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GUEST EDITORIAL

Introduction to the special issue on software defined radio: selected papers from the Wireless Innovation Forum's SDR'10

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This special issue contains extended articles based on the best papers of the research and development track of the SDR'10 Technical Conference and Product Exposition organized by the Wireless Innovation Forum.

The Wireless Innovation Forum (previously known as the SDR Forum) was established in 1996. The Wireless Innovation Forum™ is a non-profit "mutual benefit corporation" dedicated to driving technology innovation in commercial, civil, and defense communications around the world. Forum members bring a broad base of experience in Software defined radio (SDR), Cognitive radio (CR) and dynamic spectrum access (DSA) technologies in diverse markets and at all levels of the wireless value chain to address emerging wireless communications requirements through enhanced value, reduced total life cost of ownership, and accelerated deployment of standardized families of products, technologies, and services. The Forum acts as the premier venue for its members to collaborate to achieve these objectives, providing opportunities to network with customers, partners and competitors, educate decision makers, develop and expand markets and advance relevant technologies.

The Technical Conference was first established in 1992 after a highly successful workshop held in 1991. Now attracting a broad range of over 500+ registered delegates including researchers, professors, industry developers, investors, commercial network operators, radio manufacturers, system integrators, government procurement officials, regulators, engineering service providers and consultants from over 22 different countries, the conference is the only event devoted to the advancement of reconfigurable radio technologies from research through deployment.

This special issue specifically highlights extended versions of the best Research and Development (R&D) papers from the 2010 conference. These papers were evaluated by world experts in SDR, CR, DSA and communications system design. Academically focused and reviewed, these papers represent the leading edge of research in this area.

The first six articles in this special issue discuss topics related to baseband processing in SDR systems. Ahn et al. consider general-purpose graphics processing unit (GPU) as a SDR platform. The article compares implementations of WiMAX system on GPU and multiple-issue DSP processor and the experiments on baseband processing functions show significant speed-ups when massively parallel GPU is used. Noguera et al. consider field programmable gate array (FPGA) as the SDR platform. The article shows implementation of sphere detector where the design is obtained by using high-level synthesis tools. The article shows that the high-level approach allows designer to concentrate on improving the design for saving the FPGA resources. Computational complexity of software defined DVB-T2 modulator and demodulator is discussed in Grönroos et al. The study is based on GNU radio

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implementation but the article considers also alternative implementation technologies for the most demanding functions, e.g., GPU and FPGA. Palenik and Farkas propose receiver modifications to OFDM modulation based systems. The cyclic prefix is interpreted as a repetition code for increasing the error correcting capability in reception. The provided simulations show improvement with fading channels. Gomez et al. in turn consider the power control strategies for SDR systems; trade-off between radiated power at transmitter and receiver energy consumption is discussed. The article shows a model for computational requirements of baseband processing as a function of SNR, which allows joint transmitter and receiver energy consumption optimization.

The next two articles discuss design methodologies for SDR systems. Yang et al. discuss antenna design strategies for SDR systems. There are several antenna miniaturization techniques available but they typically result in decreased efficiency and/or reduced bandwidth. The paper shows a design example for a multifunctional ultra-wideband antenna used with a flexible RF front end. Castrillon et al. introduce a tool flow and environment for component based waveform development. The tool maps waveform kernels onto given platforms according to given constraints. The tool supports heterogeneous parallel platforms and helps in partitioning and scheduling parallel code. The paper shows a case study where the same transceiver design is implemented on different platforms.

Extensions to SDR instruction set architecture are discussed in two articles. Senthilvelan et al. investigate hyperbolic CORDIC instruction extensions for improving the performance of low-density parity-check decoding. The experiments show significant speed-ups with power consumption savings compared to baseline architecture. Jenkins et al. introduce extensions to instruction set architecture for accelerating confidentiality and integrity algorithms specified by 3GPP. The extensions are analyzed in terms of area and power consumption and compared to a baseline architecture. The results show that the proposed extensions produce significant improvements in the energy-efficiency.

The next three articles discuss topics related to software communication architecture. Kim et al. present implementations of smart antenna and transceiver application programming interfaces defined by WINNF. The implementation is based on an open-source SDR development. The article describes experiments, which verify the operation of the application programming interfaces. Bernier et al. explore the differences between one and two-way messaging in SCA compliant radios and compare the throughput of the messaging types. The article also describes the common pitfalls with both the messaging types. Cao et al. describe a rapid development of public safety waveform defined by JTRS program. The article shows that the proposed three-step methodology can speed-up waveform porting and development for standardized architecture.

There are three articles related to cognitive radio. Amanna et al. discuss Grey systems theory and apply it to wireless communications. The article proposes an automatic modulation classifier based on Grey relational analysis. The proposed approach requires no training or configuration. Ramkumar et al. propose cognitive radio receivers where the parameters of blind equalizer are adapted according to the cost of automatic modulation classification and symbol detection. The article formulates a suitable cost function and the performance is analyzed with the aid of simulations. Li et al. propose ontology and policy based method for adapting parameters of cognitive radio. Ontology is used for classifying various terms in lowest layers in wireless communication systems. Policy rules, in turn, are used to control the radio. The proposed approach is illustrated by implementing link optimization on GNU radio. Dhillon et al. propose a sub-space method for detecting multiple narrow-band frequency-modulated signals in low SNR conditions. The approach uses detector based on singular value decomposition. The applicability of the method is illustrated by using wireless radio microphones as signal source.

The last three articles discuss regulatory issues related to SDR systems. Aguayo González and Reed consider power fingerprinting in SDR integrity assessment. The article demonstrates how external power fingerprinting can be used to monitor execution status the system. This approach can be used for regulatory compliance assessment and intrusion detection. Zetterman et al. consider coexistence of multiple radios. The article proposes a multi-radio SDR control architecture with generic interfaces, which allows new radios to be connected to the system such that the existing and new radios adapt their behavior. The applicability of the control architecture is demonstrated with the aid of practical experiments. Datla et al. discuss cooperation of radio nodes in wireless distributed computing networks. The paper proposes a task allocation and scheduling algorithm for minimizing the energy consumption and makespan in collaborative applications. The proposed algorithm has been analyzed with the aid of simulations.

As guest editors of this special issue, we sincerely thank the authors for their valuable contributions and all the anonymous reviewers for their feedback and help in ensuring a high level of quality. We also extend our appreciation to Janani Kalidasan and S. Shenbagam for their help on setting up this issue. We hope that you enjoy the articles of the special issue and find the articles informative and useful.

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