

Signal *of quality*



Aalto University
School of Electrical
Engineering

From *the Dean*

At the Aalto University School of Electrical Engineering, science and engineering meet society. Our internationally recognised research covers fields from electrical engineering and natural sciences to information technology. The multidisciplinary applied research that we conduct combines our competence in different areas into applications that benefit society and increase well-being. We believe in constant renewal and a strong focus on rapidly developing areas of technology. A good example of this is the Industrial Internet and Internet of Things (IoT), which represents one of the most important breakthroughs of our times, both in Finland and globally.

At our school, science and technology also meet Aalto University's artistic and business expertise. Our top research group is made up of committed researchers, hard-working students, modern research infrastructures, and outstanding support organisations that all work, interact and enjoy spending time with each other. Our shared goal is to be at the forefront of science and development and to develop research results further into innovations that serve society by means of sufficiently large projects and broad research programmes.

We want to produce energy-efficient technology that observes the principles of sustainable development, regardless of whether it involves information technology, nanotechnology-based materials, system management, robotics or basic electrical engineering systems.

The top experts who have graduated from our school are practical problem solvers, researchers and entrepreneurs, who can successfully take on and deal with the opportunities and challenges presented by the technology of the future.



Jyri Hämäläinen
Dean

School of *Electrical* Engineering

The School of Electrical Engineering promotes high-quality science, technology and innovations for the good of Finnish society and all of humankind. We are working towards this goal by recruiting the best researchers, offering top research conditions and developing quality study programmes.

Our research focuses on major social issues, such as energy and environment, as well as health and well-being. One of the school's special strengths is linking research with the Finnish and international business sector. Our social influence also enhances the promotion of entrepreneurship and innovation.

The school boasts world-class research facilities and equipment, such as the Micronova Centre for Micro- and Nanotechnology, which has the largest cleanroom facilities in the Nordic countries.

Students and staff

- Students **2 000***
- Doctoral degrees: **49**
- Master's degrees: **214**
- Bachelor's degrees: **245**

*Full-time equivalent students. The figure also includes full-time doctoral students.

- Staff: about **650**, **60** of whom are professors

Departments:

- Micro- and Nanosciences
- Radio Science and Engineering
- Signal Processing and Acoustics
- Electrical Engineering and Automation
- Communications and Networking

Units:

- Metsähovi Radio Observatory
- Aalto Nanofab / Micronova

Bachelor's programme majors (in Finnish):

- Automation and Information Technology
- Bioinformation Technology
- Electronics and Electrical Engineering

Master's programmes (in English):

- Automation and Electrical Engineering
- Computer, Communication and Information Sciences
- Nano and Radio Sciences
- Life Science Technologies

Erasmus Mundus Master's programme:

- Space Science and Technology (SpaceMaster)

Aalto University School of Electrical Engineering started its operations on 1 January 2011. It is based on the Faculty of Electronics, Communications and Automation of the Helsinki University of Technology and the department of electrical engineering that preceded it.

Future *energy solutions*

Issues related to the production of energy will pose major challenges to humankind in the near future. Climate change means that carbon dioxide emissions must be reduced. At the same time, the demand for energy is growing globally. New solar power applications might offer solutions to this problem, believes **Hele Savin**, Assistant Professor of the Department of Micro- and Nanosciences.

Savin began her career in microelectronics. However, she ended up researching solar power, after noticing that the problems related to it were very similar to those she encountered in microelectronics. New nanotechnology innovations make it possible to manufacture economical, efficient and aesthetic solar cells. For the time being, however, the price of solar cells is relatively high, as cleaning the material used in them—silicon—is an expensive process. Among other things, Savin and her team are investigating how the cleaning process could be streamlined.

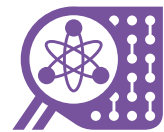
Another challenge presented by solar cells is their decrease in efficiency over time.

‘In spring 2015, we set an efficiency record of 22.1% for nano-structured solar cells. We demonstrated that in winter Helsinki, black silicon cells generated considerably more electricity than traditional cells, even though both cells have identical efficiency values,’ explains Hele Savin.

