M.TECH. THESIS ABSTRACTS 2010

Microelectronics, VLSI & Display Technology

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RF Microwaves and Photonics

Signal Processing, Communication & Networks

Power & Control

Title : Design Of 10-Bit 200 MSPS Current-SteeringDAC
Author(s) : Bugga YaduVamsi Krishna
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Supervisor : Qureshi Shafi

Abstract

A 10 bit current steering CMOS digital-to-analog converter (DAC) is designed, with optimized performance for frequency domain applications. To get the best of both binary-weighted and thermometer-coded architectures, most current-steering D/A converters are implemented using a segmented architecture. Segmentation is chosen to reduce the total area occupied by the DAC. The optimum segmentation found in this design used 6 thermometer-coded bits in the MSB section and 4 binary-weighted bits in the LSB section. With the help of Monte Carlo simulations area of the unit current source is fixed, which satisfy the yield specification of the DAC. This DAC is designed for a yield of 99.73 %. The DNL and INL specifications are chosen to be 0.1 LSB and 0.4 LSB respectively. For a sampling frequency of 100 MSPS, the SFDR is better than 57 dB for signal from dc to 40 MHz. For a sampling frequency of 200 MSPS, the SFDR is better than 49 dB for signals from dc to 80 MHz. When operating at 200 MSPS, it dissipates 12 mW from a 1.8 V power supply. Key building blocks designed for this DAC are current cells, C2MOS register, binary to thermometer decoder, latches and biasing network for current cells. Layouts for these blocks are drawn and all the measurements are taken after back-annotation. This DAC occupied a total area of 0.13 mm2. All the designs are done in 1.8 V, 0.18 µm CMOS technology from GPDK (Generic Process Design Kit) Cadence EDA tool suite

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Title : Studies On The Drift Phenomenon In HgCdTe Detectors
Author(s) : Bandari Pavan Kumar
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Supervisor : John Joseph&Ghosh Bahniman

Abstract

The spectral responsivity of HgCdTe photodetectors operating in the thermal infrared region is observed to slowly drift with time. The characteristics of the drift were investigated and were shown to have an origin different from that reported in literature. Those drifts were caused by thin film of water ice depositing on the cold area of the detector. The source of the new drift is far more serious because it is fundamental, making the acquisition of infrared radiation measurements very difficult. A model explaining the drift phenomenon in HgCdTe photodetectors is described by considering the deep trapping of charge carriers and generation of radiation induced new deep trap centers which are meta-stable in nature. A theoretical model is fitted to the experimental data. The comparison of the model with the experimental data reveals that the radiation induced deep trap centers and charge trapping effects are mainly responsible for the drift phenomenon observed in HgCdTe photodetectors.

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Title	***:***	***A Threshold Voltage And Mobility Compensation Circuit For A Moled Displays With Fast Programming Time***
Author(s)	***:***	***Narayanan PNirmal***
Roll No	***:***	***Y8104041***
Supervisor(s)	***:***	***Mazhari Baquer & Ghosh Bahniman***

Abstract

Active Matrix Organic Light Emitting Diode (AMOLED) displays are being actively developed as the flat panel display technology of future due to their several advantages such as large viewing angle, fast response time, low cost, thin size etc. For success of AMOLED display, it is important that the pixel characteristics be independent of the variations in OLED and TFT characteristics. These variations cause non-uniformity in display. Most critical among these are the variations in threshold voltage and mobility. So far, the pixel circuits in literature targeted threshold voltage variation and attempt to address mobility variations resulted in increased complexity. The thesis presents a novel principle for compensating both threshold voltage and mobility variations and proposes two pixel circuits, one using poly-Silicon technology and the other using amorphous silicon technology. The poly-Silicon based circuit comprises of 2TFT and one capacitor but uses matching property and drives the transistors in a novel way to implement a negative feedback. At a single current the circuit is able to compensate very well (Non-uniformity of less than 3%) for threshold voltage and mobility variations. However, for larger current range the performance was less optimal especially at lower current values. Further, the circuit could be programmed in less than 1µs. For amorphous silicon based backplanes a 4TFT circuit has been proposed which does not rely on matching property. The circuit was able to compensate well (non-uniformity of less than 5%) for threshold voltage shift and mobility variation at the designed value and the compensation was less optimal at lower current values. Here too the programming could be completed in less than 1µs making it potentially suitable for high resolution displays.

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Title : *Encapsulation Of Organic Solar Cells On Flexible Poly-Ethylene Terephthalate With Lithium Fluoride & Bathocuproine Layers*

Author(s) : *Sujania Anurag*
Roll No : *Y5827107*
Supervisor(s) : *Iyer S Sundar Kumar*

Abstract

One of the main problems with the flexible organic solar cells (OSC) is their rapid rate of degradation in performance after the device has been fabricated. Apart from the adverse effects on the device due to direct exposure to environment, the permeation of oxygen and water vapour through PET substrate that end up reacting with the active layer - add to the instability of the device. This work primarily focuses on the development of ultra high barrier for PET substrate. The existing device on flexible substrate processed in the lab was optimised to obtain a power conversion efficiency under AM 1.5 one-sun illumination of 0.24. The OSC device had a short circuit current density (Jsc) of 1.90 mA cm-2, open circuit voltage (Voc) of 0.44 V and a fill factor (FF) of 0.29. The devices were encapsulated with the ultra high barrier which was fabricated using thin film of lithium fluoride (inorganic) and bathocuproine (organic). The thicknesses of the thin films were optimized on the basis of two parameters: surface roughness and transmittance. The best thickness for single layer thin film of LiF was found to be around 125 nm with sufficiently high transmittance. The later part of the thesis deals with the life time study of the multi layer encapsulated device on ultra high barrier coated PET substrate along with un-encapsulated control sample and multilayer encapsulated sample. Open Circuit voltage was maintained for over 600 hrs in ultra high barrier encapsulated devices and Jsc also had a significantly higher value of 2.39 □A cm-2 till 400 hrs. The multi layer encapsulated device with the optimized thicknesses on glass substrate was studied over time along with the glass encapsulated devices. The multi-layer encapsulated device was found to survive for more than 500 hours. The higher life time of the multilayer encapsulated □□□□ device on glass substrate as compared multilayer encapsulated device on PET substrate(without ultra high barrier) established that the latter device experience more degradation because of the diffusion of O2 and H2O from the PET substrate as well which enhances the degradation of the device. It was then demonstrated that PET substrate devices with encapsulations on both the device and substrate side was more stable compared to devices with encapsulation on only the device side.

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Title : ***Characterisation And Modelling Of Organic Diodes Using Impedance-Voltage Measurements***

Author(s) : ***Goel Raghav***

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Supervisor(s) : ***Iyer S Sundar Kumar***

Abstract

Organic devices such as organic solar cells (OSC) and organic light emitting diodes (OLED) have been studied primarily with current-voltage characteristics. However given that capacitance and conductance provide an insight into the behaviour of the charges within the device, their study is expected to be extremely rewarding in understanding the device. Therefore, it is useful to understand impedance-voltage measurements for designing improved devices. This work analyses the capacitance versus voltage (C-V) characteristics of a P3HT: PCBM blend OSC. A model has been proposed which not only predicts the C-V curve but also the capacitance versus frequency characteristics and other electrode device behaviour. The increase in capacitance with voltage at low bias has been attributed to reduction in the physical distance between the locations of the differential charge modulation. This has been obtained by theoretical analysis and verified by experimental data. Various possible causes behind the decrease in capacitance and occurrence of negative capacitance have been discussed. Based on theoretical study, simulation results and data from the real devices, recombination is identified as the prime cause for negative capacitance at high biases and low frequencies. Having proposed a model for the device, the usefulness of the model is discussed. It is shown that the model can detect the occurrence of interface traps. This helps in classifying good and bad devices, understanding the cause of reduced efficiency in OSC's in case of interface traps. The model predicts that on introduction of interface traps, the bias value, at which the capacitance begins to increase, decreases. This has been duly verified by fabrication of devices and comparing the measured data with expected values from the models developed

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Title : ***Pentacene Based Organic Thin Film Transistors: Optimization & Transient Analysis***

Author(s) : ***Bansal Deepak***
Roll No : ***Y8104016***
Supervisor(s) : ***Iyer S Sundar Kumar& Mohapatra YN (PHY)***

Abstract

Organic thin film transistor (OTFT) has attracted a great deal of attention due to their potential applications in low-cost, large-area, and flexible displays, and low-end electronics. But due to low mobility, it is limited to low speed applications. For the manufacture of high performance OTFTs, a suitable gate insulator is as critical as the organic semiconductor. The ideal gate insulator should have a high breakdown voltage, good long-term stability, and good adhesion to the substrate. Organic polymers having good processability and dielectric properties, such as poly vinyl phenol (PVPh), poly vinyl alcohol (PVA), poly methyl methacrylate (PMMA), and polyimide (PI) have been widely employed as the gate insulator. However, for low-cost and large-area applications, leakage through dielectric insulator should be minimum and the dielectric should have good surface morphology for active layer, so that surface mobility can be enhanced. For minimizing leakage current and to improve mobility, dual layer structure for dielectric with cross linking agent is used. The effect of mid-gap localized states on the device is studied using a variety of pulsing modes and monitoring the resulting current transient. The contribution to current through, capture and emission have been analyzed in detail for typical leaky and non-leaky samples. Technique of Time Analyzed Transient Spectroscopy has been used for the analysis. It is shown that capture at the deep traps control switch-on transients, whereas the switch-off characteristics is controlled by emission from a continuous distribution of states resulting in stretched exponentials. The nature of transient is shown to be determined by trapping kinetics by carrying out transient analysis at an elevated temperature of 50oC.

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Title : ***Organic Thin Film Transistors:Fabrication & Temperature Dependence Of Characteristics***

Author(s) : ***Bhatasana Piyushkumar Maganlal***
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Supervisor(s) : ***Iyer S Sundar Kumar &Mohapatra Y N (PHY)***

Abstract

In recent years there has been a growing interest in organic thin-film transistors (OTFTs) due to their attractive features such as low cost, low-temperature processing, and mechanical flexibility. In this work we fabricate and characterized Bottom Gate, Top contact OTFT structure with dielectric consisting PVP(with or without cross linking agent) and PMMA. The structure are fabricated by spin coating dielectric layers of Poly Vinyl Phenol (PVP) with cross linking agent poly(melamine-co-formaldehyde on top of Indium Tin Oxide Glass substrates. And second dielectric layer by spin coating Polymethylmethacrylate(PMMA), thermal deposition of Pentacene as a semiconductor. It is shown that cross linking agent makes better interfaces between dielectric and Gate contact, and results give less leakage current and get higher saturation current. Typical transistor yield Field Effect Mobility = 0.2cm2/Vs, Ion/IOFF ratio =105, Threshold voltage = 9V, and Saturation current =3.2µA, with Sub Threshold Swing = 1.1V/decade. Design different Source/Drain Contact Masks have been use to decrease Fringe Capacitance by decreasing overlap width from 2mm to 200µm. The frequency response, as monitored by operation of an inverter circuit, improves from 240Hz to 3KHz as a result of deceasing in overlap capacitance. The characteristics are studied and analyzed in the temperature range 220K-300K. The temperature dependence of mobility is shown to be activated, and activation energy varies between 57meV to 120meV and varying drain voltage from -15V to -35V for 200µm wide channel. The mobility is also shown to be field dependent approximately varying square root of drain voltage. The threshold voltage is observed increase with decrease in temperature and increase gate voltage magnitude indicating that threshold voltage is controlled by interfacing trap concentration.

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Title : ***A Unified Analytical One-Dimensional Surface Potential Model For Partially Depleted (PD) And Fully Depleted(FD) SOI MOSFETs And An Analytical Current-Voltage Model For FD SOI MOSFETs Including The Effect Of Substrate Depletion***

Author(s) : ***Pandey Rahul***

Roll No : ***Y5827346***

Supervisor(s) : ***Dutta Aloke***

Abstract

In this work, we present a unified analytical surface potential model, valid for both partially-depleted (PD) and fully-depleted (FD) SOI MOSFETs, as well as a current-voltage model for FD SOI MOSFETs in strong inversion. Both the models are based on a simplified one dimensional and purely analytical approach. Our surface potential model builds upon an existing model, proposed by Yu et al., which is one of the most recent compact analytical surface potential models for SOI MOSFETs available in the literature, in order to improve its accuracy and removing inconsistencies in the model, thereby adding to its robustness. As a next step of our work, we present an analytical current- voltage model, in the strong inversion region, specifically for FD SOI MOSFETs, as they have become the preferred choice for integration into large scale designs, as compared to PD SOI devices, due to the superior electrical characteristics of the former, viz. better control over small dimension effects, improved subthreshold swing, etc. Our current-voltage model has been developed from the first principles, and it not only includes the effects of source-drain series resistances, self-heating, and parasitic BJT, which are essential to FD SOI device modeling, but also includes another important effect of substrate depletion, for the first time in the literature, which is of vital significance for FD SOI devices having small film thickness and low values of substrate doping.

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Title : Multilayer Organic Solar Cells With CuPc, P3HT And PCBM
Author(s) : Ojha Smriti
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Supervisor(s) : Iyer S Sundar Kumar

Abstract

The mismatch between the absorption spectra of organic materials and the broad white solar spectrum makes photon harvesting an important issue in organic solar cells. In this work, multilayer organic solar cells based on Poly-3-hexylthiophene-2,5-diyl(P3HT): [6, 6]-phenyl-C61-buytric acid methyl ester(PCBM) blends and Copper Pthalocyanine(CuPc)/PCBM bilayer solar cells were designed and fabricated. Employing CuPc with P3HT covers the absorption in the blue and the green wavelength range of the visible spectrum. CuPc/PCBM bilayer solar cells were explored which showed performance comparable to P3HT:PCBM bulk cells. The bilayer solar cells fabricated during the course of this thesis showed efficiency upto 0.8% while P3HT:PCBM cells were 1.4% efficient. The first part of the thesis deals with the study of P3HT:PCBM blend and the CuPc/PCBM bilayer cells and their arrangement in a multilayer fashion, with PCBM serving as a common acceptor for both the cells. Developing solar cells in a multijunction topology poses challenges in terms of processing, including contamination and degradation. The optimized thickness of active layers in this device was obtained through simulations and then experimentally. As expected, the multilayer cells produced a larger photocurrent when compared to individual cells. The performance parameters of the best multilayer device developed are: JSC= 5.81 mA cm-2,VOC=0.56V,FF=0.31,η= 1.01% when compared to individual cells with parameters: JSC= 4.81 mA cm-2,VOC= 0.58V,FF=0.19,η= 0.46% developed in the same fabrication run, showing that multilayer cells have immense potential to boost the performance of OSCs. Another method to extend the absorption range was implemented by employing a CuPc/PCBM cell in tandem with P3HT:PCBM with a thin recombination layer in between. This yielded a higher open circuit voltage and improved power conversion efficiency over a broad spectral range. In this thesis, a continuous composite layer of Al/MoO3 was used as an interlayer. Later, the possibility of an Al/PEDOT:PSS as an interlayer was tested. The best tandem device fabricated in this thesis work showed the following parameters: JSC= 1.27 mA cm-2, VOC= 1.00V, FF=0.10, η= 0.11% in comparison to a P3HT:PCBM device (JSC= 2.41 mA cm-2, VOC= 0.35V, FF=0.11,η= 0.09%) and a CuPc/PCBM device (JSC= 1.31 mA cm-2, VOC= 0.575V, FF=0.11,η= 0.07%), fabricated in the same fabrication run. In these devices an improved current matching was achieved and the open circuit voltage was nearly the sum of the voltages of two devices.

