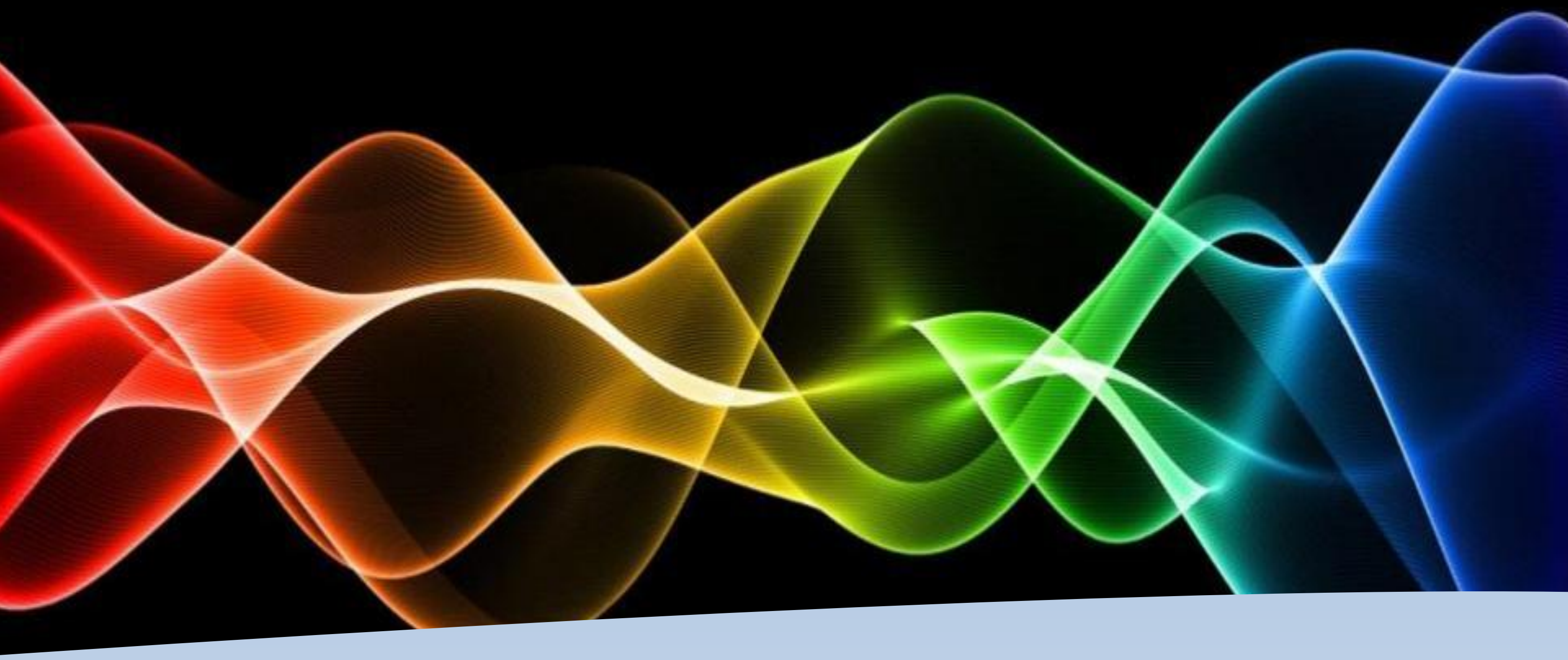
NEWSDR 2013



3rd Annual New England Workshop for Software Defined Radio

Worcester Polytechnic Institute
Worcester, MA

Friday, May 17, 2013

Sponsored By:

BEEcube, National Instruments, SDR-Boston (Boston SDR User Group), Xilinx, MathWorks, WPI, Wireless Innovation Laboratory, Nutaq (Innovation Today for Tomorrow)

Welcome

On behalf of the Boston Software Defined Radio User Group (SDR-Boston), we would like to sincerely welcome you to the third installment of the New England Workshop on Software Defined Radio – NEWSDR 2013 – located on the beautiful campus of Worcester Polytechnic Institute.

