MATLAB PROJECT ABSTRACTS

((Image Processing, Wireless Sensor Network, Power Electronics, Signal Processing, Power System, Communication, Wireless communication, Geoscience & Remote sensing)

2015 IEEE IMAGE PROCESSING PROJECT LIST BASED ON MATLAB

1. Block-Diagonalization Precoding in aMultiuser Multicell MIMO System: Competition and Coordination

This paper studies a multiuser multicell system where block-diagonalization (BD) precoding is utilized on a per-cell basis. We examine and compare the multicell system under two operating modes: competition and coordination. In the *competition* mode, the paper considers a strategic noncooperative game (SNG), where each base-station (BS) greedily determines its BD precoding strategy in a distributed manner, based on the knowledge of the inter-cell interference at its connected mobile-stations (MS). Via the game-theory framework, the existence and uniqueness of a Nash equilibrium in thisSNG are subsequently studied. In the *coordination* mode, the BD precoders are jointly designed across the multiple BSs to maximize the network weighted sum-rate (WSR). Since this WSR maximization problem is nonconvex, we consider a distributed algorithm to obtain at least a locally optimal solution. Finally, we extend our analysis of the multicell BD precoding to the case of BD-Dirty Paper Coding (BD-DPC) precoding. We characterize BD-DPC precoding game for the multicell system in the competition mode and propose an algorithm to jointly optimize BD-DPC precoders for the multicell system in the coordination mode. Simulation results show significant network sum-rate improvements by jointly designing the BD or BD-DPC precoders across the multicell system in the coordination mode over the competition mode.

2. Energy Efficient Network Beamforming Design Using Power-Normalized SNR

In this paper, we adopt a novel efficiency measure, namely the received signal-to-noise-ratio (SNR) per unit power, in amplify-and-forward (AF) relay networks. The measure is addressed as the power-normalized SNR (PN-SNR). For several relay network scenarios, we solve the PN-SNR maximization problems and analyze the network performance. First, for singlerelay networks, we find the optimal relay power control scheme that maximizes the PN-SNR for a given transmitter power. Then, for multi-relay networks with a sum relay power constraint, we prove that the PN-SNR optimization problem has a unique maximum, thus the globally optimal solution can be found using a gradient-ascent algorithm. Finally, for multi-relay networks with an individual power constraint on each relay, we propose an algorithm to obtain the globally optimal solution and also a low complexity algorithm for a suboptimal solution. Our results show that with the same average relay transmit power, the PNSNR maximizing scheme is superior to the fixed relay power scheme not only in PN-SNR but also in the outage probability for both single and multi-relay networks. Compared with SNRmaximizing scheme, it is significantly superior in PN-SNR with moderate degradation in outage probability. Our results show the potential of using PN-SNR as efficiency measure in network design.

3. Wireless Information and Power Transfer in Multiuser OFDM Systems

In this paper, we study the optimal design for simultaneous wireless information and power transfer (SWIPT) in downlink multiuser orthogonal frequency division multiplexing (OFDM) systems, where the users harvest energy and decode information using the same signals received from a fixed access point (AP). For information transmission, we consider two types of multiple access schemes, namely, time division multiple access (TDMA) and orthogonal frequency division multiple access (OFDMA). At the receiver side, due to the practical limitation that circuits for harvesting energy from radio signals are not yet able to decode the carried information directly, each user applies either time switching (TS) or power splitting (PS) to coordinate the energy harvesting (EH) and information decoding (ID) processes. For the TDMA-based information transmission, we employ TS at the receivers; for the OFDMA-based information transmission, we employ PS at the receivers. Under the above two scenarios, we address the problem of maximizing the weighted sum-rate over all users by varying the time/frequency power allocation and either TS or PS ratio, subject to a minimum harvested energy constraint on each user as well as a peak and/or total transmission power constraint. For the TS scheme, by an appropriate variable transformation the problem is reformulated as a convex problem, for which the optimal power allocation and TS ratio are obtained by the Lagrange duality method. For the PS scheme, we propose an iterative algorithm to optimize the power allocation,

subcarrier allocation and the PS ratio for each user. Numerical results show that the peak power constraint imposed on each OFDM subcarrier as well as the number of users
in the system play a key role in the rate-energy performance comparison by the two proposed schemes.