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Title : ***Designing And Fabricating Organic Solar Cells With New Magnesium Inserted Porphyrin Ring Based Molecules***

Author(s) : ***Singh Arvind***

Roll No : ***Y5827119***

Supervisor(s) : ***Iyer S Sundar Kumar***

Abstract

Three new molecules 20, 20'-ethane bis ((2, 3, 7, 8, 12, 13, 17, 18-octaethyl porphyrinato) Mg (II) (Molecule 1), (4, 4'-bipyridine) (2, 3, 7, 8, 12, 13, 17, 18-octaethyl 5,10,15,20-tetranitro porphyrinato) Mg (II) (Molecule 2) and (4-cyano-pyridine) (2, 3, 7, 8, 12, 13, 17, 18-Octaethyl-5, 10, 15, 20-tetranitro porphyrinato) Mg (II) (Molecule 3) are used for fabricating organic solar cell (OSC) devices. These molecules are derivatives of porphyrin ring found in natural and biological molecules such as chlorophyll, hemoglobin and chlorins. They are attractive because of their intimate involvement in light absorption, exciton transport, primary charge separation and charge transport processes in natural photosynthesis process. Also the complementary nature of their absorption spectra to most of the existing organic solar cell (OSC) molecules makes them fascinating for research and solar cell application. The absorption and photoluminescence properties of these molecules have been studied. The energy gap has been calculated (2.53 eV, 2.39 eV and 2.27 eV for Molecule 1, 2, 3 respectively). The HOMO and LUMO energy levels have been computed using cyclic voltammetric measurements and are found out to be -5.2, -2.67 -eV; -6.32, -3.93 eV and -6.1, -3.83 eV. Single layer OSC devices have been fabricated using these molecules. The hole mobility for Molecule 1 is determined to be 6.6x10-9 cm2 V-1 s-1 and electron mobility for Molecule 3 to be 7.7x10-9 cm2 V-1 s-1. The best efficiency of 2.74x10-4 % is obtained for ITO/PEDOT:PSS /Molecule 3/Ca/Al devices with open circuit voltage (Voc) of 1.025 V, short circuit current density (Jsc) of 1.45 μA cm-2 and fill factor (FF) of 0.184. To further improve the performance, binary bulk heterojunction devices of Molecule 2 and Molecule 3 with either of poly 3-alkyl thiophene (P3HT) or phenyl C60 butyric acid methyl ester (PCBM) are fabricated and the effect of blending is studied using electrical, photovoltaic and spectral properties. Molecule 2 is showing solubility problems in solvents common to P3HT or PCBM. So it has been modified by replacing a pyridine ring with cyano (-CN) group to give Molecule 3 with similar properties. The blending ratio of Molecule 3 and PCBM has been optimized and is found out to be between 3:7 and 2:8. The efficiency obtained for 3:7 composition is 1.82x10-3 % with Voc = 0.342 V, Jsc = 0.024 mA cm-2 and FF = 0.225. The blending of Molecule 3 and P3HT leads to efficient charge separation for excitons generated in Molecule 3 at the interface but poor performance due to poor electron mobility of Molecule 3. In order to get improved performance, ternary blend layer OSC devices of Molecule 3, P3HT and PCBM has been fabricated and studied for their absorption, morphological, electrical and spectral properties. The amount of each individual component is varied to study its effects on various properties. Best efficiency of 0.066 % was obtained for 1:1:3 composition of P3HT:Molecule 3:PCBM with Voc = 0.585 V, Jsc = 0.62 mA cm-2 and FF = 0.183. Inclusion of Molecule 3 into P3HT:PCBM binary structure causes morphological problems. Interaction of Molecule 3 with P3HT forming agglomerates is clearly seen in atomic force microscopic (AFM) images.

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Title : Fill Factor Of Bulk Heterojunctio Organic Solar Cell
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Supervisor(s) : IyerS Sundar Kumar& Mohapatra Y N (PHY)

Abstract

Fill Factor is one of the parameters that determine the efficiency of a Solar cell. Ideally I-V light curve of a solar cell should be a rectangle but in reality it is a concave curve (d2J/dV2 >0) in the fourth quadrant. However, in organic solar cell, particularly in bulk heterojunction solar cell the curvature in the fourth quadrant may become convex (d2J/dV2 < 0). This convex shape hampers the fill factor and drastically reduces the efficiency. The major goal of this work is to identify the reasons for the convex shape observed in the light characteristics by analyzing the dark and light characteristics of the organic solar cell device. The studies are undertaken on basic device structures fabricated with the P3HT: PCBM bulk heterojunction. From the dark I- V characteristics, trap distribution of the device are analysed and it is observed that there are two peaks in trap distribution for the devices showing convex shape in the light I-V characteristics and thus having low fill factor. A novel model is suggested which links the working of dark and light characteristics of the device to get more information about the traps present in the device and correlate them to the fill factor of the device. Light characteristics of the device are also investigated. The Photocurrent showed a distinct characteristic for devices showing concave curvature in their light J-V characteristics (d2J/dV2 > 0) and that for convex (d2J/dV2 < 0) curvature. Finally the effects of intensity variation are studied. Although at low intensities higher fill factor is obtained, the shape of the curve did show its

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Title : ***Design Of A 2MHz Band Width Continuous Time Delta Sigma Modulator***

Author(s) : ***G Surendranath Reddy***

Roll No : ***Y8104021***

Supervisor(s) : ***Qureshi Shafi***

Abstract

Modern electronic systems extensively use digital signal processing but require analog-to-digital (ADC) and digital-to-analog (DAC) converters to interface with the real analog world. There is a strong cost and performance advantage in designing ADCs that can be integrated on the same substrate as the digital signal processing circuitry. However, the poor component matching and reduced dynamic range of these deep sub micron CMOS technologies severely degrade the performance of the analog blocks. Delta-sigma ADCs which are based on the principle of noise shaping and oversampling are well suited for implementation in VLSI technology as they are especially tolerant to circuit non-idealities and component mismatch. The thesis involves the design of a continuous-time delta-sigma modulator for analog-to-digital conversion. The primary motivation for building continuous time delta-sigma converters is that the requirements on the anti-aliasing filter are greatly reduced in comparison to their discrete-time counterparts. The proposed third order modulator is operated at 125 MHz and is intended for 2 MHz band width wireless applications like Universal Mobile Telecommunications System (UMTS) applications. UMTS is one of the third-generation (3G) mobile communication technologies, which is also being developed into a fourth-generation (4G) technology. ΔΣ modulator employs a 2-bit internal quantizer which is implemented using Flash ADC and the Current steering DAC. Designed ADC targets a resolution of 9-bits for a signal bandwidth of 2 MHz. Systematic design procedure for the continuous-time delta-sigma modulator is explained. The loop filter of the modulator is implemented with active RC integrators. The key building blocks of the modulator like differential op-amp, CMFB circuits, latch, comparator, flash ADC and the current steering DAC are designed. Layouts of the all key building blocks are drawn and the post layout simulations at the block level are done. The simulated SNDR for the modulator is 54 dB. All the designs are done in 1.8 V, 0.18 um CMOS technology from UMC (United Microelectronics Corporation) Cadence EDA (Electronic Design Automation) tool suite.

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Title : ***A Library Of IP Cores For FPGA Based Motion Control Using Floating Point Arithmetic***

Author(s) : ***Srivastava Ruchi***

Roll No : ***Y8104054***

Supervisor(s) : ***Qureshi Shafi***

Abstract

Programmable Logic Devices such as Field Programmable Gate Arrays (FPGAs) are being considered by increasing number of designers in various fields of application such as telecommunication, video, signal processing and motor control systems. FPGAs have the potential of enabling both software as well as hardware customization as per design needs. They are re-configurable in nature; improve control system performance by supporting faster execution rates and offer reliability of a dedicated hardware circuitry. The concept of IP cores and re-usable designs can considerably reduce the development time, effort and cost. Leading FPGA vendors are offering IP cores in parameterized form which is not editable as the HDL code is usually not available. Whereas multiple IP libraries are available related to applications like signal processing, telecommunication and industrial bus interfaces etc. but a library specifically developed to cater the need of motion control applications is not available. The present work attempts to fill this gap. The focus is on developing a library of IP cores, written in editable HDL format, for essential basic elements of motion control system. The cores use floating point arithmetic for greater precision and accuracy which becomes important when precise control or precise positioning of poles/zeros is required. The floating point operators are also written in HDL format to make the cores portable across different platforms, technologies and foundries. The standard IEEE binary single precision floating point format is followed and the standard VHDL language is used to describe the code. The design was carried out using Xilinx ISE Design Suite 11.3 and synthesized using XST synthesis tool offered by Xilinx. Behavioral simulations were carried out using ModelSim SE-64 6.4b and algorithms were evaluated using MATLAB R2008a. Finally, the design was validated on Spartan-3E FPGA (xc3s500e-4fg320) using Spatan-3E starter hardware kit.

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Title : ***Evaluation Of Al Doped Zno As Anode For P3HT:PCBM Organic Solar Cells***

Author(s) : ***Athe Pallavi***

Roll No : ***Y8104043***

Supervisor(s) : ***Iyer S Sundar Kumar***

Abstract

Transparent conducting oxides (TCO) are used as electrode in organic solar cells. In this thesis, aluminium doped zinc oxide (ZnO:Al) is explored as an anode for organic solar cells and compared with indium tin oxide (ITO) which is another popular TCO. In this work aluminium doped zinc oxide thin film was deposited on glass substrate by pulsed dc magnetron sputtering technique. Thin film of ZnO:Al on glass substrate was optimized by varying deposition parameters to get properties comparable to ITO for organic solar cell application. ZnO:Al thin film with resistivity of the order of 7 × 10-3 Ω-cm and 82% transmittance was achieved. P3HT: PCBM based Organic solar cells were fabricated on ZnO:Al thin film sputtered on glass and on commercially obtained ITO coated glass. The performance parameter obtained for ITO devices are Jsc = 5.2 mA cm-2, Voc = 0.32 V, FF = 0.26, η = 0.5% and for ZnO:Al devices parameters are Jsc = 0.82 mA cm-2, Voc = 0.52 V, FF = 0.25, η = 0.1%. Reliability study in light with time was performed on ITO and ZnO:Al devices. Decay in the efficiency and short circuit current was exponential for ITO and ZnO:Al devices. Degradation rate was faster in ITO (τ1 = 0.5 hrs, τ2 = 9 hrs) devices compared to ZnO:Al (τ1 = 5 hrs, τ2 = 73 hrs) devices. The decay in efficiency is attributed to decay in short circuit density. It is suggested that the blocking of high energy photons by the ZnO is a likely reason for the device being more stable than ITO devices.

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Title : *Role Of Electron-Electron Interaction In Spin Transport*
Author(s) : *Kamra Akashdeep*
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Supervisor(s) : *Ghosh Tarun Kanti (PHY)*

Abstract

The electron spin dynamics has been studied extensively due to the prospects spin based devices hold for the future. Realization of spin based devices requires an effective implementation of three basic processes - spin injection, spin transport and spin detection. It is the spin transport that the present thesis delves into. We develop Monte Carlo method based routines which are capable of simulating spin transport in all its generality. Conventionally, Monte Carlo techniques ignore electron-electron interaction due to two reasons. Firstly, electron-electron interaction does not play an important role in conventional devices. Secondly, accounting for electron-electron interaction is computationally very intensive and is avoided as long as possible. In this thesis, we consider two forms of electron-electron (e-e) interaction - e-e magnetic interaction and e-e scattering. The e-e magnetic interaction results due to the spin magnetic moment of the itinerant electrons. It is found that e-e magnetic interaction contributes significantly to spin relaxation in high Lande g-factor semiconductors. The e-e scattering, although considered in theoretical spin relaxation studies of homogeneous systems, has been entirely ignored in Monte Carlo based spin transport investigations. We incorporate e-e scattering in our simulations to find that it leads to a change in the dominance domains of various spin relaxation mechanisms. Our work evinces the importance of e-e interaction in spin transport.

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Title : Slack Aware Adaptive Prefetching
Author(s) : Bhatia Ashish
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Supervisor(s) : Iyer S Sundar Kumar &Chaudhuri Mainak (CSE)

Abstract

Data prefetching is the technique which complements what data caching has achieved. While the main purpose of the caches is to hide data latency by caching spatially and temporally close data, prefetching techniques anticipate future accesses and issue fetches in advance of the actual requests and thus, hide access latency for the data which is being accessed for the rst time. To be e ective, prefetching must be done in such a way that prefetches are useful, timely (neither too early nor too late), and introduce little overhead. While accurate and timely prefetches improve the system performance,useless and premature prefetches not only consume memory bandwidth but also cause cache pollution, adversely impacting the system performance. In this thesis work, we have shown that by adapting the depth of prefetching to the data access pattern of the application, we can 1) reduce unnecessary memory requests caused due to useless prefetches resulting in unnecessary usage of memory bandwidth and 2) fetch useful prefetches in a timely manner, such that cache pollution caused due to early (premature) prefetching is avoided resulting in increase in overall execution speed. We have introduced a new concept called average utilization time of prefetches which along with percentage of merged prefetches quanti es the timeliness of prefetches. By optimizing average utilization time, we have shown that not only the bandwidth overhead due to useless prefetching can be reduced but also signi cant gains can be attained in the overall execution time of the application. On a set of multi-threaded workloads our technique resulted in a reduction of total memory requests by 6.8% and gain in execution time by 5.6%. On a set of multi-programmed workloads, our technique resulted in reduction of total memory requests by 7.2% and gain in execution time by 5.1%. We have described a comprehensive hardware implementation of our technique which requires 2.7% storage overhead of data cache capacity.

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Title : *Low Noise Amplifiers Design In Conjunction With Genetic Algorithm And MMIC Measurements*

Author(s) : *Prasad Ankur*
Roll No : *Y5827086*
Supervisor(s) : *Biswas Animesh*

Abstract

Low Noise Amplifiers (LNAs) play important roles in many RF/microwave receivers. They are used to amplify the received signals without adding substantial amount of noise to it. With emerging applications such as radio communications, wireless, space communications etc, in higher and higher frequency bands, the design of LNAs continue to challenge the designers with ever more stringent requirements higher performance, smaller size, higher reliability, lower power consumption and lower cost. Depending on the requirements and specifications, LNAs may be designed as MMICs or MICs. The matching of input and output impedances is easy for MMICs. However for operation of LNAs, there are optimization issues and hence Genetic Algorithm has been used which can help designer to decide on the point of operation of LNA.

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Title : Design Of High Frequency Continuous Time Filters
Author(s) : Mondal Saumen
Roll No : Y8104057
Supervisor(s) : Biswas Animesh & Srivastava KumarVaibhav

Abstract

Recently, there has been tremendous interest in CMOS integrated circuits for radio-frequency(RF) applications. This trend has been driven by the desire to integrate the entire RF circuitry on the same substrate on which the digital circuits are in order to reduce cost. The continuous scaling of CMOS technology has progressed sufficiently to offer device performance suitable for RF application at GHz frequencies. The demonstration of transistors with gate lengths of less than 0.1 μm and fT's higher than 100 GHz suggests the trend will continue throughout this decade. The Gm-C topology with simplicity, modularity, open loop configuration, and electronic tunability becomes the obvious choice for realizing high-frequency filters. In this work a very high-frequency low pass filter for the HDD (Hard Disk Drive) is designed and simulated for 3 dB cutoff frequency of 1.533 GHz. The fourth order filter is developed using the cascaded biquad technique. Its measured IIP3 is -3.51273 which shows that the filter is highly linear. The measured IM3 is -41dB which is sufficient for the Gm-C filter operation. The total power consumption is 35mW. A highly linear 600MHz centre frequency,500MHz bandwidth 6th order Butterworth bandpass filter using a Leap-Frog Gm-C topology is designed. The filter consumes a power of 44.87mW. A high pass filter with 10MHz cutoff frequency is designed using the cascaded biquad structure. At last a novel versatile filter architecture is introduced which can employ all the types of filter ;lowpass, highpass, bandpass, and bandstop filter in one topology. The above filters are designed using fully differential inverter based Operational Transconductance Amplifier (OTA) with common-mode feedback (CMFB) and common-mode feedforward (CMFF) circuit. Cadence tool has been used on IHP SiGe BiCMOS 0.25 μm node.

