OFDM Performance with Odd-Even Quantisation in Cartesian ΔΣ Upconverters

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***Abstract*— This paper studies the odd-quantisation technique when subjected to OFDM input signals in a Cartesian Delta Sigma (ΔΣ) upconverter. The results will be compared to the even-quantisation method of [9] to establish whether there is an improvement in performance. The overall performance of the odd-quantisation scheme has about 5dB reduced adjacent channel power (ACP) compared to the even-quantisation scheme. The smaller first quantisation step results in lower quantisation noise for small signals, leading to a lower noise floor. When the signal is frequency offset, a number of distortions become visible in the spectrum. The third harmonic is the biggest distortion contributor followed by the image. Interestingly, the overall better noise performance of the odd-quantisation scheme does not improve the distortion spectra. Best performance occurs when frequency offsetting is avoided.**

I. INTRODUCTION

Currently, the communication connectivity through a wireless device plays an essential role in daily life. The rapidly developing technology of wireless transmitters such as for WLAN, mobile 3G & 4G, and public digital broadcasting will require more power efficiency, good linearity, high data rate and high bandwidth. Switch mode power amplifiers (SMPAs) have high efficiency but the linearity is very critical [1,2]. Using a pulse train for driving SMPAs with pulse width and pulse position modulation (PWM/PPM) in Cartesian ΔΣ is effective for linearity requirement [3,4]. Orthogonal Frequency Division Multiplexing (OFDM) nowadays can support high data rate communications in multi-carrier systems. However, OFDM suffers from high-peak-to-average power ratio (PAPR) that will limit the energy efficiency [5]. Therefore, for wireless connectivity, in order to obtain higher data rates, directed towards maintaining spectral efficiency, performance linearity and wide bandwidth become very critical.

All nonlinear PA classes can be operated with a switching input waveform (e.g. class D and E), resulting in SMPA for a future generation of wireless base stations. This is a potential method towards high efficiency linear radio frequency of power amplifiers (RF-PAs) which has been proposed [2]. The important technique in SMPA architecture is PWM/PPM which can be used to generate an RF signal with any amplitude and phase. PWM/PPM signals are usually quantized in both amplitude and phase. The amplitude and phase of the RF signals are controlled by the pulse width and pulse position of the switched mode output respectively. Normally, baseband signals are generated in Cartesian format. Therefore, these signals must be converted to Polar format to generate PWM/PPM signals.

The authors in [3,6] developed a Cartesian ΔΣ system to generate a binary signal with an appropriate pulse width and pulse position for driving an SMPA. ΔΣ techniques was used to shape the noise away from the band of interest. They operate by subtracting the current quantised error signal from the subsequent sample [7]. The Cartesian ΔΣ technique shown in Fig.1 was used to suppress the quantisation noise but the 'Polar to PWM/PPM' block can generate unwanted spectral components when the carrier frequency of the transmitted signal is offset from its nominal frequency [8,9].

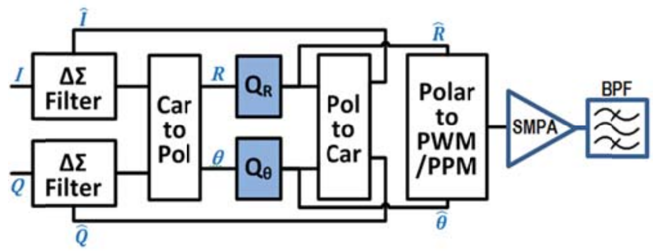

Fig. 1. Cartesian ΔΣ Upconverters. Q_R and Q_θ quantise the amplitude and phase in odd-quantisation scheme.

A novel all digital approach with a quantisation technique to generate a pulse train for driving an SMPA in the Cartesian ΔΣ system was proposed in [9]. The proposed quantiser used an even-quantisation technique where the three-level-waveform forming the output is based on pulses with an even number of clock periods. The quantised amplitudes, $\hat{R}$, of the RF signal are calculated by changing the pulsewidths in increments of two clock periods. However, this leads to a potential coarse quantisation at low signal levels as the minimum pulsewidth in the even-quantisation scheme is two clock periods.

This paper offers an alternative approach to the even-quantisation of [9] using a new scheme of odd-quantisation. Odd-quantisation was proposed to reduce the possible pulsewidths by one clock period while maintaining a constant phase reference. The acceptable pulsewidths become (0, 1, 3, 5 …) for the odd-quantisation compared to the (0, 2, 4, 6 …) values for the even-quantisation. In both cases the phase reference does not change with the pulsewidth, allowing separate quantisers for amplitude and phase.

In the following, Cartesian ΔΣ upconverter with odd-quantisation will be considered when applied to OFDM. It should be noted that most of today's modulation schemes have large signal dynamics. OFDM and Code Division Multiple Access (CDMA) are often modeled with a Rayleigh amplitude distribution. The signals must be backed off so that the electronics can handle the peak powers. The result is that there is an increased probability of low signal levels in the ΔΣ modulator. Ideally, therefore, the quantisation levels should also be concentrated at the low signal levels.

The contribution of this paper is the evaluation of the adjacent channel interference caused by the quantisation process in the ΔΣ architecture. We show that both even-quantisation and odd-quantisation schemes produce the same distortion products that increase with frequency offset. On the other hand, when the input signal is backed-off (power control), the noise problem is reduced with the odd-quantisation.

The paper is organized as follows. Section I is the introduction. Section II presents the details of the new odd-quantisation scheme. Section III and section IV give the simulation setup and results of the OFDM test signal for both even-quantisation and odd-quantisation schemes. Finally, we draw a conclusion in section V.

II. ODD QUANTISATION SCHEME

ΔΣ filtering is achieved through the processes of oversampling and noise shaping. Oversampling reduces the noise power spectral density (PSD) when the noise is spread over a wider bandwidth. As expected, increasing the baseband (BB) oversampling rate (OSR_{BB}) will decrease the in-band noise proportional to $\frac{1}{OSR}$ [7].The oversampling ratio of the baseband is given by

$$OSR_{BB} = \frac{f_s}{f_B} \tag{1}$$

where f_B is the maximum signal bandwidth and f_s is the sampling frequency. The quantisation error is also noise shaped using feedback in the ΔΣ filter. The noise transfer function (NTF) for a lowpass 2nd order ΔΣ (Fig. 2) is given by:

$$NTF = (1 - z^{-1})^2 \tag{2}$$

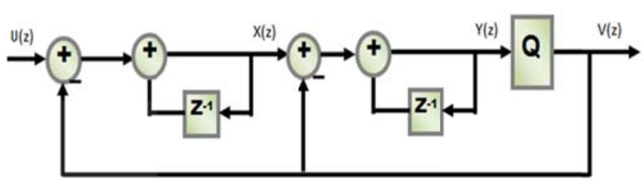

Fig. 2. Mod-2 Lowpass ΔΣ.

The comparison between even-quantisation [9] and the new odd-quantisation schemes are now discussed. The new quantisation scheme affects the Q_R and Q_θ blocks and the PWM generation block 'Polar to PWM/PPM' of Fig.1.

