



VIRGINIA MOUNTAIN SECTION NEWSLETTER

IEEE Region 3, Council 09, Section 65

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Thursday, January 18, Holiday Inn Hotel Roanoke Airport (former Clarion)

Cognitive Radio: Artificial Intelligence at Radio Frequencies

Dr. Charles W. Bostian
Alumni Distinguished Professor of ECE
Virginia Tech

ABSTRACT

A cognitive radio is a transceiver (e.g., a police radio or a cell phone) that is (a) aware of its environment, its capabilities, its current performance, and its user's needs and preferences, (b) capable of taking intelligent action based on that awareness, and (c) able to learn from experience and apply what it learned. Rather than relying on fixed FCC allocations, cognitive radios can find and use empty spots in the radio spectrum. They can negotiate waveforms and network operating modes that maximize performance subject to a set of constraints like battery life, spectrum occupancy, throughput, etc., and they offer a low cost solution to persistent problems like interoperability between incompatible public safety radio systems.

Conceptually, a cognitive radio consists of an intelligent software package (the cognitive engine) controlling a software defined radio platform. (A software defined radio is essentially a computer

that uses programmable digital logic rather than analog electronics to perform the functions of a radio transmitter and receiver.) The cognitive engine acts like an intelligent human operator, "reading the meters" and "turning the knobs" of the radio platform. It learns through a trial and error process and remembers what it learned. This talk presents a simple overview of how it all works.

Virginia Tech researchers began developing a cognitive engine as part of a pre-September 11, 2001 disaster communications system and demonstrated the first working system – a video link that could intelligently reconfigure itself to avoid jammers – in 2004. Current applications of our work include low-cost public safety radios with universal interoperability, Wi-Fi like access points that find and operate in unoccupied television channels, and large (thousands of nodes) networks of hand held radios for military applications. Sponsors include the National Science Foundation, the

National Institute of Justice, and the Department of Defense. The talk describes these systems and presents some current results.



SPEAKER

Charles W. Bostian is Alumni Distinguished Professor of Electrical and Computer Engineering at Virginia

Tech, where he has been a faculty member since 1969. Prior to joining the university, he served as a U.S. Army officer and worked briefly for Corning Glassworks. He holds B.S. (1963), M.S. (1964), and Ph.D. (1967) degrees from North Carolina State University. Since 1993, Bostian has served as the Director of the Virginia Tech Center for Wireless Telecommunications (CWT). He is also an active member of *Wireless@Virginia Tech*.

In his career at Virginia Tech, Bostian has taught more than 4000 students, and his teaching has been recognized by a number of awards, including ten certificates of teaching excellence and the William E. Wine Award for Excellence in Teaching. He is a four-time winner of the Eta Kappa Nu Outstanding Teaching Award and an elected member of the Virginia Tech Academy of Teaching Excellence. Bostian is the co-author of two widely used textbooks, *Solid State Radio Engineering* and *Satellite Communications*, now in its second edition.

Dr. Bostian's primary research interests are in cognitive electronics and radio system design. Currently he directs National Science Foundation (NSF) and National Institute of Justice (NIJ) projects on cognitive radio. He has served on two international technology assessment panels sponsored by NSF and NASA, visiting many communications research centers in Europe and Japan. These panels produced two widely read reports that significantly influenced the direction of satellite communications research. Dr. Bostian has authored or co-authored 45 journal and magazine articles and approximately 100 conference papers and presentations and contributed to the *Wiley Encyclopedia of Electrical and Electronics Engineering*.

Elected a Fellow of the IEEE in 1992 for contributions to and leadership in the understanding of satellite path radio wave propagation, Bostian is a former

chair of the IEEE-USA Engineering R&D Policy Committee and served as Associate Editor for Propagation of *IEEE Transactions on Antennas and Propagation*. On leave during the 1989 calendar year, he was as an IEEE Congressional Fellow on the staff of U.S. Representative Don Ritter, working on legislative issues related to the American electronics industry and economic competitiveness. He served on the IEEE-USA Congressional Fellow Committee, helping to select and mentor other congressional fellows. He is a Fellow of the Radio Club of America.

In his off-duty hours, Bostian is a performing folk musician, playing hammered dulcimer and string bass with the band *Simple Gifts of the Blue Ridge*. Their CD releases include *Mountain Mists* (1996), *Blue Ridge Heritage* (1998) and *Christmas with Simple Gifts* (2003). The Canadian Broadcasting Corporation and Australian Public Radio have featured their music.