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Title : ***Design Of Low-Power Low-Noise Amplifiers (LNA) For GPS And UWB Applications***

Author(s) : ***Diddi Varish***

Roll No : ***Y8104064***

Supervisor(s) : ***Biswas Animesh & Srivastava KumarVaibhav***

Abstract

Transceivers are integral part of ubiquitous communication systems. The signal received by wireless receivers is very weak and can go down to the order of -130 dBm. The presence of physical obstructions makes the situation worse. The LNA (Low-noise amplifier) which is usually the first block of transceiver is designed to handle such signals. The LNA is expected to have high gain, low noise figure, high linearity and low power consumption. The work mainly focuses on design of LNAs for two applications – GPS (Global Positioning System) and UWB (Ultra-wide band). GPS is a narrowband application centered at 1.6 GHz. This is used in cellular and embedded systems. UWB operates for very high frequency range of 3.1 GHz – 10.6 GHz. The communication systems usually employ UWB transceivers as the bandwidth of 7.5 GHz can yield very high data transfer rates. In this work traditional methodology for LNA design is detailed in the first part. Using traditional design methodology a GPS and UWB LNAs are designed. In the second part power constrained design methodology is used. As power is put as constraint these LNAs do not give the best results. But such designs are of extreme importance in low-power battery operated mobile systems. The 0.25 μm IHP SiGe BiCMOS technology is used for design. This technology uses HBT (Heterojunction Bipolar Transistor) which has excellent gain and noise performance. The designs achieve high gain, wide bandwidth and low noise as is expected for LNAs.

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Title : ***Iterative Majorization Based Localization For Wireless Sensor Networks***

Author(s) : ***Karnaty Vijayender Reddy***

Roll No : ***Y5827221***

Supervisor(s) : ***John Joseph***

Abstract

Location information is an important addition to the sensor data in a Wireless Sensor Network. This information is used in routing protocols, storage algorithms etc. In-network localization techniques that solve for the coordinates of its constituent nodes are contemporary topics of research. We have studied localization techniques with primary focus on multidimensional scaling. Multidimensional scaling techniques are less popular in Wireless Sensor Networks, because of the common notion that they are computationally intensive. Simplex algorithm, simulated annealing and iterative majorization are the relevant multidimensional scaling techniques that have been implemented and simulated, in this work, to ascertain their performance in the context of Wireless Sensor Networks. Based on our study we chose iterative majorization to implement localization. We have used certain results of MDS, which simplified the necessary computations. To bridge the gap between research and on field implementations experiments were carried out and the obtained data was used to model our simulations. In this work received signal strength intensity is used to estimate the distance between nodes. IRIS motes were used in our experiments. We found significant ground-bounce effect on the path loss of radio signal strength. In this work localization was implemented and discussed using plain 'iterative majorization' and a slightly modified 'distributed iterative majorization'.

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Title : ***A Comparative Study On Some Commonly Used Active Inductor Configurations In 0.35-µm CMOS Technology With Improved Quality Factor***

Author(s) : ***Singh Kanishka Aman***
Roll No : ***Y5827216***
Supervisor(s) : ***Biswas Animesh***

Abstract

Inductive characteristics are required in a number of high-speed applications to improve system performance, such as bandwidth improvement, gain boosting, and impedance matching, to name a few. Planar spiral inductors suffer from a number of drawbacks when used in monolithic microwave integrated circuits (MMIC) applications, such as low inductance, quality factor, and resonant frequency, large silicon area required, and dependence of inductance on silicon area. Active inductors employing active components are able to overcome these drawbacks, and hence provide an attractive replacement for spiral inductors. With emerging applications, there is an ever-existing requirement to improve the performance of these active inductors in terms of their inductance value, the quality factor offered, the resonant frequency, and the level of noise, amongst other factors. As a result, several active inductor configurations have been proposed over the last few decades. Most of these active inductors are implemented in semi-insulating gallium arsenide (GaAs) technologies, which involve high costs. This work provides a comparative study of four commonly reported active inductor configurations through simulation on 0.35-µm gate length MOSFETs in CMOS technology, and tries to improve upon the quality factor achieved for these

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Title : ***Compact Two Pole Band Pass Filter Using Composite Right/Left Handed Transmission Line***

Author(s) : ***Mishra Viveka Nand***

Roll No : ***Y8104061***

Supervisor(s) : ***Srivastava KumarVaibhav***

Abstract

Excitation of miniature Composite Right /Left Handed (CRLH) Transmission Line (TL) unit cells as resonators with improved insertion loss and hence Band Pass filter realization with CRLH TL structures with and without via (using radial stubs), with enormous size reduction presents complete theme of this thesis work. In this thesis work two types of Band Pass Filter (BPF) for C-band wireless application was designed using CRLH metamaterial unit cells of traditional Left Handed Transmission Line (LHTL) with via and modified via free CRLH TL as resonators. These resonators were fabricated using PCB manufacturing facility of the department. The first type of BPF topology is based on CRLH structure with Inter Digital Capacitance (IDC) and stubs with via. The BPF is made of two capacitively coupled CRLH resonators. The BPF's performance has been simulated and optimized by Finite Element Method (FEM) based commercial software. A prototype was fabricated and its response measured. The measured results of the tested BPF agreed very well with the simulated frequency responses, and the measurement results show the BPF's insertion loss is less than -1.6dB, the return loss is less than -11.6db and the -3dB bandwidth is larger than 240 MHz with its center frequency at 4.56GHz. Further to get repeatability in response, work was progressed with Plated Through Hole (PTH) instead of via and also replaced the via structure with radial stubs to provide virtual grounding at high frequencies. The proposed via-free unit cells were first checked for resonance using High Frequency Structure Simulator (HFSS), a FEM based commercial Software and BPF design with two resonators was simulated and optimized. A prototype for the same was fabricated and its response measured. The measured results of the tested BPF agreed very well with the simulated frequency responses, and the measurement results show the BPF insertion loss is less than -1.6dB, the return loss is less than -14db and the -3dB bandwidth is larger than 240 MHz with its center frequency at 4.72 GHz. The designed Metamaterial band-pass filters with fractional bandwidth (FBW) more than 5% (240MHz) is designed at 4.67 GHz and FBW more than 8% (320MHz) is designed at 3.92 GHz using CRLH TL with Vias and Via-free CRLH TL using radial stubs respectively. There is more than 65-70% size reduction as compared to same order band-pass filter design using half wavelength resonators on the same substrate, without compromising on the insertion loss. The good performance, small size and relatively simple fabrication process make the via-free topology of CRLH TL based BPF a good candidate to be used as integrated filter in Microwave Integrated Circuit (MIC) environment.

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Title : Study Of Wireless Power T ransfer
Author(s) : Jain Arinjay
Roll No : Y8104006
Supervisor(s) : Srivastava KumarVaibhav

Abstract

The thesis aims to study the Wireless Power Transfer (WPT) using coupled magnetic resonance principle. This principle is known as resonance effect and states that max power transfer can take place if the two objects are in resonance and coupled through the tails of their non radiative fields, while dissipating relatively little energy in off resonant objects. The analysis of the wireless power transfer has been done using coupled mode theory and the various factors which affect the efficiency and the range of power transfer are enumerated. For maximizing the efficiency and power transfer the ratio of coupling to loss called 'Figure of Merit' need to be optimised. Maximising efficiency always does not mean maximum power, it has been mathematically shown that for a condition when the loss in the receiver coil and load are same then for max power transfer the efficiency should be approximately 50%.The concept of frequency splitting and optimising the coupling coefficient has been treated, stressing the importance of 'critical coupling coefficient'. The influence of extraneous non resonant object on the power transfer is limited to slight reduction in power due to attenuation and other losses. The system need to be safe for human exposure, with the use of capacitor and low frequency of operation the electric field is confined and the exposure can be well within the safety limits. The different set ups for the realisation of Wireless Power Transfer viz Symmetrical geometry, Different geometry, Passive repeater and Multiple coaxial coil transmitter have been treated and merits and demerits for each system were analysed. Out of these, setup with multiple coils at the transmitter was found to be inefficient for power transfer. WPT has some limitations however it was felt that these limitations are matter of time and with more research and study they can be overcome. This technique of transferring power has host of applications in consumer electronics, industries and defence. With more research and commercial exploitation this technique has potential of removing the clutter of wire from our lives.

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Title : A Multi Quantum Well P-I-N Photodiode Array
Author(s) : Pogula Rajesh
Roll No : Y8104049
Supervisor(s) : Das Utpal

Abstract

A multi-quantum-well PIN photodiode array having 128 x 128 pixels has been fabricated on a semi-insulating InP substrate for near infrared wavelength operation in which InGaAsP/InP MQWs have been used as the active region of the photodiode array. The work includes basic device design and fabrication steps such as Mask design, wet and dry etching and finally metal contact deposition. The fabricated photodiode array has been tested using a curve tracer to obtain the I-V characteristics. Tanner tools have been used to design the mask for optical lithography, and the pixel formation and isolation have been carried out by using methane chemistry based RIE. Zn-Au Thermal evaporation and lift-off has been used to form the ohmic contacts for the photodiode array. The fabricated photodiode array was characterized by performing an I-V experiment on the photodiodes and most of them are having a forward cut-in voltage of ~1.0V. However, the photoresponse of the diodes were poor as the entire pixel region was covered by Zn-Au and Au having a thickness of 400nm.

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Title : Switchable Dual Band Antenna For Cognitive Radio
Author(s) : Garg Ankesh
Roll No : Y5827070
Supervisor(s) : Harish A R

Abstract

The fixed spectrum allocation policy leads to an inefficient spectral usage as most of the times the band remains un-utilized. The cognitive radio technology allows the unlicensed user to transmit and receive in the licensed band under the constraints of allowed interference to other licensed users.The cognitive users have to be very efficient in sensing spectrum and also have stringent conditions on vacating the bands as soon as the primary user is detected with high probability so that they do not interfere with the primary user. Many measures are proposed at cognitive user front end to limit the amount of interference to the primary receiver which in some cases need a stringent filter design. The receiver or transmitter design at the cognitive user end can be simplified if the unwanted signals are rejected by the antenna itself. This work describes the design of switchable dual band antenna that can operate in either one of the bands or both simultaneously, viz. both the bands are on so that signals in both the bands can be received or transmitted and either one of them is on and other one is off so that only one band is utilized. The dual band is formed using two inverted F antennas(IFA) operating at different frequencies and PIN diode switches are used to turn them on or off. The work done includes various simulations using the ideal switch cases to turn the bands on or off and also the approximate PIN diode modeling to closely follow the actual switch conditions. A detailed parametric study is carried out using simulations to show the effect of various parameters like the switch positions, switch on and off impedances and the effect of DC biasing on the performance. The performance is demonstrated by a fabricated model of the antenna and comparisons of its performance with the simulation results.

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Title : ***Comparative Study Of Techniques To Estimate The Permittivity Of Polymer Film At Microwave Frequency***

Author(s) : ***Yadav Chanchal***

Roll No : ***Y7104013***

Supervisor(s) : ***Harish A R***

Abstract

Polymers can be processed from solution into thin and flexible films by using spin coating or printing techniques, which is a key factor in manufacturing flexible electronic devices at low cost. Organic polymers have applications in printed electronics operating in the lower end of the RF spectrum. Considerable effort is being focused on extending the frequency of operation of organic polymers. The development of electronic circuits working at high frequencies requires accurate knowledge of electromagnetic properties of materials such as permittivity. In this work we perform a comparative study of three different techniques that could be used to estimate the permittivity of organic polymer film at microwave frequencies. In transmission-reflection method, the microstrip transmission line coated with an organic polymer as an overlay is used to estimate the permittivity of the polymer film. Scattering parameter response of the microstrip line varies as the permittivity of the overlay or its thickness changes. The permittivity is estimated by minimizing the difference between the theoretical (computed from the analysis of the structure using IE3D simulation tool) and measured scattering parameters. A gap in the microstrip line can be modeled as a π-network of capacitances. The series gap capacitance depends on the permittivity of the polymer that fills the gap. We propose modification to the model so that permittivity of the polymer gets incorporated in it. Using this model, we can estimate the permittivity of the polymer from the transmission coefficient of two-port network. In resonator based method, transmission line and ring resonator structures coated with the polymer film as an overlay are used to estimate the permittivity of the polymer film. The resonant frequency of the resonator depends on the guide wavelength and hence depends on the permittivity of the substrate and overlay. In this method, the permittivity is estimated by measuring the resonant frequency of the resonators. In order to improve the accuracy of the measurement, we propose a new structure which uses a sandwich substrate, which is fabricated by depositing the polymer on a grounded dielectric slab. By placing the resonator above this sandwich substrate, we are able to increase the interaction of electromagnetic fields with the polymer film, which in turn improves the accuracy of estimation. We demonstrate the efficacy of the method by conducting experiments and comparing the results with predictions.

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Title : ***RBDO Problems For MVSK, CVAR And Asymmetric Loss Function***

Author(s) : ***Sahoo Siddharth***

Roll No : ***Y5827447***

Supervisor(s) : ***Sengupta RN (IME) & Singh Yatindra Nath***

Abstract

Real life problems always have inherent uncertainties present in the systems which, one wants to study. This results in a large number of limitations while modelling a real-life problem in its true form. There are often a large number of variables involved in any problem, and their behavior, either in exact or explicit form is seldom known. This problem is further aggravated, as different variables involved in the problem may have a high degree of non-linear dependence structure amongst themselves. Any model which does not appropriately account for all these factors in their true form will inadvertently result in modelling errors, which will lead to erroneous results. Hence one needs to solve these types of problems using different techniques one of which is the concept of Reliability Based Design Optimization (RBDO) method. This research work focuses solely on the domain of finance where the emphasis is to solve portfolio optimization problems taking into account the uncertainty of parameter estimates by making use of RBDO methods. Few portfolio model formulations have been presented in this thesis work. Model I (a) is a multi-objective problem considering all the four moments pertaining to the individual asset returns, namely mean, variance, skewness and kurtosis, through which we attempt to find the optimal allocation strategy with different probabilistic constraints and explore the possibility of the effect of higher moments in formulating the optimal portfolio. For Model I (b) the objective function to be simpler in nature, where the components of the objective function are the first two moments viz, mean and variance of stocks returns. Model II builds up on the work of Roman et. al. (2007), whereby we incorporate the concept of RBDO and consider the probabilistic portfolio optimization model in which one takes into account both the risk measures namely, variance and Conditional Value at Risk (CVaR). In the last part of this thesis work, we consider three different model formulations under Model III, i.e., Model III (a), (b) & (c), where in Model III (a) we propose a novel approach of analyzing a portfolio optimization problem by considering risk under an asymmetric loss function (i.e., Linear Exponential (LINEX) loss) while estimating the mean of the Gumbel distribution (a type of Extreme Value Distribution (EVD)). We then test our RBDO portfolio model formulation, considering risk under Squared Error Loss (SEL) which is variance, in Model III (b). Finally Model III (c) considers RDBO maximization formulation of a threshold, based on the fact that the expected value of Hyperbolic Absolute Risk Aversion (HARA) utility function of returns, assuming these returns follow Gumbel distribution, is bounded from below by an unknown threshold value. We test all of our six RBDO formulation using data from both the Indian as well as the German stock market and draw some interesting conclusion relevant for portfolio optimization.