4. System Capacity Improvement by On Request Channel Allocation in L TE Cellular Network

Long-term evolution (LTE) femtocells represent a very promising answer to the ever growing bandwidth demand of mobile applications. They can be easily deployed without requiring a centralized planning to provide high data rate connectivity with a limited coverage. Femtocell is low-power, very small and cost effective cellular base station used in indoor environment. However, the impact of Femtocells on the performance of the conventional Macrocell system leads interference problem between Femtocells and pre-existing Macrocells as they share the same licensed frequency spectrum. Frequency Reuse (FR) is an effort of manipulating the frequency resource allocation upon terminal's location to improve system capacity. In this paper, an efficient method to improve system capacity through interference management in the existing FemtoMacro two tier networks has been proposed. In the proposed scheme, a novel frequency planning for two tiers cellular
networks using frequency reuse technique is used where Macro base stations allocate frequency sub-bands for Femtocells users on-request basis through Femtocells base stations to cancel interference.

5. Resource Allocation in Hybrid Access Control Femtocell Network Targeting Inter-cell Interference Reduction

Inter-cell interference is the most challenging issue in femtocell deployment within the coverage of Macro base station (MBS). In this paper, we have explored the role of femtocell in LTE network and proposed a Dynamic Resource allocation management algorithm (DRAMA) for hybrid access control in spectrum shared OFDMA network to optimize the interference and increase the quality of service (QoS). The user gets the privilege to assign the femtocell service level ensuring a minimum level of QoS. A simulation setting is developed to study the performance of DRAMA in hybrid access control Femtocell network and compared it to closed and open access control.

6. BER analysis of conventional and wavelet based OFDM in LTE using different modulation techniques

Orthogonal Frequency Division Multiplexing (OFDM) and Multiple Input and Multiple Output (MIMO) are two main techniques employed in 4th Generation Long Term Evolution (LTE). In OFDM multiple carriers are used and it provides higher level of spectral efficiency as compared to Frequency Division Multiplexing (FDM). In OFDM because of loss of orthogonality between the subcarriers there is intercarrier interference (ICI) and intersymbol interference (ISI) and to overcome this problem use of cyclic prefixing (CP) is required, which uses 20% of available bandwidth. Wavelet based OFDM provides good orthogonality and with its use Bit Error Rate (BER) is improved. Wavelet based system does not require cyclic prefix, so spectrum efficiency is increased. It is proposed to use wavelet based OFDM at the place of Discrete Fourier Transform (DFT) based OFDM in LTE. We have compared the BER performance of wavelets and DFT based OFDM.

7. A Novel detection algorithm for performance analysis of MIMO-OFDM systems using equalizer over a Rayleigh fading channel

Multiple Input Multiple Output (MIMO) Orthogonal Frequency Division Multiplexing(OFDM) systems have recently emerged as key technology in wireless communication systems for increasing data rate and system performance. The effect of fading and interference can be combated to increase the capacity of the link. MIMO systems uses Multiple Transmit and Multiple Receive antennas which exploit the multipath propagation in rich scattering environment. The matrix channel plays a pivotal role in the throughput of a MIMO link since the modulation, data rate, power allocation and antenna weights are dependent on the channel gain. When data rate is transmitted at high bit rate, the channel impulse response can extend over many symbol periods which leads to Inter-Symbol Interference(ISI). ISI always caused an

issue for signal recovery in wireless communication. In order to reduce the complexity of MIMO system, various detection algorithm such as Zero forcing(ZF), Minimum Mean Square Error(MMSE), Maximum Likelihood(ML) and a novel algorithm namely Constant Modulus Algorithm(CMA) are proposed that reduce bit error rate(BER) via spatial multiplexing. QPSK modulation is treated here for simulation purpose.Simulations are done by MatLab that shows BER vs. signal-noise ratio (SNR) curve of Constant modulus algorithm(CMA) equalizer exceeds that of ZF, MMSE and ML equalizer. In this paper antenna configuration is used.

8. Improvement in ber performance by MMSE equalizer with MIMO OFDM

During the research equalizer is always a matter of strategies.When a signal is transmitted over a radio channel,it is subject to reflection,refraction and diffraction and also the type of modulation technique selected at transmitter.The communication environment changes quickly and thus introduce more complexity and uncrtainity to channel response.Ofdm is one of the best multiplexing technique which compensate intersymbol- interference as well as co- channel- interference.In wireless Communication ,scare resources and hence imposes a high cost on the high data rate transmission.fortunately,the emergence of multiple antenna system has opened another very resourceful dimension space,for information transmission in the air.It has been demonstrated that
multiple antenna system provides very promising gain in capacity without increasing the use of gain,throughput, spectrum,reliability,and less sensivity to fading,hence leading to a breakthrough in the data rate of wireless communication system.Since than multiple input multiple output(MIMO) system has become one of the major focuses in the research community of wireless communication and information theory.The study of performance limit of information system become very important,since it gives a lot of insights in understanding designing the practical MIMO system.In order to observe the effect of multipath fading channel on the transmitted signal,a whole digital communication system simulator is developed.Ofdm along with MIMO strategies are very good
to increase the capacity of the system and minimize to intersymbol-interference.MMSE equalizer under the multipath fading and MIMO strategy has improved Bit Error Rate Perfomence in this paper.

