-robot system. This paper presents the analysis of a real-time fuzzy-based task scheduler to deal with a flexible manufacturing has four programmable CNC machine, three mobile robots and other resources. An embedded microcontroller has been used to control mobile robot according to the routing algorithm. A neuro-fuzzy controller has been used to guide the mobile robot from the source point to its destination with real-time obstacle avoidance. The obtained results of computer simulation and real experiments on group of three mobile robots show that the multi-robot system can deal with given task scheduling to achieve the required operation.

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Paper reference
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Proof of Concept of a PIC Wireless programmer Interface For Prototyping

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Abstract

In the near future, computers will be embedded everywhere and the Ubiquitous computing will be widely used. Ubiquitous computing requires multidisciplinary knowledge. To design such systems, a specific heterogeneous prototyping platform is required. Such platform has to be sufficiently versatile and in the same time easy to program even for beginners. Most ubiquitous systems are microcontrollers-based and are already too hard to program, limiting therefore their flexibility. In this paper we present a new concept of an easy to use wireless prototyping platform for Ubiquitous Computing suitable for people with limited computer skills. The prototype realized in this paper consists of a PIC that interfaces a Bluetooth USB dongle to communicate with the computer and send the program file to the targeted PIC to program it in place and from a distance.

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Paper reference
SSD'15-CIT-3-2

Formal Specification and Verification of Reconfigurable Wireless Sensor Networks

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Abstract

This paper deals with reconfigurable wireless sensor networks (to be denoted by RWSN) that should be adapted to their environment under user and energy constraints. RWSN is assumed to be composed of a set of communicating nodes such that each one executes reconfigurable tasks to control local sensors. It is controlled, in a previous research, by a multi-agent architecture. We propose, in this work, timed automata models for the specification and verification of this architecture. Each agent is modeled by timed automaton (TA) to verify functional and temporal constraints when communicating with remote agents. The paper's contribution is applied to a case study that we simulate and formally verify with UPPAAL environment.

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Paper reference
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Multihop Balanced Energy Clustering for Wireless Sensor Network

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Abstract

Wireless sensor networks are receiving significant attention due to their unlimited potential. It will change the world and the way we live such as to realize atmosphere, which is a sight through which environment becomes smart, friendly, contextaware, and responsive to human needs. One of the most significant challenges for Wireless Sensor Networks are long-lived sensor nodes and minimization in overall power consumption, because these nodes are generally battery operated. As the energy is limited in wireless sensor networks, it is very important to save the energy for increasing the network lifetime. A successful approach for prolonging networks lifetime and scalability is clustering. For increasing the network lifetime, a multihop clustering routing protocol based on grid clustering is proposed. The proposed algorithm compares with some existing protocol and increase the network life time.

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Paper reference
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Improved Performance of a Brushless DC motor Using Hardware In the Loop Control Technique

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Mohamed Abid (CES-ENIS, Tunisia)

Abstract

The evolution and the complexity of robot systems are widely increasing nowadays, this complexity is especially shown in their long simulation time. So, an increasing interest is devoted to the study of the Brushless DC Motor which represents the most adequate actuator for robot systems. In fact, the Brushless DC Motor has achieved a big breakthrough thanks to its robustness, rapidity, cleanliness, accuracy and high efficiency in many industrial applications. To guarantee the efficiency of the device under test with the whole automation system, a controller design is presented in this paper. Precision and simulation rapidity represent big challenges for power systems such as Brushless DC motor. The design is created using DSP builder blocks through simulink matlab environment integrated with FPGA board. Simulation results are presented to demonstrate the effectiveness of design control for Brushless DC Motor.

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Paper reference
SSD'15-CIT-4-2

Improvement of Filtering Systems Through Resource Description Framework

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Omar Nouali (CERIST, research center, Algeria)

Abstract

Due to traffic data created and replicated exponentially generating difficulties to manage, store and secure this traffic. The situation is paradoxical, a need for information and the difficulty of obtaining this information because it is lost in the mass (big data). The use of fully search engine based on the formulation of the request by users shows its limits in some scales. The trend is to improve information filtering approaches to better answer the user's expectations. In this work, we modeled a collaborative filtering system by Friend Of A Friend (FOAF) formalism for the representation of the users and the Dublin Core (DC) vocabulary for the representation of the resources " items". In addition, and to ensure the interoperability and openness of this model, we adopted the Resource Description Framework (RDF) syntax to describe the various modules of the system. The experiments on real datasets have shown satisfactory result.