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Title : Soft Fusion Methods For Multi Modal Speech Applications
Author(s) : Kumar Dheeraj
Roll No : Y5827167
Supervisor(s) : Hegde Rajesh Mahanand

Abstract

The complementary nature of audio and video information is well established. Video information about mouth shape and position can be used to interpret audio information in a better way. In this thesis, decisions made from audio and video information separately are late fused using Dempster Schafer (DS) theory, which provides a soft belief function for fusing information from independent modalities. Speaker diarization is the problem of finding out speaking times of each speaker and grouping together homogeneous segments. This is an increasingly relevant problem in meeting room scenarios and for automatic meeting documentation. In this thesis, speaker diarization using audio only information is performed using Bayesian Information Criteria (BIC) and video based diarization is performed using Hidden Markov Model (HMM) modeling of speaking and non speaking segments and later the two decisions are fused using DS theory. Speech recognition is the problem of finding out what is being said by listening to or by seeing someone speak or both. Applications of speech recognition are numerous and include better human-computer interface and speech controlled applications. In this thesis, speech recognition is performed using HMM modeling of audio and video features, and later the decisions made using these modalities are fused using DS theory. Based on the results of the experiments conducted for speaker diarization and audio visual speech recognition on standard databases, it can be concluded that video information when fused with audio information using a soft belief function such as DS theory gives better results than unimodal information based speaker diarization and speech recognition.

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Title : ***Client-Wise Cohort Set Selection For Text-Independent Speaker Verification***

Author(s) : ***Nagineni Srikanth***
Roll No : ***Y8104060***
Supervisor(s) : ***Hegde Rajesh Mahanand***

Abstract

Speaker Verification(SV) is the task of deciding whether an unknown speech utterance was produced by a claimed identity or not. Score variability is considered as a major source of performance degradation in establishing robust decision thresholds for text-independent Speaker Verification(SV) systems, which is caused due to many reasons. To account for such variations, different Score Normalization methods have been proposed. Score Normalization methods are broadly of two types, Background based normalization and Centered/reduced impostor score distributions. In background based normalization, it relies more on the estimation of alternate hypothesis in the Bayesian hypothesis test. However, the effects of this kind of techniques on the different score distributions are so close to the normalization method. This also acts as priori model for MAP algorithm when training the speaker models. Centered impostor distribution methods like Z-norm, T-norm, where scores are normalized by subtracting the mean and then dividing by standard deviation, both estimated from the impostor score distribution. In this thesis, we have proposed a new method over the standard T-norm by adjusting the cohort set to the each client model using normalized confusion matrix. The confusion matrix is computed as the classification by client models versus cohort models. This is called as CWCS-NORM method. In addition, we propose a client-wise hypothesized set method (CWHS) using normalized confusion matrices, in this case the confusion matrix is the actual client models versus classification that result from a specific classifier. We demonstrate that the proposed CWHS and CWCS-NORM methods are applied to Speaker Verification task using the NIST 2002 SRE and 2004 SRE databases respectively. Significant improvements in verification performance are noted.

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Title : ***Group Delay Based Methods For Spatial Analysis Of Distant Talking Speech***

Author(s) : ***Shukla Mrityunjaya***
Roll No : ***Y5827272***
Supervisor(s) : ***Hegde Rajesh Mahanand***

Abstract

Conventionally the spectral magnitude of MUSIC is used for efficient beamforming and clean speech acquisition from distant microphones. The MUSIC method is unable to resolve closely spaced DOAs with a computationally plausible number of sensors. We propose the use of the group delay function computed from the MUSIC phase spectrum for efficient DOA estimation. The group delay function which has been hitherto used for temporal frequency processing of speech signals is computed on the phase spectrum of MUSIC and is found to resolve spatially contiguous speech sources. The additive property of the group delay function in the spatial domain is also discussed using root-MUSIC polynomial analysis. We discuss its significance in resolving spatially contiguous sources using a minimal number of sensors under reverberant conditions. Both simulated and real room impulse response measurements are used to illustrate the resolving power of the proposed spectrum. The average error distribution plots for DOA estimation using a two microphone array are used to illustrate the efficiency of the MGD spectrum over the MUSIC Magnitude spectrum, Root-MUSIC, GCC, and GCC-Roth methods in clean and reverberant environments. Filter-Sum beam formers are trained using estimated DOAs on speech acquired from distant microphones. Experiments on distant speech recognition are conducted by training these beam formers on the TIMIT and the MONC data in both clean speech environments and reverberant conditions at different Direct to Reverberant Energy Ratios. Reasonable improvements in speech recognition performance are obtained using the proposed method.

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Title : ***Multi Finger Gesture Recognition In Dynamic Enviorment Under Varying Illumination Upon Arbitrary Background***

Author(s) : ***Mustafa Armin***

Roll No : ***Y8104007***

Supervisor(s) : ***Venkatesh K S***

Abstract

With the ever increasing role of computerized machines in society, the need for more ergonomic and faster Human Computer Interaction (HCI) systems has become an imperative. HCI determines the effective utilization of the available information flow of the computing, communication, and display technologies. We explore vision based interfaces in particular, and present in some detail our efforts towards developing what may be called 'accessory-free' or, at any rate 'minimum accessory' interfaces. We have developed a robust method to find the fingertip point location in a dynamic changing foreground projection in varying illumination on arbitrary background. The overall performance of the system is fast, accurate, and reliable. This dissertation basically aims at the development of sufficiently robust algorithms to detect the position of different parts of the hand by a visual band segmentation process carried out under the highly varying illumination conditions resulting from the projector output on an arbitrary background. This is a computationally efficient computer vision system for recognizing hand gestures. The system is intended to replace the mouse interface on a standard personal computer to control application software in a more intuitive manner. The system is implemented in C code with no hardwareacceleration. The main goal is to detect finger gestures without the requirement of any specified gadgets such as finger markers, colored gloves, wrist bands, or touch screens. The long term objective is to facilitate in the future graphical interaction with mobile computing devices equipped with mini projectors instead of conventional display screens. These are expected to be simultaneously communication and computing devices designed for 'anytime, anywhere use' with no assistive tools whatever. Technologically, this requires the visual or IR band detection of the finger gestures. Our approach deals with exclusively visual detection of the shape of intrusion on the front side projected background and recognition of the trajectory of multiple salient points of the intrusion contour. Gestures can then be defined in terms of derived multi-trajectory parameters such as position, velocity acceleration, curvature, direction, etc.

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Title : ***Spectral Estimation Of Distant Talking Speech Using The MVDR Method***

Author(s) : ***Manevarthe Bhargava***

Roll No : ***Y8104013***

Supervisor(s) : ***Hegde Rajesh Mahanand***

Abstract

Explicit spectral estimation of speech acquired over microphone arrays usually involves the choice of the the right pair of microphones. Presented in this thesis is an implicit approach to spectral estimation for distant talking speech using a family of minimum variance distortion less response (MVDR) estimates. The proposed approach builds on a previous approach of spectral estimation for close talking speech using a family of MVDR estimates. A mathematical formulation has been done for computing an implicit spectral estimate for speech acquired from a uniform linear array (ULA). This formulation is based on a simple mathematical relation between a fixed order MVDR spectral estimates, the harmonics in speech, and the noise power. This relationship is used for spectral modeling of distant talking speech by jointly combining a family of MVDR estimates by minimizing the squared error between the spectral estimates and the number of elements in the ULA. The Implicit MVDR spectral estimation has been improved by using robust error norm instead of least square error norm as in the previous work. The performance of the proposed Implicit spectral estimation method is evaluated in terms of Cepstral Distance Measure and Average Error Distribution(AED) plots, indicating improvements over the Fourier spectral estimates and the MVDR estimates obtained from the individual elements of the ULA. The Implicit approach gives flexibility for spectral estimation without fixing the model order.And also there is no need of estimating closest pair of microphones, instead each of the microphones output has been combined to give one spectra which is called the Implicitly estimated spectra. Experiments on continuous speech recognition for WSJ0 database indicates reasonable improvements when compared to conventional MFCC from the individual elements from the ULA. Similar experiments on speaker verification on the subset of NIST 2004 database are carried out. The DET curves computed from these experiments indicate reasonable improvements in recognition performance when compared to explicit approaches.

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Title : *Fast And Robust Real Time Digital Video Stabilization And Smear Removal Using Integral Projection Curve Warping Technique*

Author(s) : *Verma Kamlesh*
Roll No : *Y8104027*
Supervisor(s) : *Venkatesh K S & Gupta Sumana*

Abstract

Digital video stabilization is a very important tool to remove jitter and unwanted motion, captured in the video sequences caused by any relative motion between digital camcorder and the subject. A stabilized video system displays aligned image sequences. This thesis presents a novel, real time, fast algorithm to stabilize the video. A new expression of the relationship between the integral projections and motion in an image pair is characterized and named as frame signatures. These frame signatures are further compared to nd global motion vectors in horizontal and vertical directions. After nding the shift in consecutive frames, motion compensation is carried out which results in the stabilized and improved quality of video. For the rst time, the thesis describes the fractional i.e. subpixel motion compensation for videos having very small amount of disturbances or subpixel motion correction by pro- posed algorithm. This technique enables us to have a good quality video, providing drift correction facility for critical defence instruments calibration and also for hitting targets in war situations. Further, Point Spread Function (PSF) is calculated with already computed indices and directions. Motion smear (blur) is then corrected for good visual appearances, which provides smooth video with good quality. Proposed technique is suitable for verity of application in real time, due to very low com- putational cost. The wide range of applications is covered from critical defence applications to consumer electronics. Proposed stabilization technique can be used in defence applications for xing target at graticule on day TV camera (CCD) or night vision devices (Infrared or thermal zone). The minimized computational cost of this novel, fast algorithm allows real time imple- mentation on hardware. On cell phones due to annoying shaky hand movements the fast real time algorithm is capable to stabilize video. In addition of stabilizing the video, the present algorithm also removes motion blur.

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Title : Optimum Detection Of Coded Signal In Coloured Noise
Author(s) : Pandey Neeraj Kumar
Roll No : Y8104039
Supervisor(s) : Vasudevan Kasturi

Abstract

For coded signalling, Conventional Viterbi Algorithm is optimum for white noise. Although most of the current literature deals with signal detection in additive white Gaussian noise (AWGN), in many practical situations, the noise is correlated. This correlation is usually due to the non-ideal nature of the receiver filters. Conventional detection scheme proves to be a suboptimal technique in presence of such correlated noise. Optimum detectors for both uncoded and coded signalling in additive coloured Gaussian noise have been proposed earlier in the literature. In this thesis, we apply the proposed technique to specific examples and demonstrate the performance improvement over CVA detection scheme. Whitening property of the prediction error filters is the basis of the proposed technique. coloured noise is obtained by passing white noise through a filter. The computational complexity of PVA increases for higher order prediction flters and for bigger constellations. The improvement in performance by using the proposed method is demonstrated through SNR vs BER plots obtained using computer simulations.

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Title : *Generation Of Future Satellite Image Sequence Using Artificial Neural Network Model*

Author(s) : *Tamrakar Prateek*
Roll No : *Y8104048*
Supervisor(s) : *Sircar Pradip & Verma Nishchal Kumar*

Abstract

novel approach for generation of future satellite image sequence using a simple Artificial Neural Network (ANN) framework is presented. The inputs of this network are hyper dimensional color and spatiotemporal unified feature space for image sequence, so that each and every pixel is uniquely represented. The output of the network is tuned for R, G and B components of each pixel. Separate ANN is formed for each pixel for R, G and B color components. Principal component analysis and Mutual Information based feature selection techniques are used to improve the performance of model. By using Image restoration techniques quality of image sequence is enhanced. Performance of ANN Model with Fuzzy rule based Gaussian Regression Model is compared. The quality of the generated future image sequence is assessed using two image quality measures, Mean structural similarity (MSSIM) and Canny based image comparison metric (CIM). The resulting model is applied on a sequence of satellite images of tropical cyclone, Nargis, that made landfall in Myanmar on May 2, 2008 and is found to generate future image sequence successfully.

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Title : ***Image And Video Classification Using Histogram Based Support Vector Machine***

Author(s) : ***Agrawal Saurabh***

Roll No : ***Y8104058***

Supervisor(s) : ***Sircar Pradip & Verma Nishchal Kumar***

Abstract

We propose a novel technique for content based image and video classification using histogram based Support Vector Machines (SVM). Support Vector Machines (SVMs) are a relatively new supervised classification technique. They have their roots in Statistical Learning Theory and have gained prominence because they are robust, accurate and are effective even when using a small training sample. By their nature SVMs are essentially binary classifiers, however, they can be adopted to handle the multiple classification tasks common in studies. The approaches commonly used are the One-Against-One (OAO), One-Against-All (OAA) and Directed Acyclic Graph (DAG) techniques. Traditional classification approaches generalize poorly on image classification tasks because of high dimensionality of the feature space. In this thesis a new method of supervised image classification is presented in which SVM can be generalized for image classification problem where the only features are high dimensional histograms. The approach is then extended to video classification.

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Title : *Visual Occupancy Measurement*
Author(s) : *Singh Kaviraj*
Roll No : *Y4187190*
Supervisor(s) : *Venkatesh K S*

Abstract

Factors affecting visual occupancy of a road were studied and examined with the aim of improving road occupancy monitoring programs. Occupancy measurement is a prominent factor in traffic monitoring of a road. One can easily understand the importance of the fact of knowing the time for which a road is being kept busy. In our work presented in this thesis, we have studied various approaches to determine occupancy of a road and have tested for their accuracy. Occupancy of a road was found in different camera angles of the videos of traffic surveillance. Cases like side view and angled view of the camera were dealt with in detail. Occupancy of a road in a side view was measured successfully and the case of angled view was looked into to improve results. A vehicle in an angled view appears to have a different length than its actual length which produces problems in monitoring its real coordinates due to the misleading appearance. Our work proposes a method to deal with this problem. Also a number of experiments were carried out to confirm the theory. In addition to the above problem, we have proposed a method to find the number of vehicles crossing by a road under the assumption of no occlusion in a traffic flow. Also a method to determine the speed of a vehicle passing by was presented under the same conditions with a single camera.

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Title : Signal Processing Methods For Single And Multi Channel Speaker Segregation
Author(s) : Sivaprasad Beerakam
Roll No : Y8104059
Supervisor(s) : Hegde Rajesh Mahanand

Abstract

In this thesis, two novel signal processing approaches to speaker segregation are proposed. The first approach deals with the single channel speaker segregation problem. It uses sinusoidal modeling with re estimation of the phases of the sinusoidal residual followed by masking. The second approach deals with the multi channel speaker segregation problem using signal decomposition and energy envelopes. The problem of single-channel speaker separation attempts to extract a speech signal uttered by the speaker of interest from a signal containing a mixture of acoustic signals. In this work, an appropriate selection of the number of sine waves, window length and hysteresis threshold, is done so as to model and synthesize the underlying signal corresponding to the speaker with the lower pitch period, using an amplitude only sine wave synthesis. The sinusoidal residual is then computed after re-estimating the phases with known amplitudes, by minimizing a criterion function. This segregation technique is then integrated into a co-channel speaker identification system, at various target to interference ratios. Experiments on the TIMIT and GRID database indicate reasonable target speaker identification performance. In the second part, a new method which uses the loudness measure, where the energy envelope of the decomposed signal is computed to differentiate who is speaking, is proposed for multi channel speaker segregation. This method is applied to a four speaker tracking problem on the AMI meeting corpus. The speaker tracking performance is computed and compared to the ground truth provided in the corpus. The method provides reasonable improvements compared to other techniques used in literature. The primary advantage of this technique is its reasonably small computing requirement and its unsupervised nature making it amenable to real time implementation. This method also alleviates the need for large amounts of data required for model building in other statistical approaches to speaker segregation.

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Title : ***Un Supervised MultI Modal Approaches To Multiple SpeakerTracking***

Author(s) : ***M Manikanta Phanikumar***

Roll No : ***Y8104031***

Supervisor(s) : ***Hegde Rajesh Mahanand***

Abstract

Multiple speaker detection is an important component in applications like human- computer interaction, multimedia content indexing, biometrics, etc. One such application, tagging multimedia data based on who is speaking at what time assumes significance especially in recordings of meetings and conferences. In this thesis we describe an unsupervised multi modal approach to detecting and tracking more than two speakers in multimedia data recorded from multiple visual sensors and a single audio sensor. This dissertation deals with the modelling of such a complex decision making speaker detection system. The multi-speaker detection and tracking problem is first formulated as a multiple hypothesis testing problem. From this formulation we proceed to derive the multi- speaker tracking and detection problem as a condition in mutual information. The proposed method is then evaluated for multimedia recordings consisting of four speakers recorded on a multimedia recording test bed. Experimental results on the Clemson University Audio-Visual Experiments(CUAVE) multi modal corpus are also discussed. The proposed method exhibits reasonably good performance as demonstrated by the receiver operating characteristic (ROC) curves. The results of analysis based on the condition in mutual information are also encouraging. This detection system can also be applied to any similar detection or classification task where we have two modalities. So this method has also been applied to speaker detection to music signal. The results obtained are very much comparable with related work in literature.