The PWM/PPM process requires the digital clock (f_{clock}) to oversample the nominal RF carrier frequency of the signal output (f_c) by a factor of OSR_{RF}. The OSR_{RF} is given by

$$OSR_{RF} = \frac{f_{clock}}{f_c} \tag{3}$$

The phase is therefore uniformly quantised into N_P (=OSR_{RF}) increments over the range 0 to 2π. The quantised phase, $\hat{\theta}$, is determined by the pulse position. The phase reference is taken from the middle of the pulse and is 0 degrees for even pulsewidths. However the reference for odd pulsewidths is given by

$$\theta_{ref} = \frac{2\pi/_{N_P}}{2} \tag{4}$$

The quantised amplitude, $\hat{R}$, is determined by the pulsewidth as shown in Fig. 3. The top trace shows the maximum amplitude condition for OSR_{RF}=8 and has a pulsewidth of four clock periods. The output is a full square wave, and after bandpass filtering produces the sinusoidal output. The bottom trace shows a reduced amplitude sinewave with a pulsewidth of three clock periods. The phase reference for the even and odd pulsewidth conditions is clearly shown.

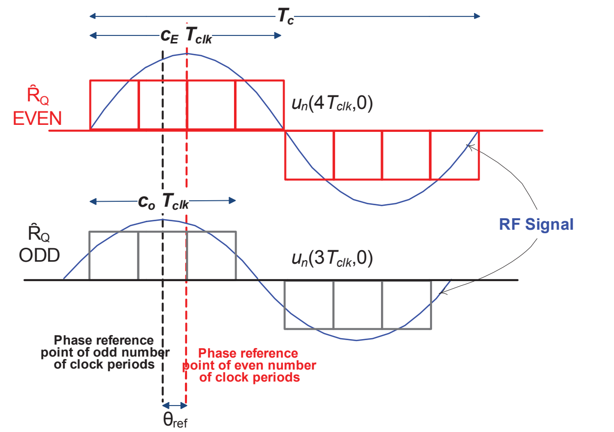

Fig. 3. Calculation for $\hat{R}$ with the even-odd number of clock periods for OSR_{RF}=8.

If the quantised amplitudes $\hat{R}$ are confined to all the even pulsewidths, then the phase reference does not change and so amplitude quantisation and phase quantisation are independent one dimensional operations; similarly, if the quantisation amplitudes are confined to all the odd pulsewidths. When both odd and even pulsewidths are allowed a change in amplitude can cause a change in phase (Amplitude Modulation (AM) to Phase Modulation (PM) conversion) and so joint amplitude and phase quantisation must be applied. This is a two-dimensional operation and leads to a great increase in quantiser complexity.

Fig. 4 shows the even-quantisation and the odd-quantisation in the Polar plane. The radius of the circles is set by $\hat{R}$. The radial lines show the quantised phase, $\hat{\theta}$. The even-quantised points of $Q_E[\hat{R},\hat{\theta}]$ are illustrated by red dots. The odd-quantised points of $Q_O[\hat{R},\hat{\theta}]$ are illustrated by the black crosses. $\hat{R}$ and $\hat{\theta}$ are the quantised values of [R,□] corresponding to the I and Q output of the ΔΣ filters. The dashed circles between each of circles (red is for even-Polar, and black is for odd-Polar) are the threshold levels for the amplitude quantiser ($\hat{L}_R$). The phase threshold levels, ($\hat{L}_\theta$), are measured midway between two phase increments, and are shown as dashed lines.

The quantised phase is based on the odd-Polar plane, as shown in Fig. 4 (below), given by

$$\hat{\theta} = (p_p + 0.5)\frac{2\pi}{N_P} \tag{5}$$

The threshold for the quantised phase is calculated by equation

$$L_\theta(p_p, p_p + 1) = p_p\frac{2\pi}{N_P} \tag{6}$$

The amplitude levels are calculated by evaluating the fundamental spectral component of the three-level waveform, $u_n(p_o, p_p)$, with amplitudes 1, 0, and -1. p_o is the pulsewidth corresponding to the c_O clock cycles (c_O is for odd) or c_E clock cycles (c_E is for even). p_p is the pulse position and refers to the time delay or advance. $p_p = (0, \ldots (N_P\text{-}1))$ and represents the PPM delay in clock periods.

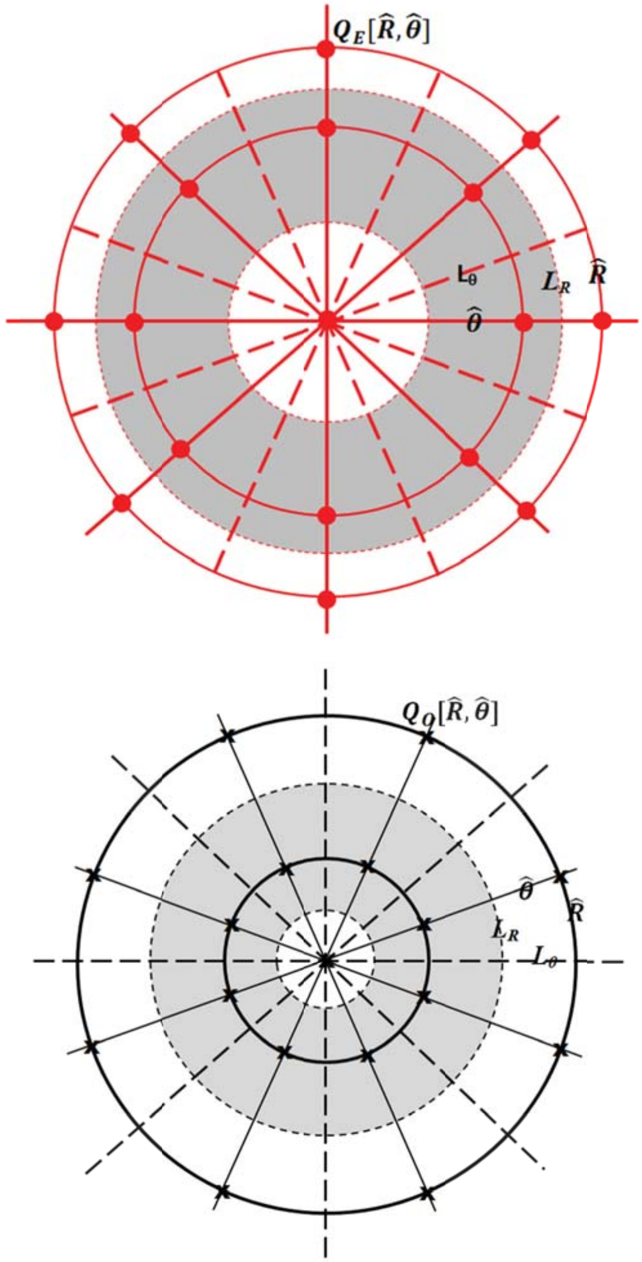

Fig. 4. The even-quantisation (top) and the odd-quantisation (below) Polar plane scale for OSR_{RF}=8.