9. Performance Evaluation of Static Frequency Reuse Techniques for OFDMA Cellular Networks

The use of orthogonal frequency division multiple access (OFDMA) in Long Term Evolution (LTE) and WiMax cellular systems mitigates downlink intra-cell interference by the use of sub-carriers that are orthogonal to each other. Intercell interference, however, limits the downlink performance of cellular systems. In order to mitigate inter-cell interference, various techniques have been proposed. This paper examines one group of these techniques, static frequency reuse. We present a comprehensive comparison of Reuse-I, Reuse-3, fractional frequency reuse (FFR), and soft frequency reuse (SFR), with varying input parameters, such as inner radius and power ratios. System simulation is used to evaluate the overall system performance in terms of throughput and SINR are evaluated. In addition to the overall system performance, cell-edge user performance, whose performance is severely limited by interference from neighboring cells, for each technique is also evaluated.

10. Spectrum Sharing Scheme Between Cellular Users and Ad-hoc Device-to-Device Users

In an attempt to utilize spectrum resources more efficiently, protocols sharing licensed spectrum with unlicensed users are receiving increased attention. From the perspective of cellular networks, spectrum underutilization makes spatial reuse a feasible complement to existing standards. Interference management is a major component in designing these schemes as it is critical that licensed users maintain their expected quality of service. We develop a distributed dynamic spectrum protocol in which ad-hoc device-to-device users opportunistically access the spectrum actively in use by cellular users. First, channel gain estimates are used to set feasible transmit powers for device-to-device users that keeps the interference they cause within the allowed interference temperature. Then network information is distributed by route discovery packets in a random access manner to help establish either a single-hop or multi-hop route between two device-to-device users. We show that network information in the discovery packet can decrease the failure rate of

the route discovery and reduce the number of necessary transmissions to find a route. Using the found route, we show that two device-to-device users can communicate with a low probability of outage while only minimally affecting the cellular network, and can achieve significant power savings when communicating directly with each other instead of utilizing the cellular base station.

11. A Practical Cooperative Multicell MIMO-OFDMA Network Based on Rank Coordination

An important challenge of wireless networks is to boost the cell edge performance and enable multi-stream transmissions to cell edge users. Interference mitigation techniques relying on multiple antennas and coordination among cells are nowadays heavily studied in the literature. Typical strategies in OFDMA networks include coordinated scheduling, beamforming and power control. In this paper, we propose a novel and practical type of coordination for OFDMA downlink networks relying on multiple antennas at the transmitter and the receiver. The transmission ranks, i.e. the number of transmitted streams, and the user scheduling in all cells are jointly optimized in order to maximize a network utility function accounting for fairness among users. A distributed coordinated scheduler motivated by an interference pricing mechanism and relying on a masterslave architecture is introduced. The proposed scheme is operated based on the user report of a recommended rank for the interfering cells accounting for the receiver interference suppression capability. It incurs a very low feedback and backhaul overhead and enables efficient link adaptation. It is moreover robust to channel measurement errors and applicable to both open-loop and closed-loop MIMO operations. A 20% cell edge performance gain over uncoordinated LTE-A system is shown through system level simulations.

12. Downlink Resource Allocation for Next Generation Wireless Networks with Inter-Cell Interference

This paper presents a novel downlink resource allocation scheme for OFDMA-based next generation wireless networks subject to inter-cell interference (ICI). The scheme consists of radio resource and power allocations, which are implemented separately. Low-complexity heuristic algorithms are first proposed to achieve the radio resource allocation, where graph-based framework and fine physical resource block (PRB) assignment are performed to mitigate major ICI and hence improve the network performance. Given the solution of radio resource allocation, a novel distributed power allocation is then performed to optimize the performance of cell-edge users under the condition that desirable performance for cell-center users must be maintained. The power optimization is formulated as an iterative barrier-constrained water-filling problem and solved by using the Lagrange method. Simulation results indicate that our proposed scheme can achieve significantly balanced performance improvement between cell-edge and cell-center users in multi-cell networks compared with other schemes, and therefore realize the goal of future wireless networks in terms of providing high performance to anyone from anywhere.