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Title : *Detection And Estimation Of Frequency Hopping Signal Using Wavelet Transform*

Author(s) : *Sirotiya Mayank*
Roll No : *Y8104036*
Supervisor(s) : *Sircar Pradip & Banerjee Adrish*

Abstract

Frequency hopping is one of the techniques used in spread spectrum signal transmission. Spread spectrum enables a signal to be transmitted across a frequency band that is much wider than the minimum bandwidth required by the information signal. The transmitter "spreads" the energy, originally concentrated in narrowband, across a number of frequency band channels on a wider electromagnetic spectrum. Frequency hopping spread spectrum (FHSS) is a method of transmitting radio signals by rapidly switching a carrier among many frequency channels, using a pseudorandom sequence. FHSS has been considered as a very e fficient and secure way of communication in military and cellular radio communications. FHSS is highly resistant to deliberate jamming. FHSS has been widely used in wireless communication systems. For receiving FHSS, we need to fi rst detect the presence of signal in wideband environment and then to estimate the hop parameters like hop time and hop frequency. Wavelet transform is widely used in extracting features from signals. In this thesis, the applications of wavelet for the estimation and detection of frequency hopping signals in wideband environment is investigated. In detection of frequency hopping signals, we propose a method using discrete stationary wavelet filter banks. We compare our results with polyphase filter using fast fourier transform (FFT) and energy detector. Simulation results show a very good detection in negative SNRs. Also, for the estimation, we propose a method, which makes use of discrete stationary wavelet transform for fi nding the hopping time, by extracting the features from an image developed by the phase information extracted from the received signal. These methods show promising results in the presence of additive white Gaussian noise.

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Title : ***Low Probability Of Intercept Radar Signals Two Dimensional Analysis Using Wavelet Transform***

Author(s) : ***Tripathi Prashant***

Roll No : ***Y8104047***

Supervisor(s) : ***Sircar Pradip & Vasudevan Kasturi***

Abstract

We focus on the analysis of Low Probability of Intercept Signals in Radar which are basically characterized by high bandwidth and high pulse width. Two dimensional analysis is done using Wavelet transform. To detect these types of radar, new direct digital receivers that uses sophisticated signal processing technique is required. In this thesis, implementation of Wavelet transform is carried out using Quadrature Mirror Filtering (QMF) and Orthogonal Wavelet techniques to decompose the input waveform into components representing the signal energy in rectangular tiles in the time-frequency plane. By analyzing the outputs at different layers of the QMF tree it is possible to do feature extraction, identify and classify the LPI waveform parameters, and distinguish among the various LPI signal modulations. Signals such as BPSK - Barker coded Sequence, Frequency Modulated CW signals, Polyphase coded signals, Costas sequence frequency hop signals, and a simple single frequency and multiple frequency signals have been generated and then analyzed using the Quadrature Mirror Filtering algorithm. The output matrices resulting from the most relevant layers of the QMFB tree processing are examined and the LPI modulation parameters are extracted under pure signal condition and under 0dB signal to noise ratio condition.

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Title : Block Based Image Denoising Using Optimal Threshold
Author(s) : Venkata Karunya CH
Roll No : Y8104066
Supervisor(s) : Sharma Govind

Abstract

Over the years,a number of very successful wavelet-based image denoising algorithms have been proposed. Among them Neighshrink with an optimal threshold and neighbouring window has become state of art algorithm, due to its complete data driven approach. However, the algorithm doesn't fully provide desired features of image. This disadvantage mainly occurs due to its inefficient exploitation of wavelet coefficients properties. In this work, Block base image denoising algorithm is proposed based on the SURE principle and Neighshrink algorithm. It utilizes the pertinence of the neighbour wavelet coefficients by using block thresholding scheme. It can decide the optimal blocksize and threshold for every wavelet subband by minimising Stein's unbiased risk estimate.

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Title : *Timing And Carrier Synchronization Of Qpsk Signals For Quasi Static Fading Channels*

Author(s) : *Rangare Samta*
Roll No : *Y8104056*
Supervisor(s) : *Vasudevan Kasturi*

Abstract

Fading is a common phenomenon in satellite communication. When a frame is transmitted over a channel, it is subjected to reflection, refraction and diffraction. The communication environment changes frequently and thus introduces more complexities and uncertainties to the channel response. The receiver needs to do carrier as well as timing recovery. The process of carrier synchronization begins with frequency and phase acquisition and continues with phase tracking. Time synchronization refers to the process of deriving timing signals at the receiver which indicate where, in time, the transmitted symbols are located. Time synchronization is one of the most significant functions performed at the receiver in a synchronous digital communication system. Because the data available to the receiver is always noisy and distorted, perfect timing information is hard to obtain in practice, although practical systems can come reasonably close. In our work data aided method has been used for achieving timing and carrier synchronization. For the fading channels, timing synchronization can be achieved for those frames only whose SNR is high. To find out such frames threshold needs to be set at the receiver. For setting this threshold we have implemented a heuristic algorithm in which we erase all those frames for which SNR becomes very low, and calculate the bit error rate for the valid frames only. The bit error rate performance of the overall system is compared with the theoretical result.

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Title : ***Performance Study Of Coded Orthogonal Frequency Division Multiplexing***

Author(s) : ***Jha Keshav Kishor***
Roll No : ***Y8104029***
Supervisor(s) : ***Vasudevan Kasturi***

Abstract

New generation of wireless communication support high data rate applications. The major problem of high data rate communication is Intersymbol Interference(ISI). Orthogonal Frequency Division Multiplexing (OFDM) is a promising technique for high bit rate transmission in wireless communications systems, which overcomes the problem of ISI. Convolutional coding with OFDM improves the reliability of transmission. Coded OFDM is a robust technique in the fading environments. In the convolutional coding with code rate 1/2 and constraint length 3, it has shown by computer simulation that coded OFDM gives much BER improvement over uncoded OFDM. We have used soft decision viterbi decoder.We have also got the analytical expression of BER in case of uncoded OFDM and coded OFDM in AWGN case.

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Title : ***Mutiple Object Tracking And Synchronization Across Multiple Camera Views***

Author(s) : ***Singh Akshata***

Roll No : ***Y8104003***

Supervisor(s) : ***Venkatesh K S***

Abstract

We propose a region-feature based approach to track multiple persons with multiple cameras in a crowded environment. Most tracking algorithms face problems in situations of blob merging and splitting,targets moving very fast, cluttered background, and partial occlusions. In this work, we have dealt with the above mentioned problems. We use individual mean shift kernels for the head, torso and the legs of an individual:this improves the robustness of tracking over the conventional mean shift method due to the redundancy arising from multiple trackers. While tracking through occlusions, at least one of the three parts is likely to be visible completely, and the assumption of object integrity prevents individual tracker failure or drift. We additionally make use of a robust edge matching algorithm that validates and iteratively refines the mean shift estimate resulting in highly accurate part localization for rigid objects in particular. In case multiple persons occupy the scene, the blobs tend to merge and split frequently due to inter-person occlusions. The trackers are re-initialized accurately after each blob splits in a crowded scene. We also implement a motion model to ensure maintenance of track through temporary occlusions or very rapid object motion. While the part based approach reinforces the mean shift process, edge tracking and motion model enhance tracking accuracy. We then extend the work to tracking with multiple cameras. Multiple camera problems like synchronisation, color balance mismatch, co-registration of objects across views were effectively solved by using flash synchronisation, white balance correction and histogram matching using Bhattacharya distances. We use the CAVIAR Data Set as well as our own IIT Kanpur test data to evaluate the performance of our tracking algorithm. i

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Title : ***Wavelet Based Macroblock Mode Allocation SchemeFor H.264/AVC***

Author(s) : ***Lokras Vishesh***
Roll No : ***Y8104067***
Supervisor(s) : ***Sharma Govind***

Abstract

To improve coding efficiency, the H.264/AVC video coding standard uses new coding tools, such as variable block size, quarter-pixel-accuracy motion estimation, multiple reference frames, intra prediction and a loop fi lter. Using these coding tools, H.264/AVC achieves significant improvement in coding efficiency compared with existing standards. However, the encoder complexity also increases tremendously. Among the tools, macroblock mode decision and motion estimation contribute most to total encoder complexity. Exhaustively checking all the prediction modes for identifying the best one (commonly referred as exhaustive mode decision) is ineffi cient. This dissertation proposes a fast wavelet-based macro-block mode selection algorithm for H.264/AVC video codec system. In the case of Inter prediction, the scheme fi rst allocates modes based on the homogeneity of the macroblock. Then it makes use of the two-dimensional wavelet transform to estimate the sub-band energy of each macro-block in a given video frame. The sub-band energy becomes a primary parameter in mode decision. For further speed up, the algorithm also incorporates an early SKIP detection scheme. For Intra Prediction, the algorithm makes use of the directional information in the wavelet sub-bands to allocate modes. Various experimental results show that the proposed algorithm can e ectively make a macro-block mode decision with a slight reduction in bitrate and negligible impact on visual quality. Furthermore, the proposed wavelet-based multi-block selection algorithm reduces the execution time by about 34% as compared to exhaustive search algorithm adopted by the H.264/AVC reference software JM.

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Title : Ratioed Cost Loop Free Multipath Routing Algorithm
Author(s) : Nautiyal Dheeraj
Roll No : Y8104017
Supervisor(s) : Singh Yatindra Nath

Abstract

Routing is the process of selecting paths in a network along which the network traffic is send. It is performed for many kinds of networks including the telephone network, electronic data networks, and transportation networks. This thesis is concerned primarily with routing in electronic data networks using packet switching technology. Routers route the traffic along the the most optimum route between a source and a destination. Routing is of two types single path routing and multipath routing. Single path routing is not optimum as far as utilisation of network resources are concerned. In place of single path if we use multiple paths then definitely we will get higher throughput, better utilisation of network resources as well as other benefits such as reduced end to end delay and reduced packet loss. Multipath routing is of two types Equal Cost Multipath (ECMP) and Optimised multipath (OMP). ECMP balances load for all equal cost paths towards a destination. OMP relies on a link state routing protocol such as Open shortest path first(OSPF) to periodically broadcast link change information. The routing algorithm utilises the link loading information to adaptively split the traffic load among multiple equal cost paths. We have proposed a new ratioed cost loop free multipath routing algorithm which is more efficient than shortest path routing.

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Title : ***Burst Assembly Techniques Using Forward Resource Reservation For Delay Improvement In Optical Burst Switching Networks***

Author(s) : ***Sethi Harjeet Singh***

Roll No : ***Y8104025***

Supervisor(s) : ***SinghYatindra Nath***

Abstract

Computer networks have grown at a rapid rate in the recent past. This is coupled with the ever increasing demand for more and more bandwidth.Thus, there is a need to build new high capacity networks that can support the growing bandwidth requirements. All-optical systems offer these features. In these networks, the data is allowed to pass intermediate nodes without undergoing optical to electronic conversion. This reduces the costs of providing high-speed electronic switching and routing at each node. All-optical Optical circuit switching (OCS) systems provide optical circuit switched connections, between edge routers over an optical core network. These are static and so they cannot efficiently handle the bursty Internet traffic. Optical packet switching (OPS) provides packet switching at the optical level, thereby offering highest possible utilization in the optical core. OPS seems infeasible in the near future due to various factors.The technology which seems to come up as an alternative to OCS and OPS is Optical burst switching(OBS). In OBS, packets are assembled into bursts consisting of many IP packets. A header packet is transmitted ahead of the burst on the control wavelength in order to reserve the resources along the burst's route. After the reservation has been completed, the data burst is transmitted on separate wave- length. The burst can be assembled using either of the various algorithms proposed in literature. This thesis aims to propose a modified burst assembly algorithm that will result in less average packet delay during burst assembly, so that the delay sensitive traffic can be effectively handled by the network.

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Title	***:***	***A Color Video Compression Scheme Using Key Frames And A Low Complexity Color Transfer***
Author(s)	***:***	***Agarwal Rakesh***
Roll No	***:***	***Y8104051***
Supervisor(s)	***:***	***Gupta Sumana***

Abstract

In this thesis, an improved, low complexity method for color video compression using key-frame based color transfer has been proposed. Compression is achieved by discarding the color information of all but few selected frames. These selected frames are either the key frames (frames selected by a key frame selection algorithm) or the Intra-coded (I) frames. Existing works tend to calculate motion vectors at the decoder end for color transfer, rendering those algorithms complex enough to be used in real life situations. Instead of calculating motion vectors for color transfer, the motion vectors present in the decoder are identified and reused. This helps in maintaining the complexity of the decoder within practical limits, and at the same time improves the accuracy of motion vectors. Use of a key frame extraction algorithm, instead of sampling the video sequence at a fixed interval, enhances the compression ratio for videos with low motion activity and improves the quality of color transfer for video with high motion activity. Thus the proposed Codec improves the compression ratio achievable by a standard video Codec. The complexity of the proposed decoder is also comparable to a standard video decoder. The quality of final decoded video has been verified using different quality metrics, including an objective image quality metric. This thesis also tries to look into the application aspects of the proposed Codec.

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Title : *Three Dimensional Environment Mapping Using Active Stereoscopic Infrared Sensors*

Author(s) : *Jain Siddharatha*
Roll No : *Y5827448*
Supervisor(s) : *Venkatesh K S*

Abstract

The need for autonomous navigation is increasingly felt in various fields, from intelligent vehicles to space explorations. To achieve this end, it is imperative that techniques be developed for generating accurate environment maps. Research has been conducted previously in this field using various techniques. Using an infrared emitter-receiver pair is one such technique, where the properties of the light reflected off an obstacle estimate its position in the environment. The purpose of this thesis was to generate high fidelity three dimensional environment maps using stereoscopic infrared sensors. The technique used in this sensor is the method of triangulation, in which the angle of the reflected infrared light is used by the sensor to calculate the object distance. Infrared sensing is more often carried out by an alternative method based on the intensity of the reflected infrared light. Most previous research is based on the intensity based approach, which has many limitations. This thesis-work was structured into four major areas. First, a static platform for precise three dimensional orientation of the sensor was built using a double stepper motor arrangement. While one stepper motor controlled the φ orientation of the sensor, the second motor was responsible for its θ orientation. Second, analysis of the behaviour of the sensors was conducted. Two sensors with different ranges (1m and 5m) were analysed. Variations among different instances of the same sensor model were also studied. Third, experiments were carried out to map environment in two dimensions. Experiments were conducted to simulate the environment mapping capabilities of a mobile robot, by superimposition of multiple frames obtained by the displacement of the fabricated static platform. Lastly, the robotic assembly was used to map complex three dimensional environments. The results are presented here.