Since $u_n(p_o,p_p)$ is a repeating waveform, the amplitude of the spectral component can be generated from one period only using the Fourier series. Here, we use a highly oversampled version of $u_n(p_o,p_p)$ to get the same result from a discrete Fourier transform (DFT).

$$U_k(p_o,p_p) = \frac{1}{K} DFT(u_n(p_o,p_p)) \qquad (7)$$

where K is the fast Fourier transform (FFT) size. The amplitude of the fundamental of the pulse wave occurs in the first frequency bin, k=1

$$\hat{R}_Q\left(\frac{p_o}{2}\right) = 2[|U_{k=1}(p_o,p_p)|], \qquad (8)$$

$\left(\frac{p_o}{2}\right)$ is the index for the different pulsewidths corresponding to the odd pulsewidth $\left(0, \frac{1}{OSR_{RF}}, \frac{3}{OSR_{RF}} \ldots \frac{N_P-1}{OSR_{RF}}\right)\frac{1}{f_c}$.

The amplitude threshold levels are given by the midpoint of two amplitude quantised levels,

$$L_R\left(\frac{p_o}{2}, \frac{p_o}{2}+1\right) = \frac{R\left(\frac{p_o}{2}\right) + R\left(\frac{p_o}{2}+1\right)}{2}, \qquad (9)$$

where the index of $\frac{p_o}{2}$ is selected in ascending order.

After quantisation, then the ‘Polar to PWM/PPM’ block is used to convert the quantised signals, $[\hat{R},\hat{\theta}]$, in Polar representation to RF using PWM and PPM schemes. The location of the pulse position of the PPM process is determined using the quantised phase, $\hat{\theta}$, which is the output from Q_θ block. A change in position depends on a change of $\hat{\theta}$ where the pulse edges must occur on the digital timing grid. The output of Q_R block, $\hat{R}$, determines the duration of the PWM process.

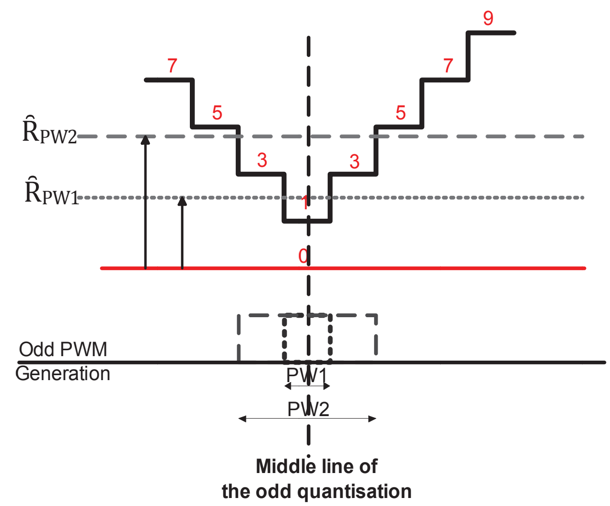

Fig. 5. Odd PWM generation.

Fig. 5 illustrates the PWM generation of odd quantised signals using a stepped triangle wave. It shows two examples of quantised amplitudes: $\hat{R}_{PW1}$ and $\hat{R}_{PW2}$. The output pulsewidths, *PW1* and *PW2*, are defined by the crossing points of the line $\hat{R}_{PW1}$ and $\hat{R}_{PW2}$ respectively and the stepped triangular waveform signal. The pulsewidth must change with two sample increments to decouple the amplitude response from the phase response. The pulsewidth then maintains symmetry about its midpoint.

III. TEST SIGNAL CHARACTERISTICS OF OFDM

Fig. 6 shows the simulation model for test signal OFDM into Cartesian $\Delta\Sigma$ upconverters. The OFDM bandwidth (B) was set at $\frac{f_c}{64}$ with f_c=1024 MHz which equivalent to a B_{ofdm} of 16 MHz (applicable bandwidth to WLAN). The sampling frequency (f_s) of the $\Delta\Sigma$ is related to the nominal carrier frequency f_c.

$$f_s = \frac{f_c}{m} \qquad (10)$$

where the index m is the number of carrier periods between each output sample of the $\Delta\Sigma$, (m=n/2, where n is an integer).

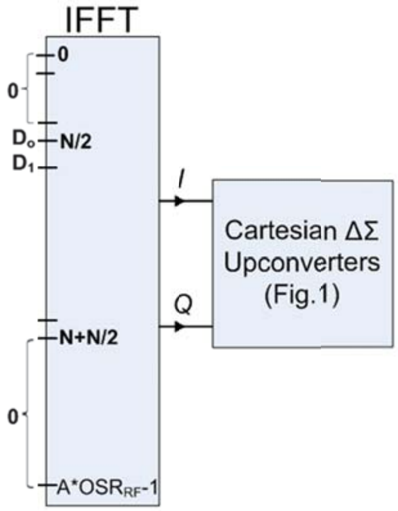

Fig. 6. OFDM as input the *I* and *Q* signal to Cartesian ΔΣ upconverters for an offset carrier.

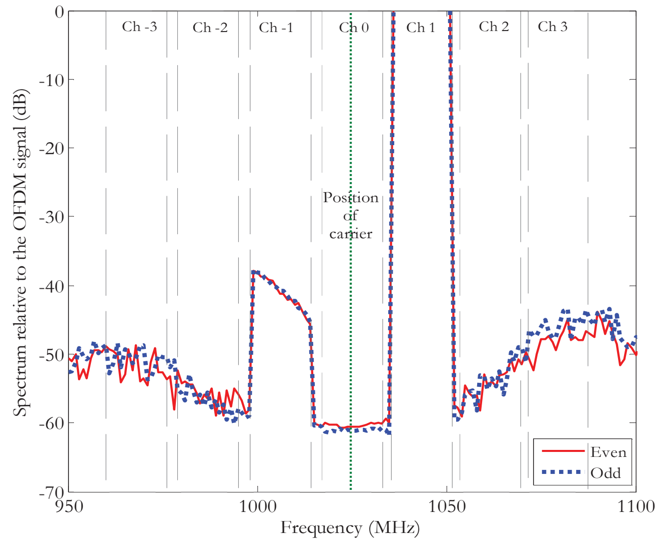

Fig. 7. Spectrum plot of even-quantisation and odd-quantisation in Cartesian ΔΣ upconverter with offset OFDM signal.

When n=1 and m=1/2, the pulse width and position is updated every half period of the carrier, which is the highest update rate. In this work we use m=1 (n=2) and update every period. If Δf is the bin frequency spacing between the active tones (A) of subcarriers, therefore B_{ofdm} is equal to $A * \Delta f$. N is the nominal number of subcarriers in the channel bandwidth, including the null sub-carriers forming the guard band between adjacent channels. The simulation parameters are summarized in Table I.

The out-of-band distortions for both even-quantisation and odd-quantisation schemes are compared by calculating their adjacent channel powers (ACPs). The desired signal was shifted one channel to the right to examine the resultant spectral images. The ACPs which are defined as the noise power in the adjacent channel divided by the signal power were calculated. The noise power includes quantisation noise as well as distortion arising from PPM.

