

# University Programs Develop New Wireless Engineers

Here is the first report of our continuing coverage of educational and research opportunities for both new and returning students

By the staffs of  
Virginia Tech and UC Davis

Wireless communications has fueled new efforts in education and research at colleges and universities and has highlighted the work of schools with strong traditions in the areas of microwave techniques, RF circuits, communications systems and other related specialties. This report, part of *Applied Microwave & Wireless*' continuing efforts to raise awareness in this area, takes a look at two of those universities' programs.

## Mobile and Portable Radio Research Group (MPRG) — Virginia Tech

Virginia Tech has electrical engineering undergraduate and graduate programs which consistently are ranked among the very best in the country. Located in Blacksburg on a plateau between the beautiful Blue Ridge and Appalachian mountains, Virginia Tech professors teach electrical engineering courses in cellular and personal communications systems, digital modem design, antennas and radio propagation engineering and communication circuits. A sampling of courses in these areas include: cellular radio and personal communications, radio wave propagation, radio engineering, analog and digital communications, simulation of communications systems, coding theory, digital signal processing and communications systems design.

The Mobile and Portable Radio Research Group (MPRG), part of the Bradley Department of Electrical Engineering, is a national resource for wireless communications research and education. In MPRG's laboratories, students and staff are involved in wireless communication design and analysis for cellular and personal communication systems of the future. MPRG's mission is to produce tools and techniques for the wireless communications industry, while



■ An MPRG student studies a computer prediction of cellular system coverage.

educating tomorrow's engineers in a state-of-the-art academic program. The group includes faculty members, research scientists and a full-time support staff. Typically fifty graduate and undergraduate students are involved in theoretical and experimental research and development efforts with more than thirty industrial firms and numerous governmental agencies.

MPRG's research focuses on developing hardware, software and innovative techniques for the expanding wireless industry. Projects span the full range of radio applications, including high-capacity wireless modems, "smart" cars and highways, ray tracing research for wireless site planning and design, position location for mobile applications, CDMA interference rejection and evaluation of new wireless standards using time delay and multipath measurements. MPRG research projects focus on the areas of wireless system design and simulation, antennas and propagation, modem design and DSP algorithm development, CDMA receiver

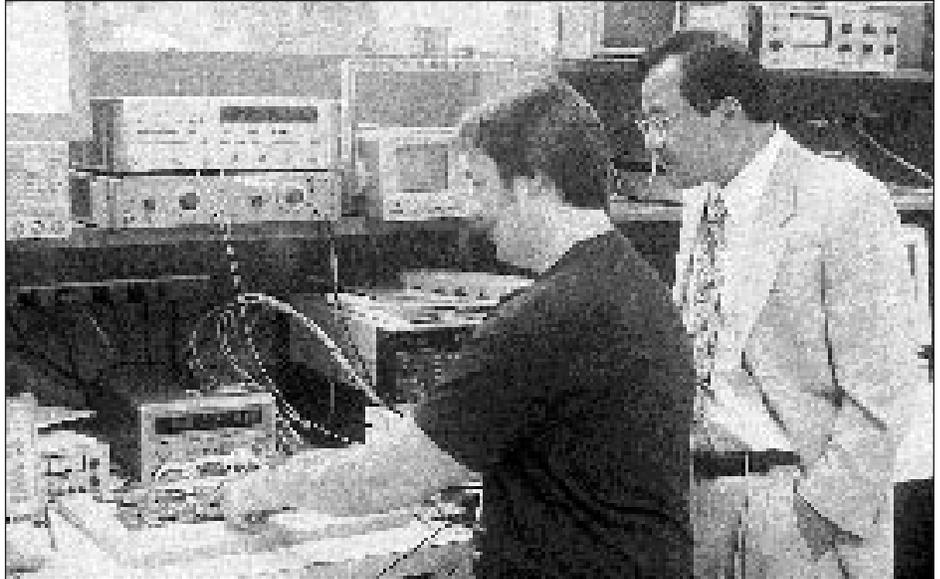
design, and wireless networking.

In the software area, MPRG has developed propagation modeling and system design tools for future wireless communication links that are used worldwide by universities and companies. These tools are also used in the Virginia Tech graduate engineering curriculum. Real-time digital signal processing software developed by the group supports interference cancellation and adaptive antenna array control, and has led to new techniques for CDMA demodulation.