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Title : *Adaptive Scheduling And Capacity Of Multiuser MIMO MAC System With Transmit Antenna Correlation*

Author(s) : *Gupta Abhishek Kumar*
Roll No : *Y5827020*
Supervisor(s) : *Banerjee Adrish &Chaturvedi Ajit Kumar*

Abstract

In present wireless communication systems, multiuser multiple-input multiple-output (MIMO) system provides a promising solution to enhance the performance of communi- cation. Although for analysis purposes independent and uncorrelated antennas are generally assumed but in practice, antenna correlation always exists caused by limited physical sizes or spacing of transmitters/receivers and is regarded as a negative factor since it may result in reduced degrees of freedom. Inspite of the previous fact, in multiuser MIMO multiple ac- cess channel (MAC) system with covariance feedback, antenna correlation at mobile stations (MS) can be potentially beneficial to the sum capacity. Especially, below a certain signal to noise ratio (SNR), antenna correlation can actually lead to a performance improvement. In this work, effect of transmit antenna correlation in multiuser MIMO-MAC has been evaluated analytically. Two extreme cases has been considered - Full correlation (FC) and No correlation case (NC). It has been proved that full correlation can be better for low SNR region especially at the cell edges which are far from base station (BS) and there exists a crossover point where the channel capacity curves for these FC and NC modes intersects each other. The approximate estimate of the crossover point is also calculated for the above case. We have also described cases where the crossover does not exist and proved that full correlation is always better in those cases. These results also motivate us to design a scheduling scheme for users with adaptive selection of their modes. We have proposed three schemes to select users mode and schedule them to maximize the channel capacity. In the first scheme named as `Distributive Scheme with Pre-Calculated Crossover In- formation', selection of mode is done at MS depending of Pre-Calculated crossover point information. In second scheme named as `Centralized Scheme with Pre-Calculated Crossover Information', all users operate in the same mode decide by Base station while in the third scheme named as `Centralized Scheme with No Crossover Information', BS searches for the best users and mode among all possible combinations of users and modes in the entire cell and schedules them. It has been shown through simulations that all the schemes perform better than the scenario when no adaptive mode selection schemes are used.

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Title **:** ***Robust Spectrum Sensing Under Noise Uncertainty And Data Correlation***

Author(s) **:** ***Mishra Abhishek***
Roll No **:** ***Y5827023***
Supervisor(s) **:** ***Sircar Pradip & Banerjee Adrish***

Abstract

Cognitive radio (CR) is a new paradigm for wireless communication in which a transceiver can intelligently detect which communication channels are in use and which are not and instantly move into vacant channels while avoiding occupied ones. This optimizes the use of available radio-frequency (RF) spectrum while minimizing interference to other users. In this thesis, we have proposed a selection based detection method for spectrum sensing in cognitive radio which is a combination of both energy detection and covariance absolute value detection methods. We had also compared energy detection and covariance absolute value methods for different types of input data and were able to show from the simulation results and theoretical analysis that the performance of the selection based method is more insensitive to the type of input data. We have also proposed a new energy detection scheme based on the principle of Bayesian inference. This method attempts to solve the problem of energy detection under noise uncertainty condition by first segmenting the received signal samples into mutual exclusive sets according to a-priori knowledge of the distribution of noise variance and then applies energy detection method to sense the presence of primary user's signal. This new method has been compared with the conventional energy detection method and is shown to outperform the latter under noise uncertainty condition.

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Title : ***Performance Analysis Of Maximal Ratio Transmission And MMSE Beamforming For MIMO Wireless Systems With Imperfect CSIT***

Author(s) : ***Jana Mrinmoy***

Roll No : ***Y8104033***

Supervisor(s) : ***Chaturvedi Ajit Kumar & Jagannatham Aditya***

Abstract

We analyze the performance of Maximal Ratio Transmission and Minimum Mean Square Error (MMSE) beamforming on multiple-antenna Rayleigh at fading channels with imperfect channel feedback. We characterize the feedback imperfections in terms of noisy channel estimation, feedback delay and nite-rate channel quantization. The Maximized SNR or Maximal Ratio Transmission (MRT) scheme has been considered in literature with imperfect Channel State Information at Transmitter (CSIT) only for Multiple Input Single Output (MISO) systems. Multiple Input Multiple Output (MIMO) MRT system has also been considered without quantization error in the CSIT. MMSE precoding has only been considered only with perfect CSI or Imperfect CSI with only estimation Error at the receiver. In this thesis we have generalized the idea for MIMO MRT with all the three kinds of imperfections in CSI. We have found optimal beamformer and combiner for MMSE scheme and also found analytical expressions for the Symbol Error Rate (SER) for both the schemes. We validate the accuracy of the analysis through simulations, and assess the relative e ects of channel estimation inaccuracy, feedback delay, and nite-rate quantization on the symbol error performances for Quadrature Amplitude Modulation (QAM) and M-ary Phase Shift Keying (M-PSK

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Title	***:***	***High SNR Analysis Of A Two User MIMO Interference Channel Without CSIT***
Author(s)	***:***	***Balaji S B***
Roll No	***:***	***Y8104012***
Supervisor(s)	***:***	***Chaturvedi Ajit Kumar***

Abstract

We analyze the two user MIMO interference channel (IC) without CSIT under high SNR. We derive the achievable DMT of five different schemes over this channel. The schemes considered are HK (Hans-Kobayashi) scheme, joint decoding, stripping decoding, orthogonal schemes like TDM/FDM and treating interference as noise. The DMT of these schemes has been considered in literature for Single Input Single Output (SISO) systems. In Multiple Input Multiple Output (MIMO) systems HK scheme has been considered with CSIT. In this thesis we have derived a bound on achievable DMT of all these schemes over MIMO IC without CSIT. We have also found a regime for approximating the IC into a single user system. We validate the tightness of the bounds through simulations, and compare the DMT bounds of all the five schemes. We have also derived STBC design criteria w.r.t pairwise error probability and approximately universal STBC design criteria for HK scheme.

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Title : *Novel Techniques For Real Time Automatic Target Detection And Tracking For Thermal Image Sequences*

Author(s) : *Srivastava Anurag Kumar*
Roll No : *Y8104005*
Supervisor(s) : *Venkatesh K S*

Abstract

Automatic detection and tracking of moving targets is a key component of an automatic visual surveillance system. In this thesis we propose a method for automatic target detection & tracking for image sequences captured from a thermal imager. Approaches for detection & tracking in both stationary as well as moving camera domain have been developed. Statistical background learning, using both single-scale and multi-scale approaches has been done to detect and localize targets of interest and remove undesirable background clut- ter. Background learning is done in presence of moving targets by using a novel n-pass iterative re nement procedure. Subsequently, the background is updated for every incom- ing frame and the foreground moving targets are extracted by background subtraction and thresholding. The algorithm ow starts with shot segmentation of the incoming long video sequence. Within each shot, the background is learned for the first few frames. Illumination compensa- tion is carried out as it is a primary requirement for correct detection in a rapid gain varying thermal image sequences. Only after this, background subtraction and target localization are implemented and this in turn is followed by the target tracking procedure. For automatic target detection & tracking in moving camera domain, the very robust SIFT (Scale-Invariant Feature Transform) algorithm has been used to nd out salient fea- tures in consecutive frames. The global shift vector between consecutive frames is computed using these feature points. An unique color coding scheme is used to show the overlapping blocks between incoming consecutive frames and to show the age of overlapped blocks. The di erent colors in the image, di erentiate the areas already learned and ready for detection and tracking, the areas which are being learned, and the areas which are not learned at all. Experimental results, obtained with real thermal image sequences, having a wide target and clutter variability, and atmospheric condition and target range variability demonstrate the e ectiveness and robustness of the proposed method.

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Title : *Image Compressive Sensing (CS) With New Sampling Operator And CS Reconstruction Using Total Variation Regularization*

Author(s) : *Kesarwani Gaurishankar*
Roll No : *Y8104023*
Supervisor(s) : *Gupta Sumana*

Abstract

The Compressive Sensing (CS) paradigm consists of recovering signals, that are sparse or compressible in a given basis, from a small set of linear projections into random vectors. The key components of compressive sensing are the sensing matrix at the encoder that must be highly incoherent with the sparsifying transformation of the signal and a non-linear reconstruction algorithm at the decoder such as Basis Pursuit(BP), Orthogonal Matching Pursuit(OMP), Iterative Thresholding associated with projection onto convex sets and their variants that attempt to find the sparsest signal from the received measurements. The first family of sensing matrices for l1 based reconstruction algorithms consists of random Gaussian/Bernoulli matrices. Their main advantage is that they are universally incoherent with any sparse signal and thus, the number of compressed measurements required for exact reconstruction is almost minimal. However, they inherently have two major drawbacks in practical applications: huge memory buffering for storage of matrix elements and high computational complexity due to their completely unstructured nature. In this thesis sensing modalities have been proposed that have an advantage in the terms of less storage requirement and due to their structured nature they provide fast computation in the non-linear reconstruction. The simulation results show that fast reconstruction can be achieved from these compressive sensing measurements. Total variation (TV) statistics is an important statistics that has been used for applications such as image denoising. The Total variation regularization has been used in this thesis for reconstruction. A performance comparable with the sparse l1 reconstruction has been achieved. Such CS reconstruction works quite well for images that have sparser gradient.In the last part of the thesis, we have also attempted to address the problem of super-resolution using directional interpolation. A Quadtree formulation in wavelet domain and spatial domain has been proposed to obtain the directions in the image, to obtain super-resolved images.

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Title : ***Human Pose Estimation In Videos Using Temporal Continuity On Static Pose***

Author(s) : ***Mishra Anima***

Roll No : ***Y8104001***

Supervisor(s) : ***Venkatesh K S & Mukerjee Amitabha***

Abstract

Human pose estimation in videos is an open and currently active research problem in the field of computer vision. Extracting meaningful 2D human pose information from video sequences is of interest for various applications like intelligent human computer interfaces, biometrics, video browsing and indexing, virtual reality or video surveillance. The human body proportion vary largely across individuals, due to gender, age, weight or race. Apart from this variability, a single human body has many degrees of freedom due to articulation, and the individual limbs are deformable due to moving muscle and clothing. There are several reasons which make human pose estimation problem very hard such as variety of clothings, different illumination conditions, unpredictable movements, and occlusion etc. This dissertation addresses the human pose estimation problem in a monocular video sequence. The proposed approach can be factored into two stages. Firstly, estimation process would be done spatially at the frame level based on probabilistic assemblies of parts using conditional random field. Secondly, estimation in the further frames is carried out by utilizing the temporal information present in a sequence. In order to maintain the temporal consistency across the sequence, we have incorporated first order Markovian chain for localising the estimation of individual body parts. This reduces the time complexity and improves the spatial accuracy.

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Title : *Action Recognition In Videos Using Fourier Shape-Motion Words*

Author(s) : *Sharma Bishwajit*
Roll No : *Y8104015*
Supervisor(s) : *Venkatesh K S & Mukerjee Amitabha*

Abstract

Any action usually consists of sequences of poses undergoing motion. Often, many poses and their local motions are common among different actions. Tagging one action video with a single label need not necessarily be the optimum solution for action recognition. To concisely represent the shape and motion features, we use a temporally windowed Fourier transform. We demonstrate that the use of Fourier space to represent shape-motion features can be efficiently tuned to discriminate between short actions, while not discriminating the actors' speed, style and anthropometry. We employ a bag-of-words model to learn the shape-motions that are common between these actions. The algorithm first learns a set of key features of shapes and its associated motion, in the Fourier shape-motion space. This is done in an unsupervised manner using K-means clustering. Next, the cluster transitions for each training video is labeled with the action being performed. With common clusters in different action sequences, we propose to construct cluster transition maps. These maps are intuitively a better representation for different actions which have common pose-motions. We analyse performance of the algorithm against number of clusters (K), feature size, and depth of the cluster transition map. We also study the computation time of our algorithm. Results on the Weizmann human action video dataset are finally presented where we achieve more than 90% accuracy.

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Title : *Multi-User Linear Detection For DS-CDMA Communications*
uthor(s) : *Kumar Rishi*
Roll No : *Y8104052*
Supervisor(s) : *Vasudevan Kasturi & Mukharjee Amitabh (CSE)*

Abstract

Direct-Sequence Code Division Multiple Access (DS-CDMA) is a popular wireless technology. In DS-CDMA communications, all of the users signals overlap in time and frequency and cause mutual interference. The conven- tional DS-CDMA detector follows a single user detection strategy in which each user is detected separately without regard of the other users. A better strategy is multi-user detection, where information about multiple users is used to improve detection of each individual user. Multiuser detection may be classified on the basis of their operation, such as linear, successive inter- ference cancellation, etc., these multiuser detectors have trade off between their complexity and performance. Bit-error rate is generally the desired pa- rameter for performance analysis. In this thesis we study via simulations, the performance of various linear multi-user detectors for synchronous DS- CDMA.

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Title : *Reduction In ICI And OOB Power Using Pulse Shaping In N-Continuous OFDM*

Author(s) : *Goel Divya*
Roll No : *Y5827171*
Supervisor(s) : *Chaturvedi Ajit Kumar*

Abstract

Orthogonal frequency division multiplexing (OFDM) technology is one of the most attractive candidates for new technologies like fourth generation (4G) mobile radio communication and Cognitive Radio systems. It effectively combats the multipath fading channel and improves the bandwidth efficiency. However, the relatively slow spectral band-edge decay of OFDM systems and their sensitivity to frequency offsets have been a subject of concern. Pulse shaping is considered a simple and effective method to reduce Inter Carrier Interference as well as out-of-band power reduction in OFDM systems, but they are not considered together while designing a pulse, so there always existed a trade-off between reduction of ICI and reduction of out-of-band power in OFDM systems with pulse shaping. In this thesis, we study pulse shaping on a new signaling format, N-continuous OFDM which renders the emitted signal's phase and amplitude continuous. The low out-of-band power in N-continuous OFDM system gives us the flexibility which opens up new possibilities in designing an optimum pulse for OFDM transmission. We discussed one such design of pulse here which exhibits more outstanding performance in these two aspects than other existing pulses. Performance of various pulse shaping functions is studied in N-continuous OFDM system and the trade-off between the reduction of ICI and reduction of out-of- band power in OFDM systems is addressed.

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Title : *Pyramidal Video Restoration And Error Concealment Based On Modified Space Time Approach*

Author(s) : *Dorababu Gundrajukuppam*
Roll No : *Y8104019*
Supervisor(s) : *Gupta Sumana*

Abstract

Many important events of the past that are of historic, political and cultural significance have been recorded in media which are susceptible to degradation. The quality of the films stored in such media gets reduced after repeated usage.Thus, it is extremely important to preserve and restore these video archives.Typical artifacts in degraded video are Blotches,Line scratches and noise. Blotches appear as regions of high contrast at random positions in the frame.Line scratches are visible as bright or dark intensity lines oriented more or less vertically over much of the image. Missing information in video sequences may arise due to transmission errors also.In video transmission, macro blocks are often lost.These can be restored by using the information from the available frames.In this thesis an efficient Space-Time Completion Algorithm is presented for the restoration of the old video archives and video transmission errors.The work presented in this thesis primarily focuses on, 1. An Efficient Space-Time Completion for Removal of Artifacts in old Video Se- quences. 2. Detection and Removal of Moving Scratches in Old Video films. 3. Modified space time completion for Error-concealment of decoded video sequences. In Space -Time Completion the missing portions or holes are filled-in by sampling spatio-temporal consistency between all patches in and around the hole.This algo- rithm is very effective in restoring the artifacts but the time complexity is large. To reduce the time complexity,we propose a new and efficient technique.We incorpo- rate Background Subtraction in which background is modeled based on time averaged reference image, and only foreground is interpolated.A Pyramidal Analysis is employed in which the foreground that contains the corrupted pixels is decomposed to several levels .At the coarse level,optimization starts and is propagated to the finer resolution levels.Using this approach a drastic reduction in time complexity has been achieved.

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Title : *Restoration Of Non-Standard Video Artifacts*
Author(s) : *Palavalasa Kranthi Kumar*
Roll No : *Y8104030*
Supervisor(s) : *Gupta Sumana*

Abstract

The video archives across the world contain many important historic, artistic and cultural records that are stored in bulk as moving pictures. Many of these historically significant items are in fragile state and need suitable conservation and restoration. Preservation of visual evidence of important moments in history and of our cultural past are not only of purely scientific value but is of immense importance in a civilized society. Automated tools for video restoration is crucial, since manual image restoration is a tedious and time consuming process. In this thesis work we primarily focus on detection and restoration of some non-standard and standard video artifacts such as 1. Intensity Flicker 2. Blotches 3. Persistent scratch The intensity flicker removal algorithm is developed by considering the interrelationship between the successive frames in an image sequence. This algorithm uses the motion compensated frames for better estimation of flicker parameters and employs multi- resolution technique to reduce the computational time needed to obtain an un-flickered frame. Blotch removal algorithm is developed by using a threshold free technique to detect the blotches and used the multi-resolution representation of each frame to reduce the computational time. Reconstruction of blotched area is done using vector median filtering approach. A novel persistence scratch removal algorithm is developed by utilizing the spatial properties of the scratch. A fore ground detection of video is used to reduce the false alarm detection in this case. An interpolation of the scratched location is done spatially using a median filter.