TABLE I
SIMULATION PARAMETERS

Parameter	Value
Modulated Signal	QPSK, OFDM
Frequency carrier, f_c	1024 MHz
OSR_{BB}	64
Oversampling ratio (OSR_{RF})	16
N	20
A	16
Δf	1 MHz
Offset frequency	20 MHz, guard band 0.25B_{ofdm}

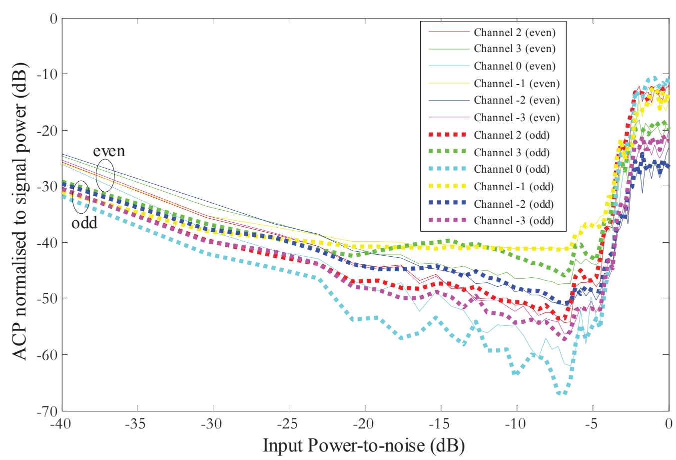

Fig. 8, Cartesian ΔΣ with even-quantisation and odd-quantisation scheme (ACP in adjacent channel vs. input level).

IV. SIMULATION RESULTS

A spectrum plot of a pulse waveform with an RF carrier OSR_{RF} of 16 and an input signal level, u= -7 dB (with respect to u_{rms}= 1) obtained at the output of the Cartesian ΔΣ upconverter is shown in Fig. 7. The adjacent channels and the nominal position of the carrier are drawn on the figure to facilitate the understanding of the plot. The signal is present in channel 1. The image is present in channel -1 and the third harmonic is situated in channel 3 with the highest noise. The noise is lowest in channel 0 as the NTF of the ΔΣ operates from f_c and maximum attenuation of quantisation noise occurs around that region (ΔΣ-filters with MOD2).

Fig. 8 shows a plot of input level (dB) against ACP (dB) for the six adjacent channels obtained after simulating the Cartesian ΔΣ scheme. The shape of the curves indicates -7dB is the optimum input signal level for best SNR. As shown in the figure, the odd-quantisation has reduced ACP compared to even-quantisation for most input signal levels; only at large signal levels is the improvement less obvious. In channel 2, the odd-quantisation scheme has at least 4.83 dB less ACP than the even-quantisation scheme. In channel 0, the odd-quantisation scheme has at least 5.57 dB less ACP than the even-quantisation scheme. Again, it can be observed that channel 3 (Fig.7) which represents the third harmonic has the highest noise. Channel -1 representing the image has the second highest noise. Channel 0 has lower noise than channel 2 as channel 0 is centered at f_c. This plot further validates the conclusions drawn from Fig. 7.

V. CONCLUSION

This paper compares even-quantisation and odd-quantisation schemes for Cartesian ΔΣ upconverters. OFDM is used as the input signal. The characteristics of the input test signals and the OSR for both schemes are kept the same. The overall performance of the even-quantisation scheme is worse than the odd-quantisation scheme as the even-quantisation structure has an inherently higher noise floor. It can be observed that the third harmonic is the biggest noise contributor followed by the image. Interestingly, the overall better performances of the odd-quantisation scheme occur at lower input signal levels. These levels benefit from the lower first quantisation step of the odd-quantisation scheme. The benefit is lost when the input signal level rises to within about 7dB of the optimum signal level. The image and third order distortions dominate the performance at large signal levels and make signal tuning by using frequency offsetting at baseband a non-attractive proposition. The type of quantisation does not improve this aspect of the output spectrum. Tuning by changing the sample rate would obviate the need for offsetting and so avoid the problem.

VI. REFERENCES

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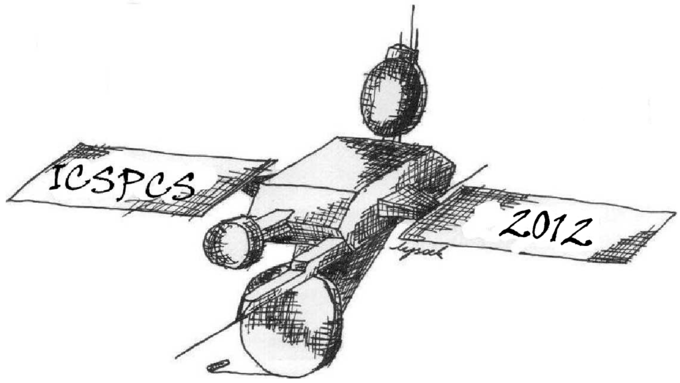

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Program of the 6th International Conference on Signal Processing and Communication Systems

Gold Coast Australia, 12-14 December 2012

Wednesday, 12 December 2012

8:00 a.m. – 9:00 a.m.	*Registration*
9:00 a.m. – 9:05 a.m.	**Official Opening**
9:05 a.m. – 10:30 a.m.	**Session 1 – Wireless Communications 1**
10:30 a.m. – 11.00 a.m.	*Coffee Break*
11:00 a.m. – 12:30 p.m.	**Session 2 – Signal Processing for Multimedia 1**
12:30 p.m. – 1:30 p.m.	*Lunch*
1:30 p.m. – 3:00 p.m.	**Session 3 – Information and Network Security**
3:00 p.m. – 3:30 p.m.	*Coffee Break*
3:30 p.m. – 5:00 p.m.	**Session 4 – Localisation and Tracking**
6:00 p.m. – 7:00 p.m.	*Cocktail Reception*

Thursday, 13 December 2012

9:00 a.m. – 9:45 a.m.	**Keynote Address - 1**
9:45 a.m. – 10:45 a.m.	**Session 5 – Communications Theory**
10:30 a.m. – 11.00 a.m.	*Coffee Break*
11:15 a.m. – 12:30 p.m.	**Session 6 – Wireless Communications 2**
12:30 p.m. – 1:30 p.m.	*Lunch*
1:30 p.m. – 2:30 p.m.	**Poster Session 1 – Communication Systems – 1**
2:45 p.m. – 3:45 p.m.	**Poster Session 2 – Signal Processing**
3:00 p.m. – 3:30 p.m.	*Coffee*
4:00 p.m. – 5:00 p.m.	**Poster Session 3 – Communication Systems – 2**
7:00 p.m. – 11:00 p.m.	*Banquet*

