



CASE STUDY

The University of Leeds Showcases Two Engineering Research Labs

Globally renowned for its teaching and research, the University of Leeds is one of the leading electronic and electrical engineering schools in the UK. The Faculty of Engineering has a staff in excess of 700 serving 3,000 students from more than 100 countries. In addition to its well-regarded academic program for undergraduate and graduate students, Leeds is home to world-class research labs that receive regular visitors from abroad from both academia and industry. Close industry links ensure that the university is responsive to the needs of both research and teaching. Notable activities at Leeds include high-frequency and terahertz electronics research and the National Facility for Innovative Robotic Systems.

Close industry links ensure that the university is responsive to the needs of both research and teaching.



Company:

- University of Leeds

Key Issue:

- Advancing research in high-frequency and terahertz electronics, as well as robotics
- Ensuring graduating engineering students are prepared for the industry

Solution:

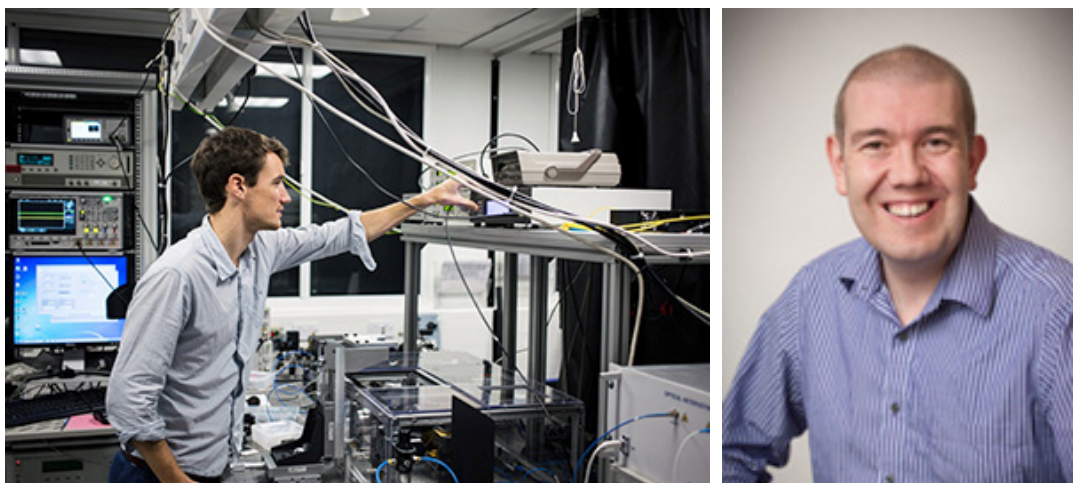
- Keysight PNA-X network analyzers
- Keysight RF & Microwave Industry-Ready Student Certification Program

Results:

- Close links with Keysight ensure that the university is responsive to the needs of both research and teaching
- The university's research labs enable significant advancements in healthcare applications, climate change observation, and inspection of sites or interiors for further evaluation
- Graduates are highly marketable for industry jobs requiring RF / microwave design and measurement skills

High-Frequency and Terahertz Labs

Leeds has fully equipped labs that focus on electronics research of the electromagnetic spectrum up to 20 terahertz (THz). One such facility is the Roger Pollard High-Frequency Measurements Laboratory, which has network analyzer capability to 1.1 THz. This spectrum is of interest because many materials exhibit unique terahertz properties that are useful for imaging and material identification. A major focus of the research is in high-frequency communications and sensing for healthcare applications. Over the years, Leeds has made significant contributions to this area of research.



The Roger Pollard High-Frequency Measurements Laboratory (left) and Professor John Cunningham (right)

The university has advanced the state of the art for understanding the fundamental interactions of terahertz radiation with a wide range of materials, including in the area of security applications, such as illegal drugs and explosives. “One challenge the Leeds team is taking on is to investigate the feasibility of developing a cost-effective handheld instrument for measuring terahertz-range signals,” says Professor John Cunningham, chair of nanoelectronics and director of the Institute of Microwaves and Photonics.