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Title : Segmentation for free: Discovering object categories in surveillance videos
Author(s) : S V P Gopi Srinath
Roll No : Y5827390
Supervisor(s) : Mukerjee Amitabha

Abstract

Video may be a better modality for unsupervised learning of object categories than annotated still images, in part because xed-camera videos can potentially provide tight segmentation of the object of interest via foreground extraction. We motivate this through a small demonstration, where seven categories of objects are discovered by mining a complex tra c surveillance video. We provide robust foregrounding by combining evidence from temporally backward background subtraction. Agents are identi ed as tracked sequences of foreground blobs. We use the Pyramidal Histogram of Words (PHOW) to estimate the distribution of codebook words across the agents, and these are clustered using a bhattacharya distance metric. Despite the agents being noisy due to occlusion and tracking errors, we show that straightforward k- means can extract classes with purity of 76.5% with cross-validation accuracies of 70.8%. Next, we show how these learned categories may be used to identify noisy or mis-tracked agents such as those that transition from one category to another. This results in improved models with purity 82.2% and cross-validation accuracy 76.2% and test recognition accuracy of 56.9%. Finally, we propose that greater amounts of annotated surveillance data be made available for object recognition tasks, and provide a template for what such datasets might provide.

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Title : Structured Light Based Visual Navigation For Moon Rover
Author(s) : Sachan Vikalp
Roll No : Y5827502
Supervisor(s) : Venkatesh K S

Abstract

With increasing demand for the development of autonomous visual navigation systems in field of robotics,accuracy of surrounding map generation has emerged as a major area of research. However, surrounding map has been generated through various sensing mechanism like infrared, lidar etc. In contrast to these sensors,map generation has been tried with structured light based laser source in this thesis. We place camera and line laser pattern at slightly offset position on a rotatory platform. This rotatory platform is used to generate 3-d virtual map of local terrain. Visual map is used to navigate the lunar rover over moon surface.We are implementing an algorithm of navigability in patch for a certain direction. In the calibrated map we divide the patch in two set of points based on some constraints: first set of obstacle points and second set of safe points. In patch each point is tested for its local slopes, height conditions. Points those satisfies the criteria belong to set of safe points and points those fails to pass the test belong to set of obstacle points. With the help of local slopes and height we can detect the presence of crater or boulder at a certain distance as an obstacle. Variance is another parameter to decide the smoothness of patch. It is very difficult to ascertain the navigability quantitatively simply based on variance. We use variance to compare smoothness relatively between two patches. Furthermore this navigability algorithm is applicable for un-manned made terrain conditions like lunar,where robot is supposed to negotiate with unknown terrain and capable for finding the feasible path

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Title : Half Z-Source Topology Based Electronic Load
Author(s) : Upadhyay Saurabh
Roll No : Y5827418
Supervisor(s) : Mishra Santanu Kumar & Joshi Avinash

Abstract

This thesis presents the design and implementation of a DC Electronic Load (ELoad) which can simulate any loading condition in a laboratory environment. The E-Load must behave like an ideal controlled current source which can draw the specified current even in the case of a very low terminal voltage of the Supply Under Test (SUT). Various switching converters have been used in the past to implement the ELoad. The use of converters allows the test power to be fed to some utility. The recently proposed Z-Source Converter (ZSC) is used for this purpose due to its ability to operate in zero input voltage condition. Steady state and small signal analysis of ZSC is performed. A prototype of the Z-Source Converter (ZSC) is fabricated and tested for verification of the theoretical analysis. Further, owing to the symmetry of ZSC, a significant reduction in the part-count is done to obtain a new converter topology, Half Z-Source topology. Various arguments are given in order to prove the equivalence of ZSC and Half Z- Source Converter (HZSC). With a slight modification in HZSC, a converter suitable for DC to AC application, nick named as Half Z-Source inverter (HZSI), is obtained. Both steady state and small signal analysis of HZSC and HZSI are performed. The E-Load is implemented using the HZSC. As the converter draws a switching current from the source, an L-C filter is attached in the input stage of the converter to make the input current continuous. A controller is designed by the root-locus technique using the small signal model of the converter. In order to improve the large signal dynamic response of the E-Load, a novel auxiliary circuit is implemented using a MOSFET with current feedback. A type-1 controller is used to suppress the oscillations and to obtain the desired transient response of the auxiliary circuit. A prototype of the HZSC based E-Load with auxiliary circuit is fabricated. Various tests are performed to verify the analysis done for HZSC, HZSI, and the E-Load with auxiliary circuit. The operational input voltage ranges from 0.5 V to 6 V. The SUT current range obtained is 0.75 A to 7 A. The slew-rate for the step-up and step-down transients comes to be 0.7 A/s and 1.4 A/s, respectively.

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Title : ***Design And Implementation Of Three Phase Front-End Rectifier For Rural Telecom Application***

Author(s) : ***Rawal Rakesh***

Roll No : ***Y4187335***

Supervisor(s) : ***Mishra Santanu Kumar***

Abstract

Rural telecom power plant converts a three phase four wire input to -48 VDC output. Due to non-ideal distribution of power in rural areas, the input supply to the power plant may be in form of three, two or single phase with varying magnitude. This thesis discusses the challenges of designing a power plant for rural telecom application. It also proposes the front-end design of a power plant that provides a DC output under variable phase input of varying magnitude This output DC can be step down to achieve a regulated -48 VDC supply for the telecom load. The power stage design and controller implementation is discussed in detail. The power stage consists of a four leg diode bridge, followed by a conventional converter circuit. Both buck-boost and boost converters are tested as candidate topologies for this system. The steady state and dynamic behavior of both these topologies are discussed. Based on developed model the PWM feedback controller is implemented using a type 3 compensation network. In order to improve the input voltage range of the system a pass-through logic is proposed and implemented in this thesis. Various protection circuits are discussed and implemented for smooth operation of the system. These protection features are maximum duty cycle limit, in-rush current protection, soft-start logic, and maximum current limit protection. An experimental prototype is used to validate the proposed design. The prototype is tested between 90 V to 390 V (L-N) under variable phase inputs and a 1A output. The neutral current is measured to be minimal in this architecture.

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Title **:** ***Large Signal Linearization Of Boost Converter***
Author(s) **:** ***Jha Kapil***
Roll No **:** ***Y5827218***
Supervisor(s) **:** ***Mishra Santanu Kumar& Joshi Avinash***

Abstract

Various methods to linearize the control-to-output behavior of a boost converter over a larger frequency range are discussed. Most of the previously reported linearizing techniques are not suitable when the reference input amplitude or frequency are large. Static linearizing modulator (SLM) has been discussed which works for relatively quite low reference signal frequency compared to switching frequency. To improve it, a dynamic linearizing modulator (DLM) for the boost converter is proposed, which transforms the open loop converter into a linear amplifier with an operating frequency range closer to the switching frequency. The modulator generates a duty by comparing the non-linear part of the boost converter dynamic equation with a sine wave reference voltage on a cycle-to-cycle basis. Feed-forward compensation and audio susceptibility for this modulator are discussed. The formulation, implementation, and verification of this technique are explained. Experimental results show the validity of the technique for a reference input frequency up to one-fifth the switching frequency when the switching frequency is 100 KHz. The impacts of non-idealities on the modulator design are explained.

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Title	***:***	***Development Of Optimal PMU Placement Strategy And Support Vector Machine Based Approach ForFault Detection Classification And Location***
Author(s)	***:***	***Ponnaganti Pavani***
Roll No	***:***	***Y8104046***
Supervisor(s)	***:***	***Srivastava S C & Singh Sri Niwas***

Abstract

Recent developments in synchrophasor measurement technology has prompted utilities to deploy it in the power system networks for wide area monitoring and critical protection and control applications, such as fault diagnosis and stability controls, in real time. The Wide Area Monitoring and Control System (WAMCS) utilize Phasor Measurement Units (PMUs), which compute voltage and current phasors at faster rate from the raw field data and time stamp the phasor data in synchronized manner with respect to the Global Positioning System (GPS) absolute time reference. In this thesis, an efficient method has been proposed for the optimal PMU placement (OPP) ensuring transmission line fault observability and also considering the impact of breaker-and-half busbar scheme at substations. A Support Vector Machine (SVM) based scheme for fault diagnosis using synchrophasor measurements, assumed to be available from the PMUs, has been proposed. Three types of SVM-Classifier (SVM-C) have been used for the fault detection, faulted line identification and the fault classification. Further, the fault location has been carried out by using the Support Vector Regressor (SVR), in which four SVMs have been utilized, one for each type of the fault. The performance of both the SVM-C and SVR has been compared with the corresponding Radial Basis Function Neural Networks (RBFNNs) based models. The effectiveness of the above methods are studied on the WSCC 9-bus and the New England 39-bus systems. It has been observed that the proposed scheme for OPP is efficient in ensuring transmission line fault observability. Also, the proposed SVM based schemes are more accurate for detecting, classifying and locating the faults than the respective RBFNN based models.

Title : *A Wide-Input Range DC/DC Converter With Battery Interface For A Rural Telecom Power Plant*

Author(s) : *Verma Brijendra Kumar*
Roll No : *Y5827148*
Supervisor(s) : *Mishra Santanu Kumar*

Abstract

Rural telecom power plant converts a three phase four wire AC input to a regulated DC output adjustable between -48 V and -56 V. Due to non-ideal power distribution in rural areas, the input supply to the power plant may be in form of two or single phase with varying magnitude. A power plant architecture is proposed in this thesis, that converts a variable phase AC input to a regulated and adjustable DC output. The conversion is carried out in two stages. The first stage converts a variable phase AC to an unregulated DC. The second stage converts an unregulated DC to a regulated and manually adjustable DC output. This thesis discusses the challenges of designing the back-end stage of the rural telecom power plant. This conversion stage has a DC input between 380 VDC to 650 VDC. The advantages and disadvantages of the various converter topologies are discussed. A forward converter with snubber reset is finally selected for implementation as it possesses a simpler design and a reduced stress profile across the active devices. The steady state and dynamic behavior of this topology are discussed. Based on this analysis an isolated feedback controller is designed using a type-1 compensation network to regulate the output voltage. Various special features like soft start, current sense, output voltage variation, and battery interfacing, for the smooth functioning of the plant are discussed. A scaled down prototype, with the prescribed voltage rating and 10 A current rating, is built to test the operation of the converter. Experimental results show a reliable and satisfactory operation of the converter for the proposed application.

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Title : ***FPGA Based Digital Implementation 0f Synthetic Ripple Modulator***

Author(s) : ***Mijar Makarand***

Roll No : ***Y5827264***

Supervisor(s) : ***Mishra Santanu Kumar***

Abstract

The continually advancing fields of VLSI, Signal Processing and Data Communication pose new challenges for the power-supply requirements of these systems. The new semiconductor integrated circuits (ICs) are continually demanding a lower power supply voltage, since it leads to a natural increase in the clock speed and integration density of the IC as well as dramatic reduction in the power consumption per clock cycle. Owing to the sophisticated requirements of a very low but regulated output voltage with a still lower ripple, higher slew-rate load, faster dynamic response, and greater dynamic efficiency – a sub-class of the efficient Switch Mode Power Supplies (SMPS) namely Hysteretic PWM controllers need to be utilized. A survey of various types of Hysteretic controllers leads to the identification of the problem of 'challenges versus advantages' in implementing each control scheme. Finally, one particular topology named 'Synthetic Ripple Modulator (SRM) based Hysteretic Controller' is arrived at, through literature, and its characteristics are proved to be extremely well suited for the desired goal of implementing a state-of-the-art power supply. Knowledge of the various implementation strategies suggests that the advantages of the SRM Hysteretic Controller originally designed for the analog domain can be replicated, if not bettered, for a digital implementation. Keeping this fact in mind, efforts are driven towards finding an efficient yet practical method of implementing the above scheme. A survey of existing hardware is done to arrive at the most optimized requirements of working with this scheme, and a solution is proposed – involving the use of a high-performance FPGA Board, a manually designed Power Stage for the output voltage supply, along-with a self-designed ADA Conversion Interface Board containing many high-speed data conversion ICs like ADCs, DACs, Comparators, etc. This solution is finally implemented in hardware. Simulations of the SRM control topology are carried out in software to fully understand the working of this scheme, and arrive at synthesizable digital equivalents of the analog controller elements. In the end, the entire hardware and software are put to test in conjunction and a successfully working state of the Multi-Loop controller is arrived at after a lot of debugging. Results are taken at this stage using test cases and the concluding analysis shows very good conformation of the results with the theory.

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Title : ***Vision Based Soil Classification And Wheel Slip Prediction For Lunar Rover Type Wheel***

Author(s) : ***Singh Binnami***

Roll No : ***Y8104068***

Supervisor(s) : ***Behera Laxmidhar & Dutta Ashish***

Abstract

Autonomous navigation in rough terrain is very important for mobile robots and wheeled vehicles designed for space applications. Prior estimation of local terrain properties is critical when driving on slopes and soft terrain, due to wheel slip and sinkage. This thesis primarily deals with vision and neural network based wheel slip prediction models for traction control of a rover wheel. First, a soil classification scheme is proposed in which, statistical texture features are estimated from terrain soil images obtained using a camera. A feed-forward neural network is trained using the extracted image texture features for classification of different soil types. The image texture features based training of a neural network was implemented for the first time for soil classifications. An image segmentation based wheel sinkage estimation algorithm is then implemented where the wheel image is separated from its background environment using colour segmentation. The wheel center coordinates are estimated for calculating the wheel sinkage based on images taken from a camera mounted on the rover. The output of the soil classifier and the sinkage detector are then used to train a neural network to predict slip expected during motion on soft terrain. The network is first trained off-line using data collected using an experimental single wheel test setup and then implemented in real-time to predict the wheel slip in different terrain soil conditions.

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Title : *Mining Of Hippocampus Data Set Using T-Test Biclustering And Bayesian Approach*

Author(s) : *Meena Sheela*
Roll No : *Y4187408*
Supervisor(s) : *Verma Nishchal Kumar*

Abstract

This work is aimed at analyzing gene expression microarray data set obtained from hippocampus of mice. The four data sets have been analyzed in three ways. In first part differentially expressed genes are obtained with the help of a robust and effective statistical method ”t-test ”which has been implemented in Matlab. In second part, a comprehensive study of biclustering algorithms has been done and the used algorithms are Cheng and Church (CC), Iterative Signature Analysis (ISA), order Preserving Sub- matrix Algorithm (OPSM), Binary Inclusion-maximal Biclustering Algorithm (Bimax), Xmotiff Algorithm, Bicluster Visualization and Detection using PC Plots. Gene Ontol- ogy annotation frame work is used to evaluate the effectiveness of algorithm in finding biologically relevant biclusters. In the third part of the work use of bayesian networks has been explained to discover dependencies among genes (regulatory networks). With the aforementioned data sets and used methods to analyze, differentially ex- pressed gene analysis would be helpful to find the genes that have been affected by ethanol treatment (differentially expressed genes). These differentially expressed genes can be used to analyze to know how ethanol changes their expression level in such a way that reduces the stress. On the other hand with the help of biclustering analysis we would able to select co-regulated genes, functionally related genes and assigning functions to unknown genes based on the known classifications. Analysis of regulatory network with the help of Bayesian networks would be helpful to understand about complicated regulatory relationship, uncover the regulatory pattern and can gain the systematic overview for biological processes.