Friday, 14 December 2012

9:00 a.m. – 10:30 a.m.	**Session 7 – Medical Applications**
10:30 a.m. – 11.00 a.m.	*Coffee Break*
11:00 a.m. – 12:30 p.m.	**Session 8 - Signal Processing for Multimedia 2**
12:30 p.m. – 1:30 p.m.	*Lunch*
1:30 a.m. – 2:00 p.m.	**Keynote Address - 2**
2:00 p.m. – 3:00 p.m.	**Session 9 – Signal Processing for Multimedia 2**
3:00 p.m. – 3:30 p.m.	*Coffee Break*
3:30 p.m. – 5:00 p.m.	**Session 10 – Communication Theory 3**

End of the Conference

ICSPCS'2012 Technical Program

Wednesday, December 12

9:00 AM - 9:05 AM

Conference Opening

9:05 AM - 10:30 AM

Session 1: Wireless Communications 1

Complexity Reduced Lattice-Reduction-Aided MIMO Receiver with Virtual Channel Detection
Satoshi Denno (Okayama University, Japan); Masahiro Morikura (Kyoto University, Japan)

Joint User Decoding: A Technique to Enhance the Benefits of Coding in a Multi-way Relay Channel
Shama N. Islam (The Australian National University, Australia); Parastoo Sadeghi (The Australian National University, Australia)

Identification and Classification of Orthogonal Frequency Division Multiple Access Signals
Ryan Gray (Naval Postgraduate School, USA); Murali Tummala (Naval Postgraduate School, USA); John C. McEachen (Naval Postgraduate School, USA); James Scrofani (Naval Postgraduate School, USA); David Garren (Naval Postgraduate School, USA)

Joint Design of Source Power Allocation and Relay Beamforming in Multi-User Multi-Relay Wireless Networks
Umar Rashid (University of Technology, Sydney, Australia); Ha H Kha (University of Technology Sydney, Australia); Hoang D. Tuan (University of Technology, Sydney, Australia); Ha Nguyen (University of Saskatchewan, Canada)

Configurable Digital Transceiver for IEEE 802.15.4 Networks
Mridula Sharma (University of Kassel, Germany); Dirk Dahlhaus (University of Kassel, Germany)

11:00 AM - 12:30 PM

Session 2: Signal Processing for Multimedia 1

Efficient Real-Time Face Detection For High Resolution Surveillance Applications
Xin Cheng (Queensland University of Technology, Australia); Ruan Lakemond (Queensland University of Technology, Australia); Clinton Fookes (Queensland University of Technology, Australia); Sridha Sridharan (Queensland University of Technology, Australia)

A Multi-Modal Gait Based Human Identity Recognition System Based on Surveillance Videos
S. M. Emdad Hossain (University of Canberra, Australia); Girija Chetty (University of Canberra, Australia)

Automatic Han Chinese Folk Song Classification Using The Musical Feature Density Map
Suisin Khoo (Swinburne University of Technology, Australia); Zhihong Man (Swinburne University of Technology, Australia); Zhenwei Cao (Swinburne University of Technology, Australia)

Scan-by-Scan Averaging and Adjacent Detection Merging to improve Ship Detection in HFSWR
Jan Hinz (Helmut Schmidt University, Germany); Martin Holters (Helmut-Schmidt-University, Germany); Udo Zölzer (Helmut-Schmidt-University Hamburg, Germany)

Full-Reference Video Quality Assessment on High-Definition Video Content
Steffen Wulf (Helmut-Schmidt-University Hamburg, Germany); Udo Zölzer (Helmut-Schmidt-University Hamburg, Germany)

Quality Based Frame Selection For Video Face Recognition
Kaneswaran Anantharajah (Queensland University of Technology, Australia); Simon Denman (Queensland University of Technology, Australia); Sridha Sridharan (Queensland University of Technology, Australia); Clinton Fookes (Queensland University of Technology, Australia); Dian Tjondronegoro (Queensland University of Technology & Smart Services CRC, Australia)

1:30 PM - 3:00 PM

Session 3: Information and Network Security

Slide Attacks on the Sfinks Stream Cipher
Ali Alhamdan (Queensland University of Technology, Australia); Harry Bartlett (Queensland University of Technology, Australia); Edward Dawson (Queensland University of Technology, Information Security Institute, Australia); Leonie R Simpson (Queensland University of Technology, Australia); Kenneth Koon-Ho Wong (Queensland University of Technology, Australia)

Elliptic Curves Cryptographic Techniques
Ali Makki Sagheer (College of Computer - University of Anbar, Iraq)

Survey on Security Attacks in Vehicular Ad hoc Networks (VANETs)
Mohammed Saeed Al-kahtani (Salman bin Abdulaziz University, Saudi Arabia)

A Secure WSN for Roadside Surveillance using RTI
Robert Paul Inglis (US Naval Academy, USA); Owens Walker (United States Naval Academy, USA); Christopher R. Anderson (United States Naval Academy, USA); Richard K. Martin (Air Force Institute of Technology, USA); Ryan Thomas (Air Force Institute of Technology & US Air Force, USA)

Application of ID cards - security components
Radek Holý (Czech Technical University in Prague, Czech Republic); Marek Kalika (Czech Technical University in Prague, Czech Republic); Jan Scherks (Czech Technical University in Prague, Czech Republic)

Modeling of Efficient Key Management Method in Multicast Networks
Abbas Mehdizadeh (Universiti Putra Malaysia, Malaysia); Fazirulhisyam Hashim (Universiti Putra Malaysia, Malaysia)

3:30 PM - 5:00 PM

Session 4: Localisation and Tracking

Using Context-Aware Sub Sorting of Received Signal Strength Fingerprints for Indoor Localisation
Montserrat Ros (University of Wollongong, Australia); Brendan Schoots (University of Wollongong, Australia); Matthew J.A. D'Souza (CSIRO ICT Centre, Australia)

Scheme for Enhanced Tracking of Mobile Subscribers in a WiMAX Network
Jason Henderson (Naval Postgraduate School, USA); Murali Tummala (Naval Postgraduate School, USA); John C. McEachen (Naval Postgraduate School, USA); James Scrofani (Naval Postgraduate School, USA)

A M2M Network-Based Realistic Mobile User Movement Prediction in Emergencies
Nusrat Ahmed Surobhi (University of Sydney, Australia); Abbas Jamalipour (University of Sydney, Australia)

Localization in Wireless Sensor Networks by Constrained Simultaneous Perturbation Stochastic Approximation Technique

Mohammad Abdul Azim (Masdar Institute, UAE); Zeyar Aung (Masdar Institute of Science and Technology, UAE); Weidong Xiao (Masdar Institute, UAE); Vinod Khadkikar (Masdar Institute, UAE); Abbas Jamalipour (University of Sydney, Australia)

A RSS Based Statistical Localization Algorithm in WLAN

Lei Wang (National University of Singapore, Singapore); Wai-Choong Wong (National University of Singapore, Singapore)

Node Localization Algorithm Based on RSSI in Wireless Sensor Network

Suzhe Wang (Northwestern Polytechnical University, P.R. China)

Thursday, December 13

9:00 AM - 9:45 AM

Keynote Address - 1

Distributed Flat Wireless Networks

Abbas Jamalipour (The University of Sydney, Australia)