13. Minimum Energy Channel Codes for Nanoscale Wireless Communications

It is essential to develop energy-efficient communication techniques for nanoscale wireless communications. In this paper, a new modulation and a novel minimum energy coding scheme (MEC) are proposed to achieve energy efficiency in wireless nanosensor networks (WNSNs). Unlike existing studies, MEC maintains the desired code distance to provide reliability, while minimizing energy. It is analytically shown that, with MEC, codewords can be decoded perfectly for large code distances, if the source set cardinality is less than the inverse of the symbol error probability. Performance evaluations show that MEC outperforms popular codes such as Hamming, Reed-Solomon and Golay in the average codeword energy sense.

14. Spectrum Sensing for Digital Primary Signals in Cognitive Radio: A Bayesian Approach for Maximizing Spectrum Utilization

With the prior knowledge that the primary user is highly likely idle and the primary signals are digitally modulated, we propose an optimal Bayesian detector for spectrum sensing to achieve higher spectrum utilization in cognitive radio networks. We derive the optimal detector structure for MPSK modulated primary signals with known order over AWGN channels and give its corresponding suboptimal detectors in both low and high SNR (Signal-to-Noise Ratio) regimes. Through approximations, it is found that, in low SNR regime, for MPSK (M >2) signals, the suboptimal detector is the energy detector, while for BPSK signals the suboptimal detector is the energy detection on the real part. In high SNR regime, it is shown that, for BPSK signals, the test statistic is the sum of signal magnitudes, but uses the real part of the phase-shifted signals as the input. We provide the performance analysis of the suboptimal detectors in terms of probabilities of detection and false alarm, and selection of detection threshold and number of samples. The simulations have shown that Bayesian detector has a performance similar to the energy detector in low SNR regime, but has better performance in high SNR regime in terms of spectrum utilization and secondary users' throughput.

Digital Signal Proccessing

1. A Novel Decorrelation Approach For An Advanced Multichannel Acoustic Echo Cancellation System

A multichannel sound reproduction system aims at offering an immersive experience exploiting multiple microphones and loudspeakers. In the case of multichannel acoustic echo cancellation, a suitable solutions for overcoming the wellknown non-uniqueness problem and an appropriate choice of the adaptive algorithm become essential to improve the audio reproduction quality. In this paper, an advanced system is proposed based on the introduction of a multichannel decorrelation solution exploiting the missing-fundamental phenomenon and a combined multiple-input multiple-output
architecture updated by using the multichannel affine projection algorithm. Experimental results proved the effectiveness of the presented framework in terms of objective and subjective measures, providing a suitable solution for echo cancellation.

2. Optimal Factoring of FIR Filters

New insights suggest that the most efficient FIR digital filters can be created by using a scaled sequence of stages, each representing a factor of the filter's transfer function. A crucial capability for building such filters concerns finding the best FIR filter factors, then carefully scaling and sequencing them. The efficiency of the resulting structure depends heavily upon obtaining such optimalfactors. We offer an algorithm to find, scale and sequence optimally factored FIR filters.

3. Partial-Aliasing Correlation Filters

Correlation filters (CFs) are useful tools for detecting and locating signals or objects within a larger signal or scene of interest. Typically, these filters are designed during the training stage without worrying about how the cross-correlation between a test
signal and the designed CF template will be carried out during the testing or use stage. Because of its computational benefits, the Fast Fourier Transform (FFT) algorithmis usually used for performing cross-correlations, leading to circular correlations and aliasing in the resulting correlation outputs. The aliasing effects can be suppressed
by zero-padding, but at the expense of using longer FFTs and thus incurring more computational complexity. In this paper, we present a new approach where CFs are designed to explicitly allow partial aliasing at test time (thus allowing the use of shorter
FFTs). This approach of allowing aliasing in the cross-correlation output and explicitly taking such partial aliasing into accountwhen designing the CF is diametrically opposite to the conventional CF approaches which try to avoid aliasing effects. We demonstrate through numerical results that these new partial-aliasing correlation

filters (PACFs) achieve better recognition performance than conventional CFs when used in block filtering architectures that allow aliasing.