In the near future, the research group intends to test the use of black silicon in other structures – particularly in cells manufactured from thin and poly-crystalline silicon.

Hele Savin, who was appointed Assistant Professor in the Tenure track career system, has gained international experience at the University of California, Berkeley and Massachusetts Institute of Technology. In addition to specialised expertise, she also gained a lot of new researcher colleagues during her time abroad. Some of them have joined Savin’s research group at Aalto University.

‘My dream is to have my technology utilised in as many solar cells as possible.’



Read more on the university career system:
tenuretrack.aalto.fi



Big things come in small packages

Micro- and nanotechnology make innovative solutions for the future possible. Topical research themes include LED technology, solar cells, metamaterials, micro- and nanorobotics and sensors.

Energy in focus

Energy research is conducted in every department of the school. Research themes are, in particular, renewable energies and energy efficiency. The reliability and high efficiency of energy production, conversion and transmission are also key research subjects.

Aalto University tenure track

Tenure track offers researchers a clear and well-supported career path towards professor-level tasks that is based on international standards. The system is based on the commitment of the university and the individual to an academic career and on promoting personal and academic growth.



Sustainable *wireless* society

The world is moving strongly towards a wireless society where mobile communication and mobile Internet are at the centre. New information and communications technologies (ICT) help us reduce its impact on the environment and support sustainable development. Yet at the same time, ICT itself consumes an increasing amount of energy to power user devices, fixed and wireless networks, and data centres. Another new challenge facing society is cyber security and how to protect society's critical infrastructure from malicious players.

'My team works on numerous topics related to ICT. At the forefront are topics related to energy-efficient ICT, such as mobile devices that would last much longer on a single charge, how we can make the mobile Internet consume less energy, and holistic approaches to build data centres that would consume less electrical energy and at the same time disseminate excess heat energy to heat buildings. We also investigate means to change the fundamental network sharing principles of the Internet and, e.g., enable a kind of priority lane for short data transfers,' says Professor Jukka Manner.

Netradar opens up the mobile world

Netradar.org is a global service for end users launched by Aalto University that uses crowdsourcing to build a picture of the performance of mobile and fixed networks around the world. It shows the real coverage of each mobile operator in the world and the quality of wireless and fixed broadband links, and also presents differences in the devices people carry with them. The user application is available on all major smart phones, tablets and computers.

It has already been downloaded more than 250 000 times and the database contains more than 7 million measurements from around the world.

'At the forefront are topics related to energy-efficient ICT.'



World-class research in ICT is being conducted at the School of Electrical Engineering. The research is closely linked to finding solutions to practical problems. The focus is on, for example, digitalisation and services, human-centred living environments, wireless Internet and device usability. School research endeavours to answer how there will be enough energy in the future to meet the growing needs of telecommunications networks.

Reaching *for space*

At Aalto University, barriers to learning are being broken with bold, ground-breaking projects. The historic contract for sending the first Finnish satellite into space was signed at the School of Electrical Engineering in March 2015.

The Aalto-1 nanosatellite was built in a student project in broad cooperation with other Finnish universities and institutes. More than 80 students have taken part in the project and it has produced dozens of theses as well as many conference and scientific publications.

'At first, building our own satellite seemed impossible. It has been rewarding to see how it is taking shape day by day.'



Joint journey to space

Aalto-1 is a CubeSat-based nanosatellite, only slightly larger than a milk carton and weighing some four kilograms. The satellite can carry three research devices: an imaging spectrometer built by VTT, a radiation monitor jointly constructed by the Universities of Helsinki and Turku and a plasma brake designed by the Finnish Meteorological Institute, which is based on the principle of an electric solar sail.

‘At first, building our own satellite seemed impossible. It has been rewarding to see how it is taking shape day by day, says **Tuomas Tikka**.

The satellite is controlled by an altitude determination and control system, which was implemented by Tuomas. His final project is the first Master’s thesis completed from this project. The system turns and tilts the satellite into different positions as required by the research instruments. The altitude determination and control system has to work flawlessly in order for measurements to be taken correctly.