9:45 AM - 10:45 AM

Session 5: Communication Theory

Soft Iterative Interference Cancellation with Successive Over Relaxation for Digital Transmission Schemes based on Multiple Sets of Orthogonal Spreading Codes

Werner G. Teich (Ulm University, Germany); Paul Wallner (Ulm University, Germany)

OFDM Performance with Odd-Even Quantisation in Cartesian $\Delta\Sigma$ Upconverters

Sirmayanti Sirmayanti (Victoria University Melbourne Australia & The State Polytechnic of Ujung Pandang, Australia); Vandana Bassoo (University of Technology Mauritius, Mauritius); Horace King (VIctoria University, Australia); Mike Faulkner (Victoria University, Australia)

DMT Performance Analysis of a Symmetric Two-user Interference Channel with Multiple Full-duplex Relays

Yongxu Hu (Nanyang Technological University, Singapore); Kah Chan Teh (Nanyang Technological University, Singapore); Kwok Hung Li (Nanyang Technological University, Singapore)

A Low-Latency Turbo Decoding Scheme for Diversities-based Communication Systems

Shen-Ming Chung (National Cheng-Kung University, Taiwan); Ming-Der Shieh (National Cheng-Kung University, Taiwan); Kuo Lung-Chih (Industrial Technology Research Institute (ITRI), Taiwan); Hsaio-Hui Lee (Industrial Technology Research Institute, Taiwan)

11:15 AM - 12:30 PM

Session 6: Wireless Communications 2

Effect of UWB Multiple Access Schemes on the Power Parameters of Multiuser Interference

Joon-Yong Lee (Handong University, Korea); ChangKyeong Kim (Handong University, Korea)

Correcting Refractive Dilution of Precision in Wireless Network Geolocation Estimates
Jason Q McClintic (Naval Postgraduate School, USA); Murali Tummala (Naval Postgraduate School, USA); John C. McEachen (Naval Postgraduate School, USA)

D.C. Iterations for SINR Maximin Multicasting in Cognitive Radio
Anh Huy Phan (University of New South Wales, Australia); Hoang D. Tuan (University of Technology, Sydney, Australia); Ha H Kha (University of Technology Sydney, Australia)

Resource Allocation for AF Cooperative Communications Using Stackelberg Game
Hanan Al-Tous (United Arab Emirates University, UAE); Imad Barhumi (United Arab Emirates University, UAE)

Comparative study of transmit weight designs for nonregenerative Multiuser MIMO downlink relay system
Cong Li (Nagoya Institute of Technology & Graduate School of Engineering, Japan); Yasunori Iwanami (Nagoya Institute of Technology, Japan)

1:30 PM - 2:30 PM

Poster Session 1: Communication Systems - 1

Estimation of Distribution Algorithm for Green Resource Allocation in Cognitive Radio Systems
Muhammad Naeem (Ryerson University, Canada); Saeed Ashrafinia (Simon Fraser University, Canada); Daniel Lee (Simon Fraser University, Canada)

A Routing algorithm With Multiple Constrained Balanced Path for overlay network
Huijun Dai (Xi'an Jiaotong University, P.R. China); Hua Qu (Xi'an Jiaotong University, P.R. China); Jihong Zhao (Xi'an Jiaotong University, P.R. China)

Performance of Implemented 4x4 MIMO Receiver for 3G LTE Advanced System
Dae-Soon Cho (ETRI, Korea)

MAC Controller for Wireless Sensor Network on IEEE 802.15.4 Standard
Meng Zhang (Southeast University, P.R. China); Chenhao Wang (National ASIC Research Center, P.R. China); Xiao Shi (School of Information Eng., P.R. China); Liu Hao (Southeast University, P.R. China)

An Upper Audio Band based Low Data Rate Communication Modem
Rahul Sinha (TCS Innovation Labs, India); P. Balamuralidhar (Tata Consultancy Services, India); Rajeev Bhujade (Tata Consultancy Services, India)

Performance Analysis of AF Relaying Cooperative Systems with Relay Selection Over Double Rayleigh Fading Channels
Haci Ilhan (Yildiz Technical University, Turkey); Ayse Ipek Akin (Yildiz Technical University, Turkey)

On Scalability, Migratability and Cost-effectiveness of Next-Generation WDM Passive Optical Network Architectures
Chen Guo (National University of Singapore, Singapore); T T Tay (National University of Singapore, Singapore)

Performance of Pre-Rake Diversity Combining in UWB-IR Communications
Ryohei Nakamura (The University of Kitakyushu, Japan); Hiroki Ishikawa (The University of Kitakyushu, Japan); Akihiro Kajiwara (University of Kitakyushu, Japan)

RCS Measurements for Vehicles and Pedestrian at 26 and 79GHz
Isamu Matsunami (Nagasaki University, Japan)

Characterizing Energy and Deployment Efficiency Relations in Cellular Systems
Beomhee Lee (Yonsei University, Korea); Seong-Lyun Kim (Yonsei University, Korea)

2:45 PM - 3:45 PM

Poster Session 2: Signal Processing

Exploring the Implementation of JPEG Compression on FPGA

Ann De Silva (Massey University, New Zealand); Donald G. Bailey (Massey University, New Zealand); Amal Punchihewa (Massey University & Senior Lecturer, New Zealand)

A Block Based Temporal Spatial Nonlocal Mean Algorithm For Video Denoising With Multiple Resolution

Wenjie Yin (Shanghai University, P.R. China); Haiwu Zhao (Shanghai University, P.R. China); Guoping Li (Shanghai University, P.R. China); Guozhong Wang (Shanghai University, P.R. China); Guowei Teng (Shanghai University, P.R. China)

Robust encoded spread spectrum image watermarking in contourlet domain

Francisco Garcia-Ugalde (National Autonomous University of Mexico, Mexico); Manuel Cedillo-Hernandez (Universidad Nacional Autonoma de Mexico, Facultad Ingenieria, Mexico); Emilio Morales-Delgado (Universidad Nacional Autonoma de Mexico, Facultad de Ingenieria, Mexico); Bohumil Psenicka (National Autonomous University of Mexico, Mexico)

Subband adaptive filter algorithm based on normalized least mean fourth criterion

Jae Jin Jeong (POSTECH, Korea); Kyuhwan Kim (POSTECH, Korea)

Vector Equalization based on Continuous-Time Recurrent Neural Networks

Mohamad Mostafa (University of Ulm, Germany); Werner G. Teich (Ulm University, Germany); Juergen Lindner (Uni Ulm, Germany)

Sparse Signal Recovery on the Sphere: Optimizing the Sensing Matrix through Sampling

Yibeltal Fantahun Alem (The Australian National University, Australia); Daniel H. Chae (The Australian National University, Australia); Rodney Andrew Kennedy (The Australian National University, Australia)

Phase-Based Salient Object Detection

Jia Wan (the Hong Kong Polytechnic University, Hong Kong); Lam Kenneth Kin-Man (The Hong Kong Polytechnic University, Hong Kong)

Visual Quality Improvement of Digital Video by Stabilization using Adaptive CMAC Filtering