These are exciting times for anyone interested in software defined radio (SDR) technology. Ever since their initial introduction to the wireless community in the 1970s, SDR has rapidly emerged as a revolutionary technology that has changed the way individuals communicate with each other, touching all members of society across a continuously growing number of applications. Public safety operations, military missions, automotive networks, and educational activities are some of the many examples of how SDR technology have affected the way we communicate with each other wirelessly.

During this event, we would like to encourage all of you to engage in conversation with your fellow attendees, exchange ideas, and talk about your latest findings with respect to SDR. We hope that you will find NEWSDR 2013 a productive event to expand your knowledge and horizons regarding SDR technology, and we would like to wish you a very positive and rewarding workshop!

ORGANIZING COMMITTEE

Travis Collins
Worcester Polytechnic Institute

George Eichinger
MIT Lincoln Laboratory

Scott Johnston
MIT Lincoln Laboratory

Neel Pandeya
Draper Laboratory

Michael Rahaim
Boston University

Alexander Wyglinski
Worcester Polytechnic Institute

"WAVES" INTERACTIVE SOUND INSTALLATION ARTIST: DANIEL PALACIOS

NEWSDR 2013

Agenda

8:30	**8:45**	**Welcome and Introduction**
8:45	**9:10**	Showcase of a complete MIMO OFDM PHY Layer FPGA implementation using Simulink & System Generator tools. ***Jean-Benoit Larouche, Universite de Laval***
9:10	**9:20**	Walk through of the migration of a PHY-related algorithm between a PC and an FPGA: facilitated by GNU Radio, Simulink and System Generator for DSP. ***Tristan Martin, Nutaq***
9:20	**9:30**	Nutaq SDR Systems Overview. ***Martin Turgeon, Nutaq***
9:30	**10:15**	**Invited Presentation**: Showcase of a complete MIMO OFDM PHY Layer FPGA implementation using Simulink & System Generator tools. ***Dr. Kapil Dandekar, Drexel University***
10:15	**10:45**	Coffee Break, Posters and Demos
10:45	**11:30**	Simplifying FPGA Design for SDR with a Network on Chip (NoC) Architecture. ***Matt Ettus, Ettus Research / National Instruments***
11:30	**12:00**	Benchmarking GNURadio on Various General Purpose Processing Architectures. ***Nathan West, US Naval Research Laboratory***
12:00	**1:00**	Lunch, Posters and Demos
1:00	**2:00**	**Keynote Presentation**: Reinventing Network Architecture. ***Dr. Joseph Evans, The University of Kansas***
2:00	**2:30**	A Methodology for Designing Scalable SDR Systems. ***Erich Whitney, The MITRE Corporation***
2:30	**3:00**	Software Defined Radio and Geophysics. ***Juha Vierinen, MIT Haystack Observatory***
3:00	**3:30**	Coffee Break, Posters and Demos
3:30	**4:15**	Software Defined Radio in MATLAB. ***Mike McLernon, Mathworks***
4:15	**5:15**	Tutorial: Hands-On Experimentation Using Simulink and Matlab. ***Travis Collins, WPI; Mike McLernon, Mathworks; Alex Wyglinski, WPI***
5:15	**5:30**	Concluding Remarks

Keynote Presentation

Reinventing Network Architecture

1:00pm - 2:00pm

Dr. Joseph Evans, University of Kansas

Networks have become complex systems incorporating wired and wireless technologies serving increasingly data intensive and critical applications. At the same time, the ongoing revolution in computing and communications has changed many of the foundational assumptions underlying today's network architectures. These changes offer opportunities for novel approaches to operations, control, and management of networks. In this talk, we will review the evolution of software defined radios and software defined networks, and discuss how the scope and scale of networks and data use can utilize more flexible and adaptive system architectures.