4. A Distributed Arithmetic based Approach for the Implementation of the Sign-LMS Adaptive Filter

A Distributed Arithmetic (DA) based scheme for the implementation of Sign-LMS adaptive filter is presented. DA is an efficient technique for the computation of the dot product of two vectors. This is done by storing the pre-computed partial-products
in memories which are then shift-accumulated for the computation of the output. DA can be used for the realization of the finite impulse response (FIR) filters, however, for the realization of the adaptive filters, the partial-products have to be updated from time to time. This is achieved by using a memory which stores the partial-products of the set of recent input samples. The proposed scheme has a convergence performance similar to that of the multiply-and-accumulate (MAC) based implementation. Results show that the throughput of the DAbased implementation is better than the MAC based implementation. Further, it is observed that the throughput is almost a constant with respect to the filter order which makes it more suitable for implementing large filters.

5. AS-band Bitstream Transmitter with Channelized Active Noise Elimination (CANE)

Bitstream Modulated transmitters based on Delta Sigma Modulation have been proved to be promising for efficient amplification of non-constant envelope signal. Such
transmitters preserve signal linearity by converting the signal to binary envelope and shaping the quantization noise out of signal band. To further suppress the noise near the in band signal that is left from noise shaping, active FIR filter structure consisting
of multiple identical amplifier units is proposed. In this paper, the Channelized Active Noise Elimination (CANE) technique is employed to create an effective band-pass FIR filter by delaying, up-converting the baseband signal and then combining them in
RF. A special power combining network is designed to maintain the overall PA efficiency while the noise power is suppressed. An S-band transmitter prototype with 2-channels has been built and tested. The results demonstrated that the CANE technique
can achieve filtering with software reconfigured flexibility while maintaining the power efficiency.

6. A Modified Imperialist Competitive Algorithm for Digital IIR Filter Design

Digital infinite impulse response (IIR) filter have become the target of growing interest, because they often provide a much better performance and less computational cost than
finite impulse response (FIR) filters. Since the problem of error surface of designing Digital IIR filters is generally nonlinear and multimodal, global optimization techniques are required in order to avoid local minima. In this paper, an evolutionary method
based on Imperialist Competitive Algorithm (ICA) has been proposed to design Digital IIR filters. By adding a step to the standard ICA algorithm, its performance has been improved in searching solution space and convergence to the global minima. Simulation results show the efficiency of the proposed method to design Digital IIR filter**.**

7. Robust acoustic echo cancellation in the short-time fourier transform domain using adaptive crossband filters

This paper presents a robust acoustic echo cancellation (AEC) system in the short-time Fourier transform (STFT) domain using adaptive crossband filters. The STFT-domain AEC allows for a simpler system structure compared to the traditional frequency-domain AEC, which normally requires several applications of the discrete Fourier transform (DFT) and the inverse DFT, while the robust AEC (RAEC) allows for continuous and stable filter updates during double talk without freezing the adaptive filter. The RAEC and the STFT-domain AEC have been investigated in the past in separate

studies. In this work we propose a novel algorithm that combines the advantages of both approaches for robust update of the adaptive crossband filters even during double talk. Experimental results confirm the benefit of incorporating the robustness constraint for the adaptive crossband filters and show improved performance in terms of the echo reduction and the predicted sound quality..

8. **Analysis of normal and epileptic EEG signals with filtering methods**

EEG sinyalleri, beyin yüzeyinden alınan, küçük genlikli ve düşük frekans bandına sahip durağan olmayan biyolojik işaretlerdir. Ortamda bulunan diğer elektriksel sinyaller ile kişinin kendisinden kaynaklı istemli-istemsiz hareketleri ek gürültülere sebep olabileceğinden EEG kayıtları diğer biyolojik işaretler gibi hassas bir ölçüm gerektirmektedir. Bu çalışmada, WAG/Rij farelerine ait normal/epileptik EEG sinyallerinde bulunan yüksek frekanslı gürültüler hareketli ortalama filtre ile düşük frekanslı gürültüler ise türev tabanlı filtre ile bastırılmış ve sinyallerin frekans spektrumları çıkartılmıştır. Böylece sinyallerin, yoğunlaştığı frekans bantları karşılaştırılarak hastalık teşhisinin kolaylaştırılması amaçlanmıştır.