Several experts, research institutes and companies have provided assistance to the project. Along with development work on the research devices carried by the satellite, the project has worked in co-operation with companies such as Space Systems Finland, which has made its laboratory facilities available to the project work group. Some project members have also done internships with Berlin Space Technologies. Project partners have provided thesis opportunities, design assistance and even jobs to project members.



‘The instruction provided by experts from research institutes and companies has been a marvellous added benefit. We get information directly from experienced professionals,’ says Tuomas Tikka.

Demonstration of top-quality education

Completion of the satellite demonstrates the high level of education at Aalto University. The new generation of nanosatellites involve technological developments, the results of which can also be used in other fields. The Aalto University satellite projects ensure that students will continue to work with the right challenges and the latest technology in the future.

‘The competence and expertise gained during development of the satellite will also have a direct impact on development in other application areas. Designing instruments for use in highly demanding conditions helps us create innovations and teaches us to appreciate and build quality,’ says Professor **Jaan Praks**, who was in charge of the project.

New window on *the human body*

More detailed specification of different physical and chemical variables from different parts of the human body and the wireless transmission of this information without causing damage to the tissues would revolutionise medical diagnostics and enable the development of much more selective and effective treatments.

'This is why accurate and selective integrated sensors have incredible potential in medicine and in various environmental applications. One example is personal diagnostics to provide information that could be used to treat diseases rather than simply alleviating the symptoms,' explains Professor Tomi Laurila.

He leads the microsystem technology research group, which develops and studies new sensor solutions based on carbon nanostructures. In collaboration with international partners, work is being done in several projects funded by the Academy of Finland and Tekes.

'It is impossible to do this kind of boundary-breaking research without a comprehensive cooperation network that contains natural science and medical expertise,' states Laurila.

The microsystem technology research groups specialises in managing the interfaces between materials, material modelling and development, and various electrochemical measurement methods.



Health Factory solves problems in the health and well-being sector

There is a worldwide social demand for expertise in health and well-being technologies. Co-ordinated by the School of Electrical Engineering, Health Factory solves problems in this field together with university stakeholders. New health and well-being sector solutions are also developed by Health Factory to promote the establishment of new enterprises.

Health and well-being

Health and well-being technology, which also has social significance, is one of the focal areas of the School of Electrical Engineering. The school develops solutions for, among others, neurological research, elderly care, medical imaging and wireless health care services.

Aalto University – *for a better world*



With more than 20 000 bold thinkers, Aalto University is a community where science and art meet technology and business. We encourage Aalto people to find their personal strengths, goals and dream teams. The outcome is science, art and entrepreneurship that we use to build a world that is more environmentally friendly and fair – every day.

Staff: 5 000, 390 of whom are professors



Students: 20 000*, 2 400 of whom are undergraduate or post-graduate students from outside Finland



*Full-time equivalent students. The figure also includes full-time doctoral students.

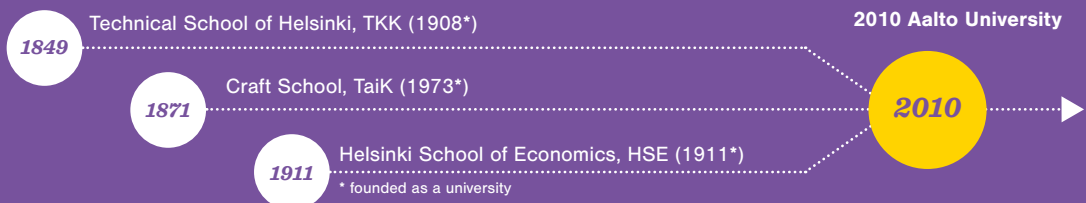
Objective:

A world-class university by 2020.

Aalto University schools

- School of Engineering
- School of Business
- School of Chemical Technology
- School of Science
- School of Electrical Engineering
- School of Arts, Design, and Architecture

History:



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