Joseph B. Evans is the Deane E. Ackers Distinguished Professor of Electrical Engineering & Computer Science at the University of Kansas (KU). He has served as Director of the Information & Telecommunication Technology Center and as Director of Research Information Technology at KU. Dr. Evans served as a Program Director at the National Science Foundation from 2003 to 2005, where he ran programs in cybersecurity and wireless networking, and was responsible for starting the NSF cognitive and software defined radio program. He has been a researcher at the Cambridge University Computer Laboratory, Olivetti & Oracle Research Laboratory, USAF Rome Laboratories, and AT&T Bell Laboratories. He has co-founded several companies, including a network gaming company acquired by Microsoft in 2000 which formed the foundation for XBox Live, and a defense-oriented venture acquired by General Dynamics in 2010 which developed TIGR, the tactical information system used worldwide by the US military. As part of the TIGR effort, he served as an embedded professor twice in Iraq and once in Afghanistan. His research interests include cognitive wireless networking, networked information systems architecture, and adaptive systems. He received the Ph.D. from Princeton University in 1989.

Invited Presentation

Cognitive Antennas and Testbed for the SDR Research Community

9:30am - 10:15am

Dr. Kapil Dandekar, Drexel University

The Drexel Wireless Systems Laboratory (DWSL, wireless.ece.drexel.edu) seeks to demonstrate the feasibility of next generation wireless systems through the design, construction, and testing of prototype wireless hardware. Cognitive radio builds upon the flexibility in physical layer algorithm implementation delivered by Software Defined Radio (SDR) to include assessment of, and adaptation to, the surrounding radio environment. In this presentation, we summarize our research in electrically reconfigurable antennas and demonstrate how these antennas can provide a valuable degree of freedom to cognitive radios (i.e., "cognitive antennas"). Cognitive antennas have the ability to dynamically change their radiation characteristics in response to the needs (broadly defined) of the overlying link and network. We investigate a variety of architectures for cognitive antennas and quantify how they can improve communication links through pattern diversity. We will present several case studies of how these antennas can be used in current and emerging communication networks with algorithms geared towards throughput maximization, interference suppression, interference alignment, encryption key generation, and user authentication. Measurement results are also included to support these concepts and motivate the release of a new Software Defined Communication (SDC) testbed developed by DWSL.

Kapil R. Dandekar received the B.S. degree in Electrical Engineering (1997) from the University of Virginia, Charlottesville, VA; the M.S. and Ph.D. degrees in Electrical and Computer Engineering from the University of Texas at Austin (1998,2001), Austin, TX. Beginning in 2001, he joined the faculty at Drexel University in Philadelphia, PA. He is currently an Associate Professor in Electrical and Computer Engineering at Drexel University; the Director of the Drexel Wireless Systems Laboratory (DWSL); Associate Dean for Research in the Drexel University College of Engineering. Dandekar's research has been supported by the U.S. National Science Foundation, Army CERDEC, National Security Agency, Office of Naval Research, and private industry. Dandekar's current research interests and publications involve wireless, ultrasonic, and optical communications, reconfigurable antennas, and smart textiles. Antenna technology from DWSL has been licensed by external companies for technology commercialization. The Software Defined Communication (SDC) testbed developed by DWSL is currently being released for adoption in the academic and industrial research community.

Technical Presentations

A Methodology for Designing Scalable SDR Systems

2:00pm - 2:30pm

Erich Whitney, The MITRE Corporation

MITRE's Software Defined Radio (SDR) development encompasses a wide variety of applications across communications, sensors, and navigation. This presentation discusses MITRE's methodology used to develop large, scalable, Field Programmable Gate Array (FPGA) based SDR systems. The process starts with up-front radio frequency (RF) planning, then explores analog and digital signal processing tradeoffs, and completes with component-based waveform design, implementation, verification, validation, and deployment. This methodology, developed through many years of experience, has resulted in multiple SDR systems successfully deployed to sponsor operations, hand-off to military contractors, and ground-breaking field experiments.