9. **Automatic Identification and Removal of Ocular Artifacts inEEG—Improved Adaptive Predictor Filtering for PortableApplications**

Electroencephalogram (EEG) signals have a long history of use as a noninvasive approach to measure brain function. An essential component in EEG-based applications is the removal of Ocular Artifacts (OA) from the EEG signals. In this paper we propose a hybrid de-noising method combining Discrete Wavelet Transformation (DWT) and an Adaptive Predictor Filter (APF). A particularly novel feature of the proposed method is the use of the APF based on an adaptive autoregressive model for prediction of the waveform of signals in the ocular artifact zones. In our test, based on simulated data, the accuracy of noise removal in the proposed model was significantly increased when compared to existing methods including: Wavelet Packet Transform (WPT) and Independent Component Analysis (ICA), Discrete Wavelet Transform (DWT) and Adaptive Noise Cancellation (ANC). The results demonstrate that the proposed method achieved a lower mean square error and higher correlation between the original and corrected EEG. The proposed method has also been evaluated using data from calibration trials for the Online Predictive Tools for Intervention in Mental Illness (OPTIMI) project. The results of this evaluation indicate an improvement in performance in terms of the recovery of true EEG signals with EEG tracking and computational speed in the analysis. The proposed method is well suited to applications in portable environments where the constraints with respect to acceptable wearable sensor attachments usually dictate single channel devices.

10. **Towards Generalizing Classification Based Speech Separation**

Monaural speech separation is awell-recognized challenge. Recent studies utilize supervised classificationmethods to estimate the ideal binary mask (IBM) to address the problem. In a supervised learning framework, the issue of generalization to conditions different from those in training is very important. This paper presents methods that require only a small training corpus and can generalize to unseen conditions. The system utilizes support vector machines to learn classification cues and then employs a rethresholding technique to estimate the IBM. A distribution fittingmethod is used to generalize to unseen signal-to-noise ratio conditions and voice activity detection based adaptation isused to generalize tounseen noise conditions. Systematic evaluation and comparison show that the proposed approach produces high quality IBM estimates under unseen conditions.

POWER ELECTRONICS

1. **Nested Multilevel Topologies**

This paper proposes multilevel topologies based on the concept of nested arrangement. Such topologies are called nested multilevel converters, since the central point of the legs are connected at the same point, with the external legs involving the internal ones. Nested configurations present advantages as compared to the equivalent NPC topologies in terms of reduced number of diodes and consequently higher efficiency. In addition to proposing a new family of power electronics converters, this paper presents an optimized pulse widthmodulation strategy that allows synthesizing voltage waveforms with higher quality, a losses comparison with the NPC topology, and a general comparison with other topologies proposed in the technical literature. Simulated and experimental results are presented to validate the theoretical expectations.

2. An AC–DC Single-Stage Full-Bridge Converter With Improved Output Characteristics

A new auxiliary circuit for an ac–dc single-stage power-factor-corrected (SSPFC) full-bridge-type converter is proposed in this paper. The new auxiliary circuit is simple, handles low power, and is active only when the converter is operating under light load conditions. In this paper, the operation of an SSPFC converter is briefly reviewed and the main principle behind the auxiliary circuit is explained. The new auxiliary circuit is introduced, its operation is explained, and its feasibility in a multilevel SSPFC is confirmed with experimental results.

3. A Novel Full Load Range ZVS DC-DC Full-Bridge Converter with Natural Hold-Up Time Operation

Two stage AC-DC converters consisting of frontend Power Factor Correction (PFC) AC-DC boost converter followed by an isolated DC-DC converter are the industry workhorse for powering network servers, telecom and other DC loads. Such converters are powered from single-phase ac utility mains. For proper operation of these loads the AC-DC converterprovides a regulated DC voltage that ranges from 12V to 48V depending on the type of load. For safe uninterrupted operation during sudden intermittences in power supplied from the AC mains, the AC-DC power converter should be able to supply such loads with constant DC output voltage in order to prevent them from unwanted resetting. The maximum duration for which the AC-DC converter can supply the load with regulated DC output voltage at its maximum output power after input AC mains failure, is known as “hold-up-time (HUT)” of the converter. This paper proposes a novel DC-DC non-resonant full-bridge converter with extended hold-up-time capability with reduced input storage capacitance.

4. A Novel Matrix Based Isolated Three Phase AC-DC Converter with Reduced Switching Losses

This paper presents a matrix based isolated three phase AC-DC converter suitable for aircraft application. A three - phase to single-phase (3x1) matrix topology with novel
modulation scheme named as Switched Rectifier Inverter (SRI) is introduced for direct line frequency AC to high frequency AC conversion which in effect, eliminates the requirement of bulky DC link capacitor and therefore, provides high power density
essential for the aircraft systems. The high frequency AC output of the matrix (3x1) converter is processed by high frequency transformer followed by rectifier to obtain isolated DC output voltage. The operation of the proposed converter with SRI modulation scheme is explained. Moreover, the input power quality under the proposed modulation scheme is discussed for wide load range. Comprehensive simulation is carried out in PSIM for an example converter of input 120 V (rms), 400 Hz AC to 400 V DC with 8 kW power.