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Paper reference
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Implementation of a Baseline RISC for the Realization of a Dynamically Reconfigurable Processor

Hajer Najjar, Riad Bourguiba, Jaouhar Mouine
(ENIT, Tunisia)

Abstract

RISC processors are widely used because of their multiple advantages. In Fact, they are based on a simple instruction set so that they increase the speed of the processor and reduce its energy consumption. In this paper, a basic RISC architecture processor is presented. This architecture will be developed later to converge to a new one with runtime reconfiguration.

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Paper reference
SSD'15-CIT-4-4

Representation of Unbalanced Terms in Multi-Valued Logic

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Abstract

Various approaches were proposed to represent and treat imperfect knowledge, in particular fuzzy logic and multi-valued logic. Such knowledge is generally expressed with uniformly distributed linguistic term sets. However, in many cases, we need to describe information with unbalanced term sets. In our work, we introduce a new approach to represent such term sets. It corresponds to an algorithm which unifies data expressed in different multi-sets on a same uniform scale. This latter can be integrated into a linguistic reasoning process with unbalanced multi-sets (using linguistic modifiers, approximate reasoning,..)

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Paper reference
SSD'15-CIT-4-5

Embedded System for Road Sign Detection Using MicroBlaze

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Kamel Besbes (University of Monastir, Faculty of Sciences, Tunisia)

Abstract

This paper presents the implementation of road sign detection application. The target hardware is a Xilinx MicroBlaze soft-processor. The algorithm is described using C language and compiled with the SDK and EDK tools targeting the Virtex $ML605$ FPGA. The input video is a real scenes acquired by a digital camera with a resolution of 480×640 pixels. Adequate architecture generated of the Microblaze with adequate communication with the system memory, allows real time execution of the application.

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Paper reference
SSD'15-CIT-4-6

Design and implementation of an enhanced on chip mesh router

Manel Langar, Riad Bourguiba and Jaouhar Mouine
(ENIT, Tunisia)

Abstract

In this paper, we describe the design and implementation of an enhanced wormhole virtual channel on chip router. It is the basic component of a mesh Network on Chip, using the XY deterministic routing algorithm. It is characterized by its simple virtual channel allocation strategy which allows reducing area and power consumption. We implemented our router using Tezzaron technology to measure its performances.

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Paper reference
SSD'15-CIT-5-1

Efficient FPGA Hardware Implementation of Secure Hash Function SHA-256/Blake-256

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Abstract

Since the beginning of study of the Secure Hash function (SHA), it has been thoroughly studied by designers with the goal of reducing the area, frequency, and throughput of the hardware implementation of this cryptosystem. The Secure Hash function algorithm has become the default choice for security services in numerous applications. In this paper, we proposed a new design for the SHA-256 and blake-256 functions. Moreover, the proposed design has been implemented on Xilinx Virtex-5 FPGA. Its area, frequency and throughput have been compared and it is shown that the proposed design achieve good performance in term of area, frequency and throughput.

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Paper reference
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Chaos-based Designing of a Highly Nonlinear S-box using Boolean Functions

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Abdennaceur Kachouri, Mounir Samet
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Abstract

In this manuscript we present a novel method to design a strong substitution box having important cryptographic properties. Our method is based on chaos and take into account that an S-box can be viewed as a set of Boolean functions. Therefore, we will take advantage of the different characteristics of chaotic functions to generate random Boolean functions with high nonlinearity. Using these Boolean functions, we can create a highly nonlinear S-box. Afterwards, the proposed methodology is analyzed and tested for the following criteria: bijective property, nonlinearity, strict avalanche criterion, output bits independence criterion and equiprobable input/output XOR distribution. Numerical simulation and security analysis demonstrate that the proposed S-box has important cryptographic properties.