Erich Whitney has over twenty years of digital design experience in image processing, ASIC development, internet routers, and FPGA-based signal processing systems. He received his BSEE and MSEE degrees from the University of New Hampshire, College of Engineering and Physical Sciences and has been with MITRE for just over five years. He is currently the Group Leader of the Digital Architecture Group in department E536, Electronic Systems Development where his work is focused on developing FPGA-based SDR systems.

Benchmarking GNU Radio on Various General Purpose Processing Architectures

11:30am - 12:00pm

Nathan West, US Naval Research Laboratory

The growth of Software Defined Radio (SDR) using general purpose processors (GPPs) brings a new engineering decision of processor selection to radio design. Processor selection is an important engineering decision that affects size, weight, power, and data throughput of a SDR. We approach the problem by benchmarking a variety of general-purpose processors using the GNU Radio framework. We present a methodology of benchmarking for SDR, an integrated set of tools for benchmarking, and results from select processors. Specific results compare processors against each other as well as comparing performance with SIMD optimized code and non-SIMD code.

Nathan West is an electrical engineer at the United State Naval Research Laboratory and a PhD student at Oklahoma State University. He recently finished an MS degree at Oklahoma State University with a thesis on physical layer watermarking using phase dithering. He is interested in physical layer security, and beam shaping techniques.

Technical Presentations

Software Defined Radio and Geophysics

2:30pm - 3:00pm

Juha Vierinen, MIT Haystack Observatory

We present software defined radio implementations of various geophysical instruments, such as an ionosonde, a riometer, a beacon satellite ionospheric tomography receiver, and an HF radar system. We also discuss our experiences with using off-the-shelf software defined radio hardware as digital receivers for high power large aperture radars and ionospheric heaters.

Juha Vierinen was born in Finland in 1979. He received the M.Sc., and Ph.D. degrees from the Helsinki University of Technology, Espoo, Finland, in 2005 and 2012, respectively.

He joined the Sodankyla Geophysical Observatory, Sodankylä, Finland, in 2006. Since 2013, he has been with the MIT Haystack Observatory in Westford, MA, where he is currently a post doctoral associate. He has worked with several high power large aperture radar facilities, including the European Incoherent Scatter Radar Association in Fenno-Scandinavia and the Jicamarca Radio Observatory in Peru.

His main research interest is applying the methods of statistical inverse problems to geophysical radar and radio measurements, with the help of software defined radio. Topics of this research include: ionospheric incoherent scatter radar, planetary radar, space debris, meteor radar, HF radar, beacon satellite tomography, riometers and ionospheric sounders. This ongoing work has resulted in a large number of publications, and the release of the GNU Chirp Sounder and GNU Ionospheric Tomography Receiver open source software packages.

Showcase of a complete MIMO OFDM PHY Layer FPGA implementation using Simulink & System Generator tools.

8:45am - 9:10am

Jean-Benoit Larouche, Universite de Laval

Multimode tunable RF SDR Systems. The powerful Virtex-6 FPGA is used to implement the baseband OFDM modulator/demodulator. The tunable RF section (Radio420x), from its Zero-IF architecture, takes the digital-baseband OFDM modulated packets and brings their spectral contents on a frequency range configurable from 300 MHz to 3 GHz. Demodulated data are exchanged with external host (Matlab) for analysis and/or for the upper communication layers. An application showcases continuous wireless HD video transmission between TX & RX section.