5. Reduced current harmonics in the NPC inverter with a novel space vector PWM

The three-phase three-level diode clamped inverter due to its supreme performance compared to a two-level inverter is one of the widely used multilevel inverter topology for medium voltage, high power applications. One of the popular control strategies for the inverter is space vector pulse width modulations (SVPWM) which has superior advantages in terms of its implementation and harmonic reduction. A three-level neutral point clamped (NPC) inverter with space vector

modulation is presented in this paper. Duty cycles of the inverter switches are calculated based on a two-level inverter space vector diagram. A switching sequence is proposed in this paper to reduce the total harmonic distortion (THD) in the line current as well as to increase the C bus utilization of the inverter. The current harmonics of conventional SVPMW based inverter is compared for various modulation indices with the new modulation method and the result is encouraging.

6. Soft Switching Three Level Inverter (S3L Inverter)

The Soft Switching Three Level Inverter – abbreviated to S3L Inverter – was first introduced in 2011. It is a novel circuit topology for PWM inverters, whose areas of application include electrical drives and grid-tie inverters for photovoltaic installations and wind power plants, and for power supplies. It is of very simple design and therefore inexpensive. It is implemented completely as soft switching and hence offers very low switching losses. This means that its efficiency is very high, and it can achieve very high values for the switching frequency. This paper begins by describing how the device functions. It then goes on to discuss specialised methods of control. A variant of the S3L Inverter with a deactivatable snubber circuit is presented. A quantitative comparison between a well-known hard switching NPC 3-level inverter and the novel S3L Inverter using 90 kVA (three-phase) prototypes illustrates the advantages of the S3L inverter.

7. A Novel Low Power 3T Inverter

Though CMOS logic inverter is widely appreciated because of its negligible static power consumption still sometimes it is deprecated because of the high dynamic power consumption. The high dynamic power consumption is because of the charging and discharging of the load capacitor and also because of the unwanted short-circuits current from Vdd to ground. The proposed three transistor saturated NMOS inverter reduces the short-circuit current and hence reduces the overall power consumption. The proposed inverter reduces the average power consumption by 35% for any input signal of frequency less than or equal to 1 MHz and by 15% for any input signal up to around 10MHz. But the power consumption slowly increases when the input frequency goes beyond 100 MHz. So the proposed inverter can be used in MHz applications to save a good amount of
power.

8. A Cascaded Asymmetric Multilevel Inverter with Minimum Number of Switches for Solar Applications

Solar energy is one of the renewable energy which is used to generate electricity with the help of PV arrays. DC-DC converter is used to step up the DC voltage from PV arrays and then it is connected to an inverter for AC applications. Conventional inverters have many issues like non sinusoidal output, high total harmonic distortion (THD), high switching stress and more number of switches. So multilevel inverter (MLI) have gained much importance over conventional inverters for high voltage and high power applications, due to the increased number of voltage levels producing less number of harmonics. In this paper, a cascaded asymmetric multilevel inverter is proposed which contains minimum number of switches and can be employed in AC applications using solar energy. The proposed topology consists of 25 output levels using 10 switches with near sinusoidal output, thereby reducing gate driver circuitry and optimizing circuit layout. Asymmetric multilevel inverter is more
advantageous than symmetric multilevel inverter in obtaining more number of output levels using same number of voltage sources. The other advantages of proposed topology are low voltage stress and reduced THD. The THD for proposed inverter circuit is only 4.98%. Modeling and simulation is carried out using MA TLAB/SIMULINK.

9. Design of a Single Stage Grid-Connected Bucl<-Boost Photovoltaic Inverter for Residential Application

This article introduces the design of a three-switch single-phase single-stage grid-connected buck-boost photovoltaic inverter topology for residential applications. The proposed design topology has numerous desirable features such as better utilization of the photovoltaic array, low cost, compact size, simpler control and higher efficiency. For switching of inverter power circuit, we used a combination of sinusoidal pulse width modulation (SPWM) and square wave signal

under grid synchronization condition. Moreover, to control SPWM duty cycle and to regulate the inverter's instantaneous ac output current, a closed-loop SPWM control scheme is employed to stabilize the output as fast as possible. The design and analysis of the inverter control circuit and grid synchronization methods are portrayed in detail. The proposed design is mathematically modeled which is simulated in PSIM. Finally, the simulation results are presented to verify the viability of the proposed singlestage
three-switch buck-boost inverter for grid-connected photovoltaic application and confirmed the capability of the inverter to feed a sinusoidal current to the utility grid at a wide range of input photovoltaic dc voltage.

