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 DOI 10.1515/freq-2012-0045 — Frequenz 2012; 66(9–10): 239–240

Editorial

On March 7/8, 2012, more than eighty researchers in the field of wireless communications from eleven nations attended the 7th Karlsruhe Workshop on Software Radios. Out of the 26 papers presented at this conference we chose eight to contribute to this special issue of FREQUENZ.

The concept of cloud computing, where computing resources are dynamically allocated in a network may be extended for operating future radio communications standards. A software defined radio cloud data center with distributed antennas may provide wireless services to a large area with millions of user sessions per day. In their contribution *Tools for Analyzing Computing Resource Management Strategies and Algorithms for SDR Clouds*, the authors Vuk Marojevic, Ismael Gomez-Miguelez, and Antoni Gelonch present different mapping algorithms that allocate the computation resources to different cores. Different scenarios were simulated and the algorithms' performances were investigated. The computing resource management tools developed are made available for free download.

One of the main features of Software-Defined Radios (SDR) is their flexible adaptivity to different communication standards. In their paper *An Optimization Algorithm for SDR Multi-Standard Systems Using Directed Hypergraphs*, Patricia Kaiser, Amine El Sahili, and Yves Louët develop a tool that helps finding the optimal implementation for a given set of communication standards. To achieve this goal, a cost function is introduced, that takes computational costs as well as building costs into account. Using graph theory, it is shown that the proposed algorithm leads to a minimum cost design of the SDR implementation.

The flexibility offered by a SDR often comes at the cost of increased processing delay. This delay can be critical in Carrier Sense Multiple Access (CSMA) protocols due to strict timing requirements. The idea presented by André Puschmann, Mohamed A. Kalil, and Andreas Mitschele-Thiel in their article *A Flexible CSMA based MAC Protocol for Software Defined Radios*, describes a protocol that separates the time critical channel sensing block from the core block. This separation allows to experiment with different channel sensing blocks that could be implemented on an FPGA or on the host computer, without changing the rest of the MAC layer. They evaluate the performance of the modified protocol in terms of maximum throughput, saturation throughput and fairness.

Program making and special events (PMSE) systems are of paramount interest for the information and entertainment industries. Corresponding devices are employed in opera houses, on stages, and for all events that call for live radio transmission of voice, music, video, or data. The article *A Spectrum Sensing Network for Cognitive PMSE Systems* by Johannes Brendel, Steffen Riess, Andreas Stoeckle, Rafael Rummel, and Georg Fischer provides an overview over an experimental spectrum management system that is planned by the Cognitive (C-) PMSE project funded by the German Federal Ministry of Economics and Technology (BMWi). The paper describes the physical components of the spectrum sensing network as well as the system's information storage and learning mechanisms in some detail. It is pointed out that the spectrum sensing network of the C-PMSE project may be extended to a universal research platform for general cognitive radio devices, networks and applications.

Ziad Khalaf and Jacques Palicot in their paper *On the Use of the Sparse Property of the Cyclic Autocorrelation Function to Blindly Estimate the Cyclostationarity* propose a new method to estimate the cyclic autocorrelation vector (CAV) of linearly modulated signals. This method is based on a compressed sensing technique and turns out to work blindly, i.e. no a priori information is needed for the estimation process. The new CAV estimation algorithm is compared with the classical method proposed by Dandawate and Giannakis in 1994. As performance metrics for the estimates the authors use a mean square error type 1 between the theoretical and the estimated CAV as well as a mean square error type 2 that measures the deviation in the estimation of the cyclic frequency. Concluding from their evaluations performed in the present contribution, they claim that their estimator, which may for example be employed in spectrum sensing for cognitive radio, outperforms the classical method.

It is well known that cyclostationary features introduced into a communications signal by its internal structure may be easily identified at the receiver side. Those features are inherently defined by the physical layer description of a radio standard. The contribution *Extended Cyclostationary Signatures for OFDM in the Presence of Hardware Imperfections* by Johannes Schmitz, Milan Zivkovic, and Rudolf Mathar uses such signatures to make information about the carrier frequency, the occupied bandwidth and the modulation scheme used by the subcarriers available at the receiver. Theoretical investigations as well as experiments carried out with GNU radio and Universal Software Radio Peripherals (USRPs) indicate that cyclostationary detection is well suited for low SNR scenarios. However, the authors also report about susceptibility of the cyclostationary detector to carrier frequency and sampling rate offset impairments.

One of the main problems of practical implementation of software radios is the performance of the RF-front end which must work over a wide bandwidth. The different amplifiers, being part of the RF-front end, as well as the analog-to-digital conversion lead to non-linear distortions. Michael Grimm, Rajesh Kumar Sharma, Matthias Hein, and Reiner Thomä in their contribution *DSP-based Mitigation of RF Front-end Non-linearity in Cognitive Wideband Receivers* propose a feed-forward non-linear filter to reduce intermodulation products. Their focus is on the analysis and the gradual reduction of the non-linearity for reliable spectrum sensing, such that on the one hand weak signals are properly detected and transmit opportunities are not missed on the other. Measurements with low-cost SDR hardware show that this approach is feasible and may reduce intermodulation products

With their paper *System-Level Mitigation of Undersampling ADC Nonlinearity for High-IF Radio Receivers* Georg Vallant, Michael Epp, Markus Allén, Mikko Valkama, and Friedrich K. Jondral show that correction of the analog-to-digital converter (ADC) output in order to increase the spurious-free dynamic range (SFDR) when undersampling the incoming signal at an intermediate frequency (IF) that is located in a high, i.e. fifth or seventh, Nyquist zone is effective. The proposed system-level post-correction decomposes the ADC's nonlinearity into a static and a dynamic part. In the post-correction procedure, the integral nonlinearity related distortion can be reduced by a look-up table based correction; the dynamic post-correction is tackled by a parallel Hammerstein model derived from a Volterra series model. After an elaborate discussion of the underlying theoretical investigations, experimental results are presented for two different ADCs that show improvements of the SFDR in higher Nyquist zones of up to 15 dB.

To conclude, we hope that all readers enjoy the paper published in this special issue and thank all authors of the 7th Karlsruhe Workshop on Software Radios for their excellent contributions and for making this conference a great success.

Karlsruhe, July 2012

Friedrich K. Jondral
Michael S. Mühlhaus