Highlights:

- 2x2 MIMO Implementation
- Simulation/Implementation from the same source model
- Model-based using Xilinx System Generator (Simulink models)
- HD wireless video transmission case example
- QAM 64 modulation scheme

Sponsor Presentations

Simplifying FPGA Design for SDR with a Network on Chip (NoC) Architecture

10:45am - 11:30am

Matt Ettus, Ettus Research LLC/National Instruments

As wireless communication systems grow more complex, researchers are forced to adopt heterogeneous computation approaches that combine the strengths of general purpose processors and Field Programmable Gate Arrays (FPGAs). This combination leads to increased computational bandwidth and reduced latency, but it comes at the cost of increased development complexity. Beyond the usual correctness requirements of any design, FPGAs also impose resource limits and timing closure requirements along with long compile-run-test cycle times which slows down the design process and forces algorithm designers to become intimately familiar with design components outside of their normal area of interest.

Third Generation Universal Software Radio Peripheral (USRP) devices from Ettus Research have been developed with a unique processing architecture based around a Network on Chip. This allows for separate, easily composable processing blocks which may operate in their own clock domains. Blocks communicate with each other over a network which handles routing and flow control automatically, and carries both data and control together. Data can be in packet or streamed format as appropriate. Designers can create individual blocks which can be dynamically connected to form complex flow graphs. Additionally, the network can transparently be extended between chips and to multiple boards connected by various forms of interconnect like 10 Gigabit Ethernet and PCI Express.

Matt Ettus is a core contributor to the GNU Radio project, a free framework for Software Radio, and is the creator of the Universal Software Radio Peripheral (USRP). In 2004, Matt founded Ettus Research to develop, support and commercialize the USRP family of products. Ettus Research was acquired by National Instruments in 2010, and Matt continues as its president. USRPs are in use in over 100 countries for everything from cellular and satellite communications to radio astronomy, medical imaging, and wildlife tracking. In 2010, the USRP family won the Technology of the Year award from the Wireless Innovation Forum.

In the past Matt has designed Bluetooth chips, GPS systems, and high performance microprocessors. Before that, he received BSEE and BSCS degrees from Washington University and an MSECE degree from Carnegie-Mellon University. In 2011, Matt was named an eminent member of Eta Kappa Nu. He is based in Mountain View, CA.

Sponsor Presentations

Walk through of the migration of a PHY-related algorithm between a PC and an FPGA: facilitated by GNU Radio, Simulink and System Generator for DSP

9:10 am - 9:20 am

Tristan Martin, Nutaq

Development and implementation of narrowband- SISO wireless waveforms can be performed easily by feeding RF to today's high end processors, such as the new Quad Core™ i7 family of processors from Intel®. But when it comes to wideband, multi-user, or MIMO waveforms, processors rapidly struggle to achieve real-time implementation, eventually requiring parallel processor computing.

Including an FPGA between the RF module and the computer drastically reduces the load on the CPU by offloading high-speed and high-parallel computing PHY-related algorithms, as well as reducing the power consumption, highly desirable for portable applications. The combined system of GNU Radio for PC plus System Generator for FPGA provides the ideal environment to accelerate radio waveform development on a mixed PC-FPGA hardware architecture.

In this session, we will walk through a simple demonstration that shows how it easy to migrate PHY-related algorithms from the PC to an FPGA in order to drastically free-up the processor load. Two whitepapers will be made available:

- Advanced MIMO Waveform Deployment Using GNU Radio
- Offloading GNU Radio Processing with FPGA Logic

Nutaq SDR Systems Overview

9:20am - 9:30am

Martin Turgeon, Nutaq

Software Defined Radio in MATLAB

3:30pm - 4:00pm

Mike McLernon, Mathworks

MATLAB is an oft-used tool to perform communications system analysis, modeling, and simulation. In the last few years, it has grown a capability to participate in SDR design by interfacing to USRP(R) hardware. This presentation will show how MATLAB-authored System objects can be used to hierarchically design a digital transmitter and receiver. It will also show how code generation can be used to accelerate the receiver's execution.

