

Success Story

North Carolina State University Senior Design Course Inspires a Practical Wireless Communication Industry Workshop



"I would not be able to offer the Bits to Waves workshop without the use of NI AWR Design Environment since the ability to use the software immediately is key to building the digital radio components within the one-day scope of the class."

Dr. David Ricketts, North Carolina State University

Customer

Dr. David Ricketts received his PhD in engineering and applied sciences from Harvard University and his BS and MS degrees in electrical engineering from Worcester Polytechnic Institute. Prior to joining academia, he spent eight years in the industry developing more than 40 integrated circuits in mixed-signal, RF, and power management applications. Ricketts's research crosses the fields of physics, materials science and circuit design, investigating the ultimate capabilities of microelectronic devices and how these devices are harnessed by differing circuit topologies to produce the highest performing systems.

Challenge

Dr. Ricketts, an electrical engineering professor at North Carolina State University (NC State), developed a one-semester senior design course that guides students through the fundamentals of radio communications from design through to fabrication. Following on the success of this course, Ricketts felt the next challenge was to develop an accelerated workshop that offered the same design through fabrication in a single day for working professionals attending industry-related technical gatherings such as the annual International Microwave Symposium (IMS), recently held in Honolulu, Hawaii.

At-A-Glance

Application

- Radio Design

Software

- [NI AWR Design Environment](#)
- [Microwave Office](#)
- [AXIEM](#)
- [iFilter](#)
- [AntSyn](#)

Benefits

- Intuitive and easy to use
- Fast learning curve



Solution

Prof. Ricketts relied upon his professional connections through the IEEE MTT society to help bring to fruition his idea of a one-day workshop that could be offered to industry as well as academia. He enhanced and streamlined his RF/microwave class materials and combined them with NI AWR software into the interactive [Bits to Waves: Building a Modern Digital Radio in One Day](#) workshop for IEEE professionals that is now offered at IEEE conferences throughout the world.

In this interactive one-day experience participants learn the basic theory of modern digital radios as well as the RF circuits and systems used to build them. After an introductory lecture on digital radios, participants select an RF building block to design and build (Figure 1). There are short videos and tutorials for attendees to view in order to successfully design each component in the 2-4-hour time window allotted, including double-balanced mixers, microstrip filters, low-noise amplifiers, power amplifiers, baluns, and more. A component is selected and designed within NI AWR Design Environment, specifically Microwave Office circuit design software and AXIEM 3D planar electromagnetic simulator, as well as NI AWR software AntSyn™ and iFilter™ synthesis tools. Participants then transfer their designs to a printed circuit board (PCB) and each component is measured for its high-frequency electrical response.

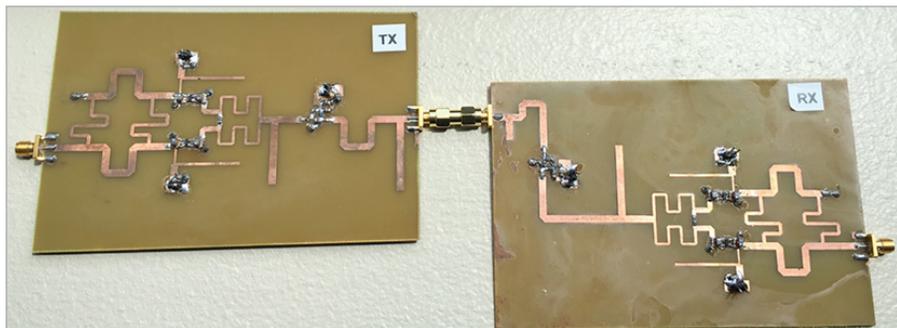


Figure 1: Full radio design fabricated using the techniques learned in the Bits to Waves workshop.

Participants in this unique workshop need only a basic background in RF circuits such as S-parameters and basic transmission-line theory. Example designs are available to ensure that everyone, from the most advanced RF designer to the student, can build a successful RF component.

The course is now the basis for a new challenge: a student design competition that will be offered at the 2018 International Microwave Symposium (IMS). In this competition, participants will design, construct, measure, and demonstrate a 16 quadrature amplitude modulation (QAM) wireless transmitter at 950 MHz. They will design a Wilkinson combiner, a branchline coupler, a double-balanced mixer, a power amplifier, and an antenna prior to arriving at IMS and during the contest they will fabricate their designs and test each component and the complete radio on site. The performance metric will be received power/error vector magnitude, with the highest number winning the competition.

Conclusion

Dr. Ricketts chose NI AWR Design Environment for his Bits to Waves workshop because the software's powerful, yet intuitive user-interface helped ensure the success of his students in learning the basics of modern digital radio design in one semester. Workshop participants find NI AWR software so easy to use that they are able to apply the design concepts taught in the morning to a practical design in the afternoon and have design-to-fab-to-test success in one day.