Amir Zahoor (Blekinge Institute of Technology, Karlskrona, Sweden); Wittaya Koodtalang (Blekinge Institute of Technology, Karlskrona, Sweden); Muhammad Shahid (Blekinge Institute of Technology, Karlskrona, Sweden); Benny Lövström (Blekinge Institute of Technology, Sweden)

On the Probability Density Function of the Product of Rayleigh Distributed Random Variables

Anushka Widanagamage (Queensland University of Technology, Australia); Anagiyaddage D. S. Jayalath (Queensland University of Technology, Australia)

Experimental Demonstration of Absolute Polar Duty Cycle Division Multiplexing

Amin Malekmohammadi (The University of Nottingham, Malaysia); Mohd Khazani Abdullah (SIGtech, Malaysia)

Modulation Frequency Domain Adaptive Gain Equalizer Using Convex Optimization

Rizwan Ishaq (Dept. of Elec. Engineering, University of Deusto, Bilbao, Spain); Muhammad Shahid (Blekinge Institute of Technology, Karlskrona, Sweden); Benny Lövström (Blekinge Institute of Technology, Sweden); Begoña García Zapirain (University of Deusto, Spain); Ingvar Claesson (Blekinge Institute of Technology, Sweden)

4:00 PM - 5:00 PM

Poster Session 3: Communication Systems – 2

An Enhanced Spectral Efficiency Chaos-Based Symbolic Dynamics Transceiver Design

Georges Kaddoum (LACIME laboratory, Canada); Francois Gagnon (Ecole de Technologie Superieure, Canada); Denis Couillard (Ultra Electronics TCS, Canada)

Weight Adjust Algorithm in Indoor Fingerprint Localization

Xin Song (Shanghai Jiao Tong University, P.R. China); Feng Yang (Shanghai Jiaotong University, P.R. China); Lianghui Ding (Shanghai Jiao Tong University, P.R. China); Liang Qian (Shanghai Jiao Tong University, P.R. China)

System Architecture for Autonomous Driving with Infrasturcture Sensors

Kyungbok Sung (ETRI, Korea); Dong-Yong Kwak (ETRI, Korea)

UltraWideband Wireless Channel in presence of atmospheric gases and refined engine oil

Ahmed Alshabo (University of Wollongong, Australia); David Stirling (University of Wollongong, Australia); Montserrat Ros (University of Wollongong, Australia); Peter J Vial (University of Wollongong, Australia); Tadeusz A. Wysocki (University of Nebraska-Lincoln, USA); Beata Wysocki (University of Nebraska-Lincoln, USA)

Robust Blind Multiuser Detection in DS-CDMA Systems over Nakagami-m Fading Channels with Impulsive Noise including MRC Receive Diversity

Pamula Vinay Kumar (MIC College of Technology, India); Srinivasa Rao Vempati (Anurag Engineering College, India); Habibulla Khan (KL University, India); Tipparti Anil Kumar (Kakatiya Institute of Technology and Science, India)

Low-Complexity Interference-Aware Single Relay Selection in Multi-Source Multi-Destination Cooperative Networks

Dawoon Lee (Yonsei University, Korea); Sooyong Choi (Yonsei University, Korea)

Improvement of Scatter Search Using Bees Algorithm

Ali Makki Sagheer (College of Computer - University of Anbar, Iraq); Ahmed Sadiq (Computer Science, Iraq); Mohammed Salah Ibrahim (Computer Science & Anbar University Computer College Computer Science Dept, Iraq)

A Behavior Analysis Based Mobile Malware Defense System

Dai Fei Guo (Siemens Corporate Technology, P.R. China); Ai-Fen Sui (Siemens Corporate Technology, P.R. China); Tao Guo (Siemens, P.R. China)

Novel Dynamic Shadow Approach for Fault Tolerance in Mobile Agent Systems

Rahul Hans (D A V Institute of Engineering and Technology, India); Ramandeep Kaur (Guru Nanak Dev University, Amritsar, India)

Polynomial approximations for bit error probability for 4-DPSK transmission

Sharon Lee (University of Queensland, Australia)

Reliable Cooperative Wideband Spectrum Sensing based on Entropy estimation

Srinu Sesham (Research & Hyderabad Central University, India); Samrat Sabat (University of Hyderabad, India); Siba Kumar Udgata (University of Hyderabad, India)

A Fuzzy Logic Node Relocation Model in WSNs

Yashar Maali (University of Technology Sydney, Australia); Ali Rafiei (University of Technology Sydney, Australia); Mehran Abolhasan (University of Technology Sydney, Australia); Daniel Franklin (University of Technology Sydney, Australia); Farzad Safaei (ICT Research Institute, University of Wollongong, Australia)

Friday, December 14

9:00 AM - 10:30 AM

Session 7: Medical Applications

Sampling, Quantization and Computational Aspects of the Quadrature Lock-In Amplifier
John Leis (University of Southern Queensland, Australia); Christopher J Kelly (University of Southern Queensland, Australia); David Buttsworth (University of Southern Queensland, Australia)

QRST Cancellation in ECG Signals During Atrial Fibrillation: Zero-Padding versus Time Alignment
Shima Gholinezhadasnefestani (University of Ulster, United Kingdom); Omar Escalona (University of Ulster, United Kingdom); Kimia Nazarzadeh (University of Pune, Australia); Vivek Kodoth (The Heart Centre Royal Victoria Hospital, Belfast- Northern Ireland, UK., United Kingdom); Ernest Lau (Royal Hospitals, United Kingdom); Ganesh Manoharan (Royal Hospitals, United Kingdom)

Empirical Study of Remote Respiration Monitoring Sensor Using Wideband System
Nao Shimomura (The University of Kitakyushu, Japan); Mitsugu Otsu (The University of Kitakyushu, Japan); Akihiro Kajiwara (University of Kitakyushu, Japan)

Infrared Camera Imaging Algorithm to Augment CT-Assisted Biopsy Procedures
Behrooz Sharifi (University of Southern Queensland, Australia); John Leis (University of Southern Queensland, Australia)

High Precision Ultrasonic Positioning Using Phase Correlation
Md. Omar Khyam (UNSW, Australia)

11:00 AM - 12:30 PM

Session 8: Networks and Protocols

User Traffic Classification for Proxy-Server based Internet Access Control
Saad Y. Sait (IIT Madras, India); M. Sandeep Kumar (IIT Madras, India); Hema A Murthy (Indian Institute of Technology Madras, India)

Semi-Decentralized Scheduling of Users in Heterogeneous WCDMA
Erik Geijer Lundin (Ericsson AB, Sweden); Katrina Lau (University of Newcastle, Australia); Graham C Goodwin (the University of Newcastle, Australia)

SCAR: A Dynamic Coding-aware Routing Protocol
Jin Wang (National University of Singapore, Singapore); Cenzhe Zhu (National University of Singapore, Singapore); Qinfeng Guo (National University of Singapore, Singapore); Teck Yoong Chai (Institute for Infocomm Research, Singapore); Wai-Choong Wong (National University of Singapore, Singapore)