Mike McLernon serves as a manager overseeing the development of Communications System Toolbox and adjacent software-defined radio capabilities. He has been with MathWorks since 2001, and has worked in the communications field for over 25 years, in both the satellite and wireless industries. Mike has a B.S.E.E. from the University of Virginia and an M.E.E.E. from Rensselaer Polytechnic Institute.

Poster Presentations

Primary User Emulation Detection Using Frequency Domain Action Recognition

Di Pu, Worcester Polytechnic Institute

In this project, we propose an approach for detecting primary user emulation attacks in cognitive radio networks based on the video processing method of action recognition. Specifically, we apply this method to analyze the FFT sequences of wireless transmissions operating across a cognitive radio network environment, as well as classify their actions in the frequency domain. Built upon the previous approach proposed by the authors, this new approach is initiated via energy detection to locate the existing wireless transmissions within a specific frequency band. The approach employs a covariance descriptor of motion-related features in the frequency domain, which is then fed into an artificial neural network for classification. The proposed approach is validated via computer simulations as well as by experimental hardware implementations using the USRP2 software-defined radio (SDR) platform. The computer simulations show that our new approach overcomes the limitations from the authors' previous approach.

Implementation and Analysis of Spectral Subtraction and Signal Separation in Deterministic Wide-Band Anti-Jamming Scenarios

Travis Collins, Worcester Polytechnic Institute

With the increasing volume of wireless traffic that military operations require, the likelihood of transmissions interfering with each other is steadily growing to the point that new techniques need to be employed. Furthermore, to combat remotely operated improvised explosive devices, many ground convoys transmit high-power broadband jamming signals, which block both hostile as well as friendly communications. These wide-band jamming fields pose a serious technical challenge to existing anti-jamming solutions that are currently employed by the Navy and Marine Corps. This research examines the feasibility of removing such deterministic jammers from the spectral environment, enabling friendly communications. Anti-jamming solutions in self-jamming environments are rarely considered in the literature, principally due to the non-traditional nature of such jamming techniques. As a result, a combination of approaches are examined which include: Antenna Subset Selection, Spectral Subtraction, and Source Separation. These are combined to reduce environmental interference for reliable transmissions. Specific operational conditions are considered and evaluated, primarily to define the limitations and utility of such a system. A final prototype was constructed using a collection of USRP software defined radios, providing solid conclusions of the overall system performance.

Poster Presentations

Ontology Based Waveform Reconfiguration

Leszek Lechowicz, Northeastern University

We present the details of a method for ontology-based waveform reconfiguration. In this method cognitive radios share the same base SDR ontology, which allows the radios to understand the concepts in a uniform way thus enabling transfer of more complex concepts from one node to another. In the process of reconfiguration, nodes can receive descriptions of waveforms expressed in Web Ontology Language (OWL) and Rules and then automatically configure their processing according to the specification. Such specifications would contain both structural descriptions of software components and finite state machines (FSM) necessary to compose the waveform from simpler software modules. The waveform configuration process encompasses generating state machines, building a model of the waveform by generating OWL individuals and relationships between them using the inference engine and the specified rules. The constructed model is then used to instantiate state machines and other software components and to connect them in the specified way. The result of the overall process is such that a cognitive radio is able to learn and construct a waveform it did not know before.

A proof-of-concept system has been built confirming the feasibility of the proposed method. In the process of this system's evaluation three different waveforms (BPSK31, QPSK31 and RTTY) have been described in OWL and Rules, the descriptions were successfully transferred from one node to another and then used by the receiving node to construct fully functional software modules implementing the waveforms.