Another application being researched at Leeds is a high-power terahertz signal source running at double the output power of current sources today. Such a single-frequency signal source would have important applications for satellite communications with benefits in the areas of atmospheric observations and climate change.

Robotics Lab

Another strong area of research at Leeds over the past 20 years is robotics. To complement this effort, the university opened the National Facility for Innovative Robotic Systems in October 2014. With more than £4 million in funding, the robotics facility plays a part in the British government's goal to improve the country's international competitiveness.

"The lab is equipped with a broad set of state-of-the-art technologies, including the latest 3D printing technology and high-precision manufacture and assembly systems," said Professor Ian Robertson, centenary chair in microwave and millimetre-wave circuits and head of school.



The National Facility for Innovative Robotic Systems lab (left) and Professor Ian Robertson (right)

Robotics research at Leeds spans a range of applications. For example, the university investigates small-scale custom robotics that can cheaply and effectively explore industrial facilities that monitor safe gas levels or inspect pipes. Another area of opportunity is the use of robotics in the medical field. Robots can assist with a patient's rehabilitation after a stroke, for example. The most diverse application of robotics is the exploration of Egypt's pyramids. Robots have explored pyramid interiors with cameras and measuring devices to evaluate materials and other information. **One such expedition yielded pictures of 4,500-year-old markings from inside the Great Pyramid of Khufu,** gathered by a robot explorer designed in part by University of Leeds engineers. These images may provide clues as to how the pyramid was built.

Longtime Partnership with Keysight

For more than 30 years, Leeds has had a strong working relationship with Keysight Technologies and its predecessors Hewlett-Packard and Agilent. The partnership started in 1981 when the late Roger Pollard, who went on to become the dean of engineering at Leeds, began working at Keysight's Santa Rosa, California, facility for a six-month sabbatical. After that, he returned each summer for six weeks. Continuing this tradition until he retired in 2011, Pollard made key contributions in the field of network analyzer measurements, and his name is on numerous Keysight patents. That partnership continues today with Roger Stancliff, Leeds visiting professor and chief technology officer for Keysight's Component Test Division. Stancliff spends time each year at Leeds working with faculty and students and on new research collaborations.



Keysight millimeter-wave network analyzer to 1.1 THz

It's no surprise that Keysight's presence can be found in the Leeds research labs. One notable test instrument is the Keysight PNA-X network analyzer, which, along with 750 GHz to 1.1 THz test heads from Virginia Diodes Inc., measures passive components, semiconductor devices, antennas, and materials. The system primarily measures S-parameters but can be configured, with additional hardware, to make absolute power, gain compression, pulsed, and time domain measurements. It can also characterize material parameters. In addition, Leeds has a suite of Keysight test instruments, including network analyzers, wireless test sets, and waveform generators such as the Keysight PSG high-performance microwave signal generator.

To ensure that its graduating students have strong, marketable skills, Leeds participates in Keysight's RF & Microwave Industry-Ready Student Certification Program. The program confirms students' technical knowledge, design expertise, and hands-on measurement proficiency in the use of Keysight EEs of EDA software design tools and Keysight instruments.

"We're proud of the long history of work with Keysight," noted Robertson. "The relationship has made a significant impact on the research and student education at Leeds."

“We’re proud of the long history of work with Keysight. The relationship had made a significant impact on the research and student education at Leeds.”

- PROFESSOR IAN ROBERTSON

Learn more:

- [Keysight network analyzers](#)
- [Keysight PSG signal generators](#)
- [Keysight University Student Certification Program](#)
- [Keysight PathWave Design Software \(previously known as EEsos EDA software\)](#)
- [Keysight education solutions for researchers, educators, and students](#)

This article is a reprint of the original online publication dated February 5, 2015. Professor John Cunningham is currently deputy head of the School of Electronic and Electrical Engineering at the time of this reprint.

Learn more at: www.keysight.com

For more information on Keysight Technologies’ products, applications or services, please contact your local Keysight office. The complete list is available at: www.keysight.com/find/contactus