A QoS enabled two-stage service differentiation model for the Internet
Flavius Pana (Katholieke Universiteit Leuven, Belgium); Ferdi Put (Katholieke Universiteit Leuven, Belgium)

Obtaining Application-based and Content-based Internet Traffic Statistics
Tomasz Bujlow (Aalborg University, Denmark); Jens M. Pedersen (Aalborg University, Denmark)

1:30 PM - 2:00 PM

Keynote Address - 2

From Complex Algorithms to Analog Electronic Circuits: Generalized Recurrent Neural Networks

Werner Teich (Ulm University, Germany)

2:00 PM – 3:00 PM

Session 9: Signal Processing for Multimedia 2

Translation-Invariant Motion Perception for Multiple Objects Using Grid Partitioning Representation
Mio Nishiyama (The University of Tokyo, Japan); Tadashi Shibata (The University of Tokyo, Japan)

A 3-D Mesh Watermarking with Uncomplicated Frequency Selectivity
Taichi Nonoshita (Ehime University, Japan); Toshiyuki Uto (Ehime University, Japan); Katsuhiro Ichiwara (Ehime University, Japan); Kenji Ohue (Ehime University, Japan)

Initial contour independent level set image segmentation method using synergetic vector flow fields
Krisorn Chunhapongpipat (Chulalongkorn University & Faculty of Science, Thailand); Ratinan Boonklurb (Chulalongkorn University, Thailand); Sirod Sirisup (National Electronics and Computer Technology Center, Thailand); Rajalida Lipikorn (Chulalongkorn University, Thailand)

Classifier Selection using Sequential Error Ratio Criterion for Multi-Instance and Multi-Sample Fusion
Vishnu Nallagatla (Queensland University of Technology, Australia); Vinod Chandran (Queensland University of Technology, Australia)

3:30 PM - 5:00 PM

Session 10: Signal Processing for Communications

Efficient Computation of Commutative Anisotropic Convolution on the 2-Sphere
Zubair Khalid (The Australian National University, Australia); Rodney Andrew Kennedy (The Australian National University, Australia); Parastoo Sadeghi (The Australian National University, Australia)

Multiplicative and Additive Perturbation Effects on the Recovery of Sparse Signals on the Sphere using Compressed Sensing
Yibeltal Fantahun Alem (The Australian National University, Australia); Daniel H. Chae (The Australian National University, Australia); Rodney Andrew Kennedy (The Australian National University, Australia)

Enhancement of Printed Log-periodic Dipole Array Antenna Performance using Fractal Koch Geometry
Achmad Munir (Institut Teknologi Bandung, Indonesia); Devy Freshia (Institut Teknologi Bandung, Indonesia); Chairunnisa Chairunnisa (Institut Teknologi Bandung, Indonesia)

Further Results on the WLS Design of Variable Fractional Delay Filters
Chuan-Wei Chu (Curtin University, Australia); Yee Hong Leung (Curtin University, Australia)

Improving the Performance of the Time-of-Arrival Estimator in MIMO Systems

Li Zhang (National University of Singapore, Singapore); Yong Huat Chew (Institute for Infocomm Research, Singapore); Wai-Choong Wong (National University of Singapore, Singapore)

Order-4 Quasi-Orthogonal Cooperative Communication in STFC MB-OFDM UWB

Zixuan Lin (University of Wollongong, Australia); Le Chung Tran (University of Wollongong, Australia); Farzad Safaei (ICT Research Institute, University of Wollongong, Australia); Tadeusz A. Wysocki (University of Nebraska-Lincoln, USA)

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2.5. *Full-Reference Video Quality Assessment on High-Definition Video Content*, Steffen Wulf (Helmut-Schmidt-University Hamburg, Germany), Udo Zölzer (Helmut-Schmidt-University Hamburg, Germany)

2.6. *Quality Based Frame Selection For Video Face Recognition*, Kaneswaran Anantharajah (Queensland University of Technology, Australia), Simon Denman (Queensland University of Technology, Australia), Sridha Sridharan (Queensland University of Technology, Australia), Clinton Fookes (Queensland University of Technology, Australia), Dian Tjondronegoro (Queensland University of Technology & Smart Services CRC, Australia)

Session 3 – Information and Network Security

3.1. *Slide Attacks on the Sfinks Stream Cipher*, Ali Alhamdan (Queensland University of Technology, Australia), Harry Bartlett (Queensland University of Technology, Australia),Edward Dawson (Queensland University of Technology, Information Security Institute, Australia), Leonie R Simpson (Queensland University of Technology, Australia), Kenneth Koon-Ho Wong (Queensland University of Technology, Australia)

3.2. *Elliptic Curves Cryptographic Techniques*, Ali Makki Sagheer (College of Computer - University of Anbar, Iraq)

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A not-for-profit organization, IEEE is the world's largest technical professional organization dedicated to advancing technology for the benefit of humanity.

Message from the General Chairman

On behalf of the Organizing Committee, it is our pleasure to welcome you to the 6th International Conference on Signal Processing and Telecommunication Systems, ICSPCS'2012, at the Gold Coast, Australia. The roots of ICSPCS go back to a series of successful symposia and workshops, namely, the International Symposia on DSP and Communication Systems (DSPCS), and Workshops on the Internet, Telecommunications and Signal Processing (WITSP). Accordingly, the topics covered by ICSPCS stretch over the entire protocol stack of modern telecommunication systems from the physical and data link layers to networking and application layers along with the related processing, applications, and services. The technical program for this year covers a range of topics such as wireless communications, communications theory, communication systems, networks and protocols, information and network security, localization and tracking, signal processing for multimedia and communications, and medical applications. One of the main goals of this international conference is to bring together researchers and scientists from academia and industry that work in the aforementioned areas to present and discuss their latest research results, explore new ideas and solutions, and to facilitate networking among colleagues. As in the previous years, the Organizing Committee has succeeded in achieving an official technical co-sponsorship of the IEEE Communications Society for the conference. As a result, ICSPCS'2012 has been listed in the IEEE database of conferences and the proceedings will be published in IEEEXplore.

This year, a total of **306** papers were submitted from **36** countries from **Asia, Australia, Europe, Middle-East, Africa, and Americas**. Based on the results obtained from a rigorous peer review process with at least three peer reviews per paper, the program committee finally accepted **52** full papers for oral presentation and **34** papers for poster presentation at the conference. To complement the program, the Organizing Committee invited two keynote speakers: Professor Abbas Jamalipour of the University of Sydney, Australia and Dr. Werner Teich of the University of Ulm, Germany.

As putting together and organizing an international conference is a team effort, we wish to thank the authors for preparing and submitting their contributions to ICSPCS'2012. We would like to thank the technical program committee and reviewers for their hard work to ensure a high quality program. We express our sincere gratitude to our sponsors for their great support: IEEE, IEEE Communications Society, and The Peter Kiewit Institute.

We hope that you will find this edition of the international conference interesting and we wish you all a pleasant and enjoyable stay at the beautiful Gold Coast, Australia!

Hans-Jürgen Zepernick
General Chair, ICSPCS'2012