Extending CRUSH for simultaneous full bandwidth transmit and receive on the USRP

Jonathon Pendlum, Northeastern University

Cognitive radio algorithms require low latency, high performance signal processing to make real time decisions for spectrum sharing. Our previously presented architecture, called CRUSH (Cognitive Radio Universal Software Hardware), reduces the data transfer latency by coupling a field programmable gate array (FPGA) with the USRP. The USRP forwards full rate (100 MSPS, 14-bit) analog-to-digital converter (ADC) data over a high-speed serial interface to the FPGA on a Xilinx ML605 board. We have extended the platform to allow the FPGA to provide full rate (100 MSPS, 16-bit) digital-to-analog converter (DAC) data to the USRP over the high-speed serial interface. This grants CRUSH the ability utilize the USRP's full transmit and receive bandwidth simultaneously. The improvements to the CRUSH platform are demonstrated by using only FPGA processing to generate a wideband BPSK waveform, transmit and receive the waveform on the same USRP, transform the received waveform into the frequency domain with a Fast Fourier Transform (FFT), and send the FFT output via Ethernet to the host computer for plotting.

Poster Presentations

MIMO Optical Communications with Arduino (MOCA)

Victor Chen, The Cooper Union

MOCA is a proof-of-concept multiple-input multiple-output (MIMO) Visible Light Communications(VLC)link implemented using low cost, off-the-shelf LEDs and Arduino boards. With about $100, we developed a simple MIMO transmitter and receiver that can be used for prototyping in classroom and research. The 2-by-2 MOCA achieves data throughput of 2 kbps over a link distance of 30 cm. The transceiver circuit has low dynamic power consumption, and is suitable for operation up to 1 MHz. Further improvements on the throughput and link distance can be achieved with the use of more powerful SDRs such as the USRP2.

Estimation of Spectrum Occupancy in Heterogeneous Radio Access Environments using Random Spectral Sampling

Sean Rocke, Worcester Polytechnic Institute

Opportunistic spectrum access (OSA) networks place new challenges upon existing spectrum monitoring paradigms. Currently, limited infrastructure exists for spatio–temporal characterization of spectrum occupancy across a wide region. Service Providers are usually limited to characterization of spectrum usage within bands relating to their own infra-structural investments in electrospace, while Regulators and Policy-makers are challenged with effective decision-making over much larger volumes of this space. Wideband sensing is still challenged with the detection of intermittent use, particularly in low–occupancy scenarios, and in medium to high–occupancy cases their benefits can diminish. Furthermore, in many of the approaches spectrum sensing is channel–oriented and thus ill–suited for modeling the impact of heterogeneous Radio Access Technologies on spectrum occupancy. However, such heterogeneous scenarios are an inevitable consequence of the use of OSA networks.

We propose a channel–agnostic stratified random sampling approach to statistical characterization of wideband spectrum occupancy for spectrum monitoring networks. Unlike typical compressed sensing schemes for low signal occupancy scenarios, in this approach the spectrum reconstruction objective is relaxed to improve performance in medium to high occupancy settings. This method thus facilitates statistical occupancy characterization for various occupancy levels. We investigate several forms of temporal and spectral sensing randomization and compare their performance in occupancy characterization.

Poster Presentations

Digital Pre-distortion for Interference Reduction in Dynamic Spectrum Access Networks

Zoe Fu, Worcester Polytechnic Institute

In this research work, we analyze the impact of Radio Frequency (RF) front-end component impairments of cognitive radio (CR) transceivers on spectrally agile multicarrier waveform transmission, and then propose a digital pre-distortion (PD) approach to effectively correct associated non-ideal behaviors. Although there has been a substantial amount of research conducted into reduction of out-of-band (OOB) radiation caused by multicarrier signal forming, spectrum regrowth can be reproduced when signal goes through RF front end components, and thus potentially deteriorates liability of DSA network. Our goal is to mitigate OOB interference produced by RF front-end impairments between primary users (PU) and secondary users (SU) in Dynamic Spectrum Access (DSA) networks. The digital PD algorithm we propose uses indirect learning architecture (ILA) together with least square (LS) estimation for PD system identification. The results show that the proposed algorithm is able to evidentially alleviate distortions such as nonlinearity and memory effects caused by RF front-end components like power amplifier (PA), which translate to mitigation of OOB leakage in spectrum with non-contiguous multicarrier modulation (NC-MCM) employed.

