

## Success Story

# Aalto University Students Design a 1.5 GHz Doppler Radar Using NI AWR Software



“NI AWR software’s ease of use enables students to fully focus on their exercises without spending time learning numerous different design tools. After completing the course, students feel very capable of tackling virtually any real-world microwave engineering design or analysis challenge.”

Ville Viikari, Aalto University

## Company

Aalto University, Helsinki, Finland, has six schools with nearly 20,000 students and 4,000 employees and is ranked fifth in the world among universities founded in the Twenty-First Century. The university has a long tradition of cooperation with the surrounding society and business world, which improves the student learning experience by bringing in real-world business examples and teaching required work skills through partner workshops. Important research areas at the School of Electrical Engineering include traditional electronics, electrotechnology, and telecommunications technology.

## Challenge

Microwave Engineering II is a master-level course offered in Aalto University School of Electrical Engineering. The goal of the course is for students to learn to analyze and design passive and active microwave components such as couplers, filters, mixers, oscillators, and amplifiers, as well as systems consisting of many components.

To reach this goal, the students design various components during the course and integrate them into a complete system at the end. The theme in 2018 was to design a 1.5 GHz Doppler radar on a single printed-circuit board (PCB) using surface-mount passive and active components. The designed building blocks required to realize the radar were an oscillator, amplifiers, a mixer, couplers, and filters.

## Solution

Professor Viikari chose NI AWR Design Environment simulation software to teach his students how to design the components and integrate them into the radar PCB. Two key advantages of NI AWR software are that the tools are free as part of the AWR University Program and the platform is easy to use and intuitive.

The design of each component was based on a simplified architecture with theoretical exercises supporting the students’ understanding of the underlying principles. Design practicalities were then introduced, for instance, the use of realistic lumped component models, including the PCB layout in the simulations as well as possible bias networks. At the end of the course, the entire design was fine-tuned, and its operation was verified with system-level simulation tools.

### At-A-Glance

#### Application

- Radar

#### Software

- [NI AWR Design Environment](#)
- [Microwave Office](#)
- [AWR Connected™ for Optenni](#)

#### Benefits

- Ease of use
- Fast learning curve
- Complete tool set
- Confidence with analysis

Matching networks were designed with the AWR Connected for Optenni Lab software solution. An example of balanced mixer and low-pass filter student designs are shown in Figure 1 and the simulation results of the mixer are shown in Figure 2.

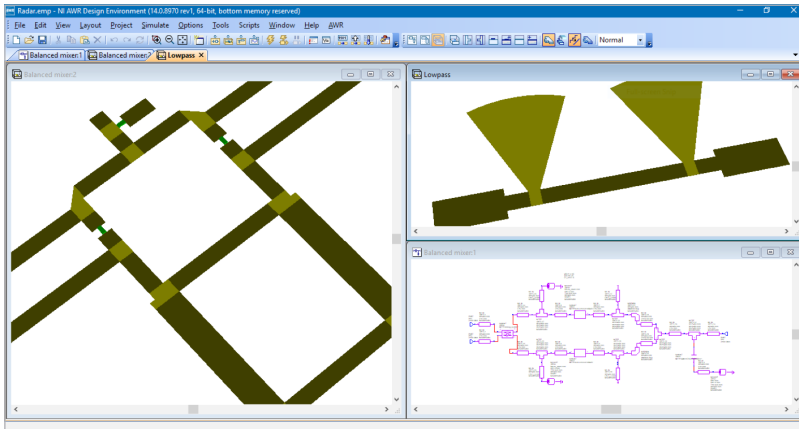


Figure 1. Microwave Office screen showing mixer and low-pass filter designs.

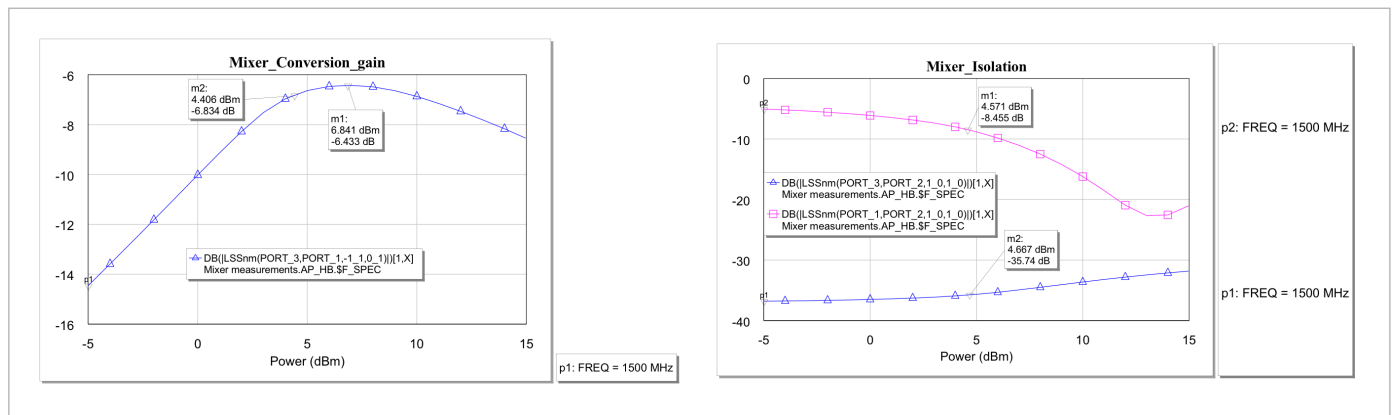


Figure 2: Mixer simulation results for gain and isolation.

## Conclusion

The goal of the Aalto University Microwave Engineering II course is to support student learning through hands-on design and simulation exercises, as well as to familiarize students with professional simulation tools. Professor Viikari chose NI AWR Design Environment software for this course because it is very intuitive and provides a complete tool set, from circuit and electromagnetic (EM) simulation to system analysis and PCB layout design. The software's ease of use enables students to fully focus on their exercises without spending time learning numerous different design tools. After completing the course, students feel very capable of tackling virtually any real-world microwave engineering design or analysis challenge.



Special thanks to Ville Viikari, Associate Professor and Director of Electronics and Nanotechnology Master Program for his contributions to this success story.