Hardware tools and products developed by MPRG, include real-time propagation measurement systems, spread spectrum modems, multipath channel sounders, adaptive arrays and real-time bit error rate simulation systems that are currently being used by carriers and manufacturers worldwide.

MPRG faculty have broad knowledge in the wireless spectrum. Dr. Ted Rappaport, director and founder of MPRG, joined the Virginia Tech faculty in 1988. He conducts research in communication system design, RF propagation prediction and measurements, position location, and digital signal processing. He is the author of one of the first wireless communications textbooks and holds several U.S. patents. Dr. Brian Woerner joined the faculty in 1991 and has contributed in the development of code division multiple access (CDMA) systems. His particular interests involve the design of improved modulation, error correction and code division multiple access techniques. His areas of research include position location for wireless communications, multiuser detection and interference cancellation for advanced CDMA systems. Dr. Jeffrey Reed joined the faculty in 1992 and specializes in applying digital signal processing to communication systems. He conducts research in adaptive antenna arrays, position location, advanced cochannel interference suppression and advanced receiver design and system implementation. Dr. William Tranter, Schlumberger Professor of Electrical Engineering at the University of Missouri-Rolla, worked with MPRG on sabbatical during the summer and fall of 1995 and continues to work with MPRG faculty on several projects.

Virginia Tech and MPRG are conducting research and graduating qualified wireless professionals at a rapid pace. During MPRG's first six years, more than 130 students received advanced electrical engineering degrees with particular emphasis on wireless communications, and more than 500 students completed courses that emphasize wireless communications concepts. MPRG continues to strive for excellence in research, education and technology transfer to the wireless industry. For information, contact:



■ UC Davis researcher Earl McCune Jr. demonstrates the world's fastest CDMA and TDMA system (60 Mchips/s at 2.4 GHz) to Dr. Handa of Japan.

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### Research Activities in Wireless Digital Communications at the University of California, Davis

UC Davis Electrical and Computer Engineering and Computer Science departments consist of more than 10 professors and 50 graduate students, post doctoral fellows, research engineers and visiting professors. The Wireless and Digital Communications Research Laboratory, directed by Professor Kamilo Feher, is one of UC Davis' laboratories. Dr. Feher's laboratory works closely with Dr. Rick Branner's Microwave/RF research laboratory, Dr. Michael Soderstrand's DSP laboratory, Dr. Shi Ho Wang's computer-aided design R&D team and Dr. Todd R. Reed's image processing, multimedia and computer vision teams.

The Wireless and Digital Communications Research Laboratory is a productive experimental wireless modulation/RF design center. Dr. Feher's laboratory includes the AirTouch multi-base station campus-wide CDMA research test bed (900 MHz) manufactures by QUALCOMM and 2.4 GHz wireless high-speed data test beds. The research team has published more than 300 papers related to improved efficiency, GSM, PCS-1900, CDPD, IS-136, WLAN and HIPERLAN applications. The fast, flexible and reconfigurable TDMA to direct sequence spread spectrum CDMA system, IOCOMM, manufactured under license by Lockheed-Martin, uses Feher's

inventions and processors for FQPSK up to 100 Mchips/s CDMA and up to 200 Mb/s clear mode TDMA wireless systems. GMSK and FQPSK systems based on Feher's and colleagues' discoveries have been implemented up to 50 GHz by EIP Microwave.

The team's applications include improved generations of GSM, PCS-1900, modems and integrated low-cost IC chip radio architectures. Work also is underway on solutions for multiple standard single chip designs for TDMA and CDMA, improved performance of CDPD, IS-136 TDMA

with improved transmission efficiency, and new generations of WLAN, WLL and IEEE 802.11 systems.

Past and present industrial allies with Dr. Feher's laboratory at UC Davis include: Tellabs, AFC, AAL, Autel, Novalink, kB/Tel-Gruopo Pulsar, IOTA, Hewlett-Packard, Motorola, National Semiconductor, Marquette Electronics, US West-New Vector, II Morrow, Spar Aerospace, IDC, Geotek, Lockheed-Martin, EIP Microwave, LORAL, NeoSoft, Siemens, UBBB, Ericsson, NTT, NASA, INTEL, NHK, Matsushita, CNET, CRC/DOC,

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