SMSE-based Cognitive Radio over Non-Contiguous Frequency Bands in Mobile Environment

Ruolin Zhou, Western New England University

Recently, cognitive Radio (CR) arises to be a possible solution to solve the spectral congestion problem by introducing opportunistic usage of frequency bands that are not heavily occupied by licensed users. On the other hand, all multi-carrier transmissions, such as OFDM, MC-CDMA, and CI/MC-CDMA, are collectively classified as spectrally modulated spectrally encoded (SMSE) since data modulation and encoding are applied in the spectral domain. We design, implement, and demonstrate an autonomous CR system in mobile environment. Specifically, we employ the SMSE framework to generate multi-carrier transmission waveforms over non-contiguous frequency bands for the cognitive radio. Combined with an intelligent spectrum sensing engine, the cognitive radio detects the availability of each and every subcarrier in the operational bandwidth. By turning off those subcarriers occupied by the primary users, the cognitive radio stitches available multiple spectrum bands and implements a non-contiguous SMSE transmission. In highly mobile environment, the inter-carrier interference (ICI) caused by Doppler shift can be eliminated by our Total ICI Cancellation scheme. Therefore, a portable, flexible, agile, and robust cognitive radio node in highly mobile environment is implemented and demonstrated.

Implementing GSM Mobile-Side SMS Using OpenBTS

Shawn Neugebauer, Booz Allen Hamilton

Poster Presentations

Inexpensive Device for Whitespace Sensing

Steve Pennington, The University of Kansas

This demonstration will present an inexpensive low power wideband spectrum sensing device. At the core is a micro Linux server running on a Raspberry Pi or Beagle Board device. A FunCube dongle USB sensor is initially being used for the RF device but the use of inexpensive HDTV USB receivers is being implemented to provide for TV whitespace sensing. A GPS receiver and battery complete the hardware implementation. As the USB RF devices under consideration are relatively narrowband, software has been written to tune across the band of interest to capture a wider spectrum picture. Mobile devices such as this are constrained in both local storage and network uplink capability so the data can be summarized in terms of frequency, time, and position (in the case of a mobile sensor). A simple onboard web server allows an interested user to query plots of energy versus frequency, energy versus time, or raw data samples. Posting of data to a cloud-based server is also supported to enable analysis of data across multiple sensors.

Spectrally Agile, Affordable, Commercially Derived Network Communication Research Platform

William Watson, Raytheon BBN Technologies

Notes

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generous contributions from our sponsors.

BEEcube

BEEcube is a computer hardware and software firm that specializes in configurable technology applied to the most demanding computing applications. BEEcube is at the forefront of technology innovation within the Telecommunications market and is a leading supplier of advanced system-level reconfigurable platforms, with applications in wireline and wireless communications, such as LTE-Advanced, MIMO WiFi, microwave backhaul links, Software Defined Radio (SDR), and Software Defined Networking (SDN) / Openflow.

MathWorks

MathWorks is the leading developer of mathematical computing software. Engineers and scientists worldwide rely on its products to accelerate the pace of discovery, innovation, and development.

SDR-Boston
Boston SDR User Group

The Boston Software Defined Radio User Group, or SDR-Boston, is the primary host organization of the NEWSDR event series. Founded in 2010, the objective of SDR-Boston is to facilitate the bringing together of individuals interested in software defined radio technology within the New England region. By organizing events such as NEWSDR'13, it is expected that the presentation of the latest findings and the exchange of ideas between SDR experts would yield further advances in this emerging area.

WI Wireless Innovation Laboratory

The Wireless Innovation Laboratory (WI Lab) was founded in August 2007 by Professor Alexander M. Wyglinski in order to advance our understanding of technologies and algorithms that can help improve society's usage of radio frequency spectrum for a wide range of wireless applications.

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