10. Design of Single-Stage Buck and Boost Converters for Photovoltaic Inverter Applications

In conventional inverters, implementation of a transformer greatly enhances the Total Harmonic Distortion (THD) which is counted to have a negative impact on the inverter output. In order to overcome this limitation, transformer can be replaced by buck and boost converters thereby making a transformer-less inverter which will greatly reduce the THD and enhance the efficiency. In this paper, the design of a single stage buck and boost converters has been presented for photovoltaic inverter applications. The proposed design employs a single-stage switch mode buck converter and a single-stage switch mode boost converter. The converters are so designed that the boost converter provides an output voltage of 312V DC from 24V PV array while the buck converter provides an output voltage of 7.07V pulsated DC from 312V AC grid. The designed buck and
boost converters are then employed to run a single-phase fullbridge inverter. The circuit is simulated using the PSIM software. The simulation results show that the designed buck and boost converters can be used to replace transformers from conventional inverter circuit to make low-THD, highly efficient and cost effective transformer-less inverter topology.

11. An Integrated Three-Port Bidirectional DC–DC Converter for PV Application on a DC Distribution System

In this paper, an integrated three-port bidirectional dc–dc converter for a dc distribution system is presented. One port of the low-voltage side of the proposed converter is chosen as a current source port which fits for photovoltaic (PV) panels with wide voltage variation. In addition, the interleaved structure of the current source port can provide the desired small current ripple to benefit the PV panel to achieve the maximum power point tracking (MPPT). Another port of the low-voltage side is chosen as a voltage source port interfaced with battery that has small voltage variation; therefore, the PV panel and energy storage element can be integrated by using one converter topology. The voltage port on the high-voltage side will be connected to the dc distribution bus. A high-frequency transformer of the proposed converter not only provides galvanic isolation between energy sources and high voltage dc bus, but also helps to remove the leakage current resulted from PV panels. The MPPT and power flow regulations are realized by duty cycle control and phase-shift angle control, respectively. Different from the single-phase dual-half-bridge converter, the power flow between the low-voltage side and high-voltage side is only related to the phase-shift angle in a large operation area. The system operation modes under different conditions are analyzed and the zero-voltage switching can be guaranteed in the PV application even when the dc-link voltage varies. Finally, system simulation and experimental results on a 3-kW hardware prototype are presented to verify the proposed technology.

12. A Bridgeless Boost Rectifier for Low-Voltage Energy Harvesting Application

a single-stage ac–dc power electronic converter is proposed to efficiently manage the energy harvested from electromagnetic microscale and mesoscale generators with low-voltage outputs. The proposed topology combines a boost converter and a buck-boost converter to condition the positive and negative half portions of the input ac voltage, respectively. Only one inductor and capacitor are used in both circuitries to reduce the size of the converter. A 2 cm × 2 cm, 3.34-g prototype has been designed and tested at 50-kHz switching frequency, which demonstrate 71% efficiency at 54.5 mW. The input ac voltage with 0.4-V amplitude is rectified and stepped up to 3.3-V dc. Detailed design guidelines

are provided with the purpose of minimizing the size, weight, and power losses. The theoretical analyses are validated by the experiment results.

13. Modular Multilevel Inverter with New Modulation Method and Its Application to Photovoltaic Grid-Connected Generator

This paper proposed an improved phase disposition pulse width modulation (PDPWM) for a modular multilevel inverter which is used for Photovoltaic grid connection. This new modulation method is based on selective virtual loop mapping, to achieve dynamic capacitor voltage balance without the help of an extra compensation signal. The concept of virtual submodule (VSM) is first established, and by changing the loop mapping relationships between the VSMs and the real submodules, the voltages of the upper/lower arm's capacitors can be well balanced. This method does not requiring sorting voltages from highest to lowest, and just identifies the MIN and MAX capacitor voltage's index which makes it suitable for a modular multilevel converter with a large number of submodules in one arm. Compared to carrier phase-shifted PWM (CPSPWM), this method is more easily to be realized in field- programmable gate array and has much stronger dynamic regulation ability, and is conducive to the control of circulating current. Its feasibility and validity have been verified by simulations and experiments.