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Paper reference
SSD'15-CIT-5-3

A New Approach for Encryption System Based on Block Cipher Algorithms and Logistic Function

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Medien Zeghid (Salman Bin Abdulaziz University, Saudi Arabia),
Adel Baganne (Lester-Ubs, France),
Rached Tourki (FSM, Tunisia)

Abstract

In this paper, a new approach for encryption system based on a block cipher algorithm and a logistic function is proposed. The main goal of the present work is to study the weaknesses of different operating modes in order to propose appropriate modifications. The experimental results show that the proposed modifications can be easily implemented and they do not need high level of consumption or hardware occupation. In addition, the security analysis proved the resistance of the new algorithms to statistical attacks, differential attacks and initial key sensibility.

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Paper reference
SSD'15-CIT-5-4

Proposed Efficient Arithmetic Operations Architectures for Hyperelliptic Curves Cryptosystems (HECC)

Anissa Sghaier (Faculty of Sciences Monastir, Tunisia),
Medien Zeghid (Salman Bin Abdulaziz University, Saudi Arabia),
Machhout Mohsen (Electronics and Micro-Electronics Laboratory, Tunisia)

Abstract

Because it offers several benefits over other public-key cryptosystems much effort are done to make Hyper Elliptic Curve Cryptosystems (HECC) more practical, such as RSA, it offers a comparable level of security with a smaller key size. For this reason, HECCs can be used in embedded environments where speed, energy, power, chip and memory area are constrained. However, HEC use a complex mathematical background, so it's difficult to be implemented on hardware. They can be defined over real numbers, complex numbers and any other field. So we need arithmetic operations (addition, subtraction, multiplication and division) which have much application in cryptography and coding theory. We have to note that the overall performance of HECC is mainly determined by the speed of arithmetic operations. The most algorithms that manipulate these operations use polynomial coefficients in base 2 and they are defined over finite fields. But, the problem is clearly viewed over real field and simple to be presented. Arithmetic operations are based on the complexity of a mathematical problem, and to have an optimized architecture we need to optimize arithmetic operations. In this paper we describe a high performance, area efficient implementation of arithmetic operations in HECC over real field and a new design methodology is presented. The proposed architectures operations are implemented in FPGA.

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AES IP for Hybrid Cryptosystem RSA-AES

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Abstract

AES (Advanced Encryption Standard) is a symmetric-key algorithm, meaning the same key is used for both encrypting and decrypting data. In this paper, we present three hardware architectures for AES, namely Serial/Serial, Parallel/Serial and Parallel/Pipelined. These architectures can be used as IPs in hybrid cryptosystem RSA-AES implemented on an FPGA PSoC. The highlights of our work are: implementing S-Box memories of SubBytes transformation on Slices of FPGA which reduces the hardware resources and using the Xtime () functions in the implementation of MixColumns transformation which accelerate the execution time. Such architectures cater to different applications and offer good tradeoffs between performances and occupied areas.

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SHA-2 Hardware core for Virtex-5 FPGA

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Abstract

Hash functions play an important role in modern cryptography. They are widely used to provide services of data integrity and authentication. The hash algorithms are based on performing a number of complex operations on the input data that require a significant amount of computing resources especially when the input data are huge. Thus, hardware implementation is far more suitable, for security and performances execution issues, compared to the corresponding software implementations. Hash functions perform internal operations in an iterative fashion, which open the possibility of exploring several implementation strategies In this paper, we are concerned by optimizing the hardware implementation of the SHA-256 algorithm on virtex-5 Xilinx FPGA. Our main contribution in this paper is to design a compact SHA-256 core and to speed-up its critical paths. These are respectively seven and six words addition. The CS (Carry Save) representation is advantageously used to overcome the carry propagation, until the last addition. Specials efforts were made to design, at the LUT level, the two components (compressors 7:2 and 6:2) which are the key feature of our design; there delay is data path independent and equivalent to the delay of two LUT6. The resulting architecture is compact and operates at $170Mhz$ with throughput of $1,36Gbps$.

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