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Title : *Performance Analysis Of Outer And Inner Rotor Permanent Magnet Brush Less DC Motor*

Author(s) : *Udaykiran Kasimala*
Roll No : *Y8104028*
Supervisor(s) : *Gupta Nandini*

Abstract

Brushless permanent magnet dc (BLDC) motors, commonly called brushless dc motors are poly-phase permanent magnet synchronous motors which are electronically commutated and sequentially switched on. These are usually operated in the self- control mode. These are mostly used for control purpose such as computer disk drives, robotics, automatic, high–quantity, turntables and tape capstans, etc. In a brushless PM Synchronous motor, there is no provision for rotor side excitation control. The control is done entirely through the stator terminals. For variable speed drive applications, both constant torque and constant power operating modes are required. Recently, these permanent magnet BLDC motor have been applied to modern electric vehicles. Load requirement in electric vehicle is fundamentally different from industrial motor drives. They usually require high starting torque, high rate of acceleration/deceleration and frequent start-stops. They desire high controllability, good transient and steady state performances. Objective of the thesis is to perform electromagnetic analysis of BLDC motor with two different topologies of rotor and subsequently propose a design that can meet the requirements in electric vehicles additionally; the methodology to perform parametric analysis to improve the design performance is also presented.

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Title : ***Modeling And Simulation Of Outer Rotor Permanent magnet Brushless DC motor***

Author(s) : ***Varkala VijayKumar***

Roll No : ***Y8104062***

Supervisor(s) : ***Gupta Nandini***

Abstract

Outer rotor permanent magnet brushless DC (PMBLDC) motors have currently attracted considerable attention from researchers due to their high efficiency, silent operation, compact size, high reliability and low maintenance requirements. These motors are preferred for numerous applications. The current thesis describes detailed modelling and simulation of an Outer Rotor Permanent magnet brushless DC motor using finite element analysis. The finite element method has proved to be a useful tool in numerical magnetic field computation relating to electrical machines. In the present work, 2D Transient (Dynamic) and Magneto static (Steady-state) analysis of an Outer rotor PMBLDC motor is performed. For this purpose, Maxwell is used. Maxwell is a high performance interactive software package, which uses finite element analysis to solve three dimensional and two-dimensional electric, magneto static, eddy current, and transient problems. Further, system level simulation is performed on an Outer rotor PMBLDC motor. This provides a combined simulation environment capable of modelling and analyzing the interaction between PMBLDC motor and the control circuit. To reduce computational time in system level simulations, an indirect interaction analysis method is used. By creating equivalent circuit models for electromechanical devices, and electrical analogs for mechanical subsystems, it is possible to perform accurate parametric design studies. This is implemented by using Maxwell and SIMPLORER in conjunction. In summary, a design methodology for design of an outer rotor PMBLDC motor using finite element analysis is outlined in this thesis. Keywords: Outer rotor permanent magnet brushless DC (PMBLDC) motor, Finite element method, Transient Analysis, Indirect Interaction Analysis, Magneto static Analysis.

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Title : ***Harmonic Study Of Space Vector Modulation Of 3-Phase To 3-Phase Matrix Converter***

Author(s) : ***Sama Madhusudhan Reddy***

Roll No : ***Y7104043***

Supervisor(s) : ***Sensarma Partha Sarathi***

Abstract

Matrix Converter is nothing but a forced commutated cycloconverter. This thesis is limited to 3-phase to 3-phase Matrix Converters. 3-phase to 3-phase Matrix Converter is a direct AC/AC power frequency converter. This is achieved without any dc-link and hence the converter design is compact. It can be used as a compact and efficient way to convert electric power for motor drives, variable frequency generators and reactive power control. Space Vector Modulation(SVM) strategies are known to provide improved harmonic performance, maximum voltage/current transfer ratio and reduced switching losses compared to Sine-triangle modulation methods. As a consequence Space Vector Modulation strategy has been applied lately on 3-phase to 3-phase Matrix Converters by emulating Voltage Source Rectifier-Voltage Source Inverter approach(Indirect Transfer Function Approach). On applying SVM strategy, it is immediately observed that there are significant low-order harmonics in the switched signals at the input and/or output side of 3-phase to 3-phase Matrix Converter. The amplitude of these low order harmonics gets worse as input power factor and gain of the converter is varied. The source of the low-order harmonics is difficult to see. Hence in the thesis SVM format is changed to Naturally sampled format i.e, equivalent modulation signals of SVM of Matrix Converter are developed. In this modulation signals format, it is easy to understand the harmonic picture of switched signals. The thesis mainly focuses on the aspect of identifying the sources of low order harmonics at the input and output side of 3-phase to 3-phase Matrix Converter and eliminating them significantly. And in the process a new modulation strategy is found such that even by varying input power factor and modulation index of the converter, the amplitude of low order harmonics is negligible. Its feasibility is validated through numerical simulation and experiment.

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Title : *Development Of Optimal PMU Placement Strategy And Support Vector Machine Based Approach For Fault Detection, Classification And Location*

Author(s) : *Ponnaganti Pavani*
Roll No : *Y8104046*
Supervisor(s) : *Srivastava S C& Singh Sri Niwas*

Abstract

Recent developments in synchrophasor measurement technology has prompted utilities to deploy it in the power system networks for wide area monitoring and critical protection and control applications, such as fault diagnosis and stability controls, in real time. The Wide Area Monitoring and Control System (WAMCS) utilize Phasor Measurement Units (PMUs), which compute voltage and current phasors at faster rate from the raw field data and time stamp the phasor data in synchronized manner with respect to the Global Positioning System (GPS) absolute time reference. In this thesis, an efficient method has been proposed for the optimal PMU placement (OPP) ensuring transmission line fault observability and also considering the impact of breaker-and-half busbar scheme at substations. A Support Vector Machine (SVM) based scheme for fault diagnosis using synchrophasor measurements, assumed to be available from the PMUs, has been proposed. Three types of SVM-Classifier (SVM-C) have been used for the fault detection, faulted line identification and the fault classification. Further, the fault location has been carried out by using the Support Vector Regressor (SVR), in which four SVMs have been utilized, one for each type of the fault. The performance of both the SVM-C and SVR has been compared with the corresponding Radial Basis Function Neural Networks (RBFNNs) based models. The effectiveness of the above methods are studied on the WSCC 9-bus and the New England 39-bus systems. It has been observed that the proposed scheme for OPP is efficient in ensuring transmission line fault observability. Also, the proposed SVM based schemes are more accurate for detecting, classifying and locating the faults than the respective RBFNN based models.

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Title : *Analog Implementation Of Peak Current Mode Controlled SEPIC Converter For Low Power Space Applications*

Author(s) : *Gudipalli Pavan Kumar*
Roll No : *Y8104044*
Supervisor(s) : *Sensarma Partha Sarathi*

Abstract

Due to heavy dependence on satellite technology in day to day life,we need to make this system more reliable.This depends upon how effectively its power board is functioning. This in turn depends upon how efficiently we designed that board. Virtually all space crafts work on DC power supply.This DC power can be extracted from solar energy or chemical energy or nuclear energy.Out of these available energy sources chemical energy is not suitable for long time applications and Nuclear energy is suitable for large power applications.In case of small and medium power applications solar energy is most suitable and dependable source of power.The efficiency of solar panels is generally very less,so we need to efficiently use the available power. In this thesis one scheme was proposed for low power space applications.This scheme needs both solar and chemical(battery) energies.Proposed scheme transmits power available out of the solar panels to the load.If,solar energy is not available chemical energy is used to power the load. Mathematical modeling of DC bus section of the scheme is developed under perturbed conditions. Developed mathematical model was simulated in MATLAB/ Simulink and hardware is also developed for the simulated model.Control mechanism is implemented in analog platform

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Title : ***Analysis And Verification Of Self Excitation Of Induction Generator Connected To A3-Phase Converter***

Author(s) : ***Vamshi KrishnaMiryala***

Roll No : ***Y8104063***

Supervisor(s) : ***Sensarma Partha Sarathi***

Abstract

In the present scenario of increasing energy demand and dissipating fossil fuels, emphasis on renewable energy resources like solar, wind, hydro, tidal etc are increasing. Among different Electrical machines used for energy conversion from wind, Squirrel cage induction machine (SCIM) is the cheapest, robust and low maintenance machine. In remote and stand alone generation systems, low maintenance requirement and robustness makes the SCIM an obvious choice for energy conversion from wind. Contrary to grid connected system, stand alone system's SCIM must develop its rated air gap flux from machines residual flux, or from the little voltage available at the station. This process of developing air gap flux of the machine from very low value to its rated value in the absence of grid voltage is known as self excitation,and the SCIM used is often termed as self excited induction generator (SEIG). One popular way of self excitation of induction machine is to connect a 3 phase capacitor bank in parallel with machine, but this strategy suffers from poor voltage regulation and frequency variation at utility grid. One of the popular solution to this problem is to connect SCIM to a 3 phase inverter-rectifier set with a capacitor connected at the DC-link. The power generated by SCIM is transfered to DC-bus and then is fed to utility grid at constant frequency . In the present work, SEIG connected to DC-bus with 3 phase converter is considered. The converter and SEIG losses are modeled at low DC-bus voltage, i.e near to the gate drive's supply of the 3 phase converter. Influence of different losses of the system on self excitation of SEIG are studied. To depict the SEIG rotor's speed range for which self excitation of SEIG for is possible, An approximate mathematical expression is in terms system parameters and losses. Effect of different modulation techniques on self excitation process of SEIG are studies. A control strategy and modulation strategy is proposed to have the maximum possible speed range for self excitation of SEIG. Speed ranges for self excitation of SEIG for different modulation schemes is tested on a low power machine, and the results are compared with simulation results and with the derived expressions.

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Title : ***Design, Development And Testing Of DSP Based Embedded Controller For Power Electronics Applications***

Author(s) : ***Das Animesh***

Roll No : ***Y8104004***

Supervisor(s) : ***Sensarma Partha Sarathi***

Abstract

Embedded system is defined as a special purpose device which is designed to perform some dedicated jobs. It has hardware, as well as software modules embedded within the system. Hardware modules takes care of the role of performance and security, whereas the software module is used for the functionality features. In recent days, the applications of embedded systems are found almost all over the sphere, ranging from small gadget to big plant automation. It has got wide applicability in different fields such as drive controls, telecommunication sector, medical instrumentations, military applications etc. The main task of the processing of signals within an embedded system is performed by a micro controller or digital signal processor(DSP). In Electrical Engineering, DSP based embedded system is used to perform various control functions like controller implementation, power system stability, voltage and field current regulation in synchronous motor, digital filter implementation. Proper algorithms are required for the physical implementation of these application areas with higher efficiency and reliability. In this thesis, design and development of DSP based embedded controller for power electronics application is presented. One Texas Instrument(TI) make TMS320F2812 DSP (PGFA package) and other associated surface mounted components are used for the development of the board. As required by the embedded system, properly timed power sequence is implemented. After designing of the board, application codes are developed in Code Composer Studio (CCS) and interfacing is checked through the Serial Communication Interface(SCI) and JTAG(Joint Test Action Group) chain. All the associated modules in the embedded design are checked by some elementary tests such as loop back test, toggle test. After confirming the proper functioning of the custom made board with these basic tests, PI controller is developed which in turn checks the over all applicability of the design.

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Title : *Hardware Implementation Of Buck-Type Unity Power Factor Active Rectifier*

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Roll No : *Y8104008*
Supervisor(s) : *Sensarma Partha Sarathi*

Abstract

In the existing railway locomotives, single phase AC voltage(medium) is converted to DC voltage for the input stage of the traction drive system.In DC traction, this voltage is further regulated to a suitable level through DC-DC converters whereas for ac traction, a voltage source inverter(VSI) delivers controlled voltages for required control of the AC traction motor.Conventional unity power factor front end recti ers, which process the input electrical power, are usually of the boost type which result in a DC link voltage which is higher than the peak value of the input AC voltage. Therefore all these drive systems which are in use, currently require an input step down transformer which is housed in the mobile locomotive. This transformer must be rated somewhat in excess of the total drive power which adds to weight, volume and generated heat in the engine enclosure. It has been a major stumbling block in the design of lightweight traction power systems. In this thesis, a single phase front end buck recti er topology is proposed which provides a viable alternative and carry an inherent capability to eliminate the input trac- tion transformer.These converters achieve recti cation coupled with attenuation in the DC voltage level as compared to the input AC. A simple control strategy is implemented to get unity power factor at input ac side. A multi level Input Series Output Parallel (ISOP) con guration has been adopted to reduce individual switch ratings while simul- taneously achieving modularity and redundancy. A simple common duty ratio scheme is presented in order to get equal sharing of input ac voltage and output load current be- tween two low power buck recti er modules. However this scheme can be extended to any `N' number of input series output parallel(ISOP)connected converters. Multi loop control structure with suitable protection strategy has been adopted and implemented on digital eld programmable gate array (FPGA) controller. FPGA is widely being used for the control of power electronics converters.It o ers a number of advantages like parallel processing,high speed and is rich in digital I/O's. In this thesis, basic modules required for developments of controller for power electronic systems are developed and tested with standard signals.The complete analysis of system starting from plant modeling,choice of control strategy and design of controllers have been presented. The validity of proposed control strategy is con rmed through both computer simulation and real time implementation.

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Title : *Direct Torque Control Of Interior Permanent Magnet Synchronous Motor With And Without Speed/Position Sensors*

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Roll No : *Y8104053*
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Abstract

An Interior Permanent Magnet Synchronous Motor (IPM-SM) requires continuous position feedback for the control as a self-controlled drive with torque and speed control. This entails the use of a position sensor for the generation of drive signal to the power converter feeding the IPM-SM. The use of mechanical position sensor is not attractive for industrial application as its use reduces the overall reliability and robustness of the drive system. Therefore, it is desirable to have a position and speed sensor-less drive system. This thesis aims at the following control schemes of the IPM-SM drive. (i) A closed-loop direct torque control of an IPM-SM for variable speed drive with speed/position sensor. & (ii) A speed and position sensor-less direct torque control scheme of the IPM-SM drive. To achieve the closed loop control of torque and stator flux linkage, two PI controllers have been used and one PI controller is used to close the speed loop. The reference voltage vectors are generated using space vector modulation (SVM) technique. In sensor-less direct torque control scheme of the IPM-SM drive, a speed estimator based on the stator flux linkage and torque angle has been successfully incorporated. The project reported here involves a brief literature survey of the IPMSM drive followed by the Direct Torque Control (DTC) of the IPM-SM for constant stator flux operation. And thereafter, a speed/position sensor-less scheme of the IPMSM has been attempted. The simulation and hardware results for step change in speed, step change in torque, speed reversal operations have been carried out.

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Title : *Modular DC Power Supply For Telecom Application*
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Supervisor(s) : *Das Shyama Prasad&Mishra Santanu Kumar*

Abstract

In rural area, due to the non-ideal distribution of power, the input supply to the power plant may be in form of three, two or single phases with varying magnitude. Telecom power supply in rural area converts a three phase four wire ac input to -48 volt DC output. This thesis primarily focuses upon the challenges of designing a power plant for rural telecom application. It also proposes the front-end design of a power plant that provides a DC output under variable phase input of varying magnitude This output DC can be stepped down to achieve a isolated regulated -48 VDC supply for the telecom load. Due to increased load demand, a single plant cannot supply the increased load. Hence two or more converters are connected in parallel in modular fashion to cater to the telecom load. In this thesis, various techniques of paralleling of dc-dc converter are discussed. It increases the current sourcing capability of entire system and simultaneously reduces the stress on the switch used in the dc-dc converter. Paralleling of converters demands modularity of the developed system. Snubber design analysis is also done for the protection for the forward converter to demagnetize the core of the transformer as it helps in protection of the switch. Various protection schemes are discussed and implemented in hardware for safe operation of the system. It includes maximum duty cycle limit, soft start, and inrush current limit and over current protection. Entire system is simulated in Pspice –OrCAD and controller design is done in MATLAB. A scaled prototype of a dc power supply is developed and tested in the laboratory.

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