Date: Thursday, Jan. 18, 2007

Social: 6:30 PM

Dinner: 7:00 PM

Speaker: 8:00 PM

Cost: Members & Guests \$ 15.00
Students \$ 8.00

Reserve by **5 PM Monday Jan. 15**

Dr. Wilbur Dale (540) 464-7547

mail to:dalewn@vmi.edu

Please specify number of attendees.

Directions to

Holiday Inn Hotel Roanoke Airport (formerly the Clarion)

2727 Ferndale Drive NW
1581 Exit 3 Hershberger Rd West
1st Rt. onto Ordway Drive,
¼ mile, Rt. Into Parking Lot.

Three New IEEE-USA E-Books Provide an Engineer's Guide to Lifelong Employability

IEEE-USA's latest series of e-books comprise an Engineer's Guide to Lifelong Employability, with

installments on Resumes; The Transition from School to Work; and What Are You Worth? For more information, and to order, visit: <http://bmsmail3.ieee.org:80/u/4856/78313>

CONGRATULATIONS

Dr. Jih-Sheng (Jason) Lai was elected to Fellow of the IEEE, effective January 1, 2007, for contributions to high performance high power inverters.

Dr. Lai was one of 268 members from around the world who have demonstrated an "extraordinary record of accomplishments in any of the IEEE fields of interest." They join a group of thousands of other IEEE distinguished Fellows who have contributed to the advancement or application of engineering, science and technology. The IEEE Board of Directors awards the honor of Fellow to no more than 0.1 percent of the voting membership as of 31 December of the preceding year. The full list 2007 Fellows can be viewed at <http://www.ieee.org/web/aboutus/fellow/new-fellows.htm>. To learn more about the IEEE Fellow Program or nominate an individual, please visit <http://www.ieee.org/fellows>.

To be eligible for election to Fellow, one must first be a Senior Member of IEEE. We are pleased to congratulate **Dr. Robert W. Hendricks** who was elevated to IEEE Senior Member in November 2006. Senior Member status is a recognition by one's peers of career achievement and contribution to the profession.

The IEEE has a special program each year to promote Senior Member upgrades. This program makes it easy to process a Senior Member application and it gives a financial incentive of a \$10 rebate to the Section for every new Senior Member that is approved.

If it is at least 10 years since you received your undergraduate degree, and you have had significant engineering

responsibilities and accomplishments in the last five years, you likely qualify for senior membership. Please consider upgrading your membership, and remember to mention VMS in your application so we get the appropriate credit and rebate.

VMS Membership (Dec. 27, 2006)

Associate Members	17
Affiliate Members	48
Members	271
Life Members	22
Senior Members	72
Life Senior Members	16
Fellows	15
Life Fellows	11
Student Members	230

Not counting Students, Associates, and Affiliates we have 407 members of whom 49 are in the various Life categories. Of these 407, 293 are Members or Life Members, 88 are Senior Members or Life Senior Members, and 26 are Fellows or Life Fellows.

IEEE CONSULTANTS AFFINITY GROUP/VMS

The Virginia Mountain Section Consultant's Network Affinity Group has been officially approved by IEEE. The purpose of this Affinity Group is to share information concerning consulting opportunities, and to make a list of consultants and their areas of expertise available to potential employers.

The following is an initial listing of consultants:

1. Tuttle International Tech. Marketing, Roanoke

(540)977 4007, Re Electromechanics, Robotics, and Intellectual Property Processes.

2. Squire Consulting,

www.jimsquire.com. Biomedical engineering, instrumentation, endovascular stenting, patent litigation.

3. David H. Geer, PE Geer & Associates, LLC

540-774-4905

d.geer@ieee.org

Mathematical models for industrial processes.

Software development and maintenance in C, C++, Ada, and Fortran.

Website design, development, and maintenance.

Anyone wishing to be added to this group, or desiring more information should contact Ed Tuttle, Affinity Group Chair, tuttleone@earthlink.net.

LOOKING AHEAD

February Meeting

February 15, 2007

Undergraduate Student Paper Contest

IEEE Communications Society to Launch Certification Program

The IEEE Communications Society (ComSoc) has selected New York-based Professional Examination Service (PES) to develop a certification program for engineers working in communications technology. ComSoc is planning to roll out the first certification, in wireless cellular technology, late in 2007. When fully developed, the program will comprise a number of certifications in various areas of communications technology.

During program development, PES will collaborate with a broad cross-section of stakeholders, including practicing engineers from small and large companies worldwide, to conduct an extensive analysis of the knowledge and skills required by engineering professionals in wireless cellular communications technology. Following the analysis of practice, PES will conduct item and examination development workshops and a standard-setting study with representative groups of stakeholders, as well as provide consultative services to keep ComSoc informed of new trends and technologies in certification assessment.

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