Introduction of ITEE Faculty and CWC

Prof. Jari Iinatti  
Education Dean of ITEE  
Head of CWC – Networks and Systems

Prof. Markku Juntti  
Head of CWC – Radio Technologies
University of Oulu and Faculties - Eight

Key Figures
• Established in 1958
• Total funding 240 M€
• 8 faculties
• 14 000 students
• 2 900 employees
• ~220 professors
• ~1600 researchers/teaching
• ~ 25 study programmes
• 18 international M.Sc. programs

Eight Faculties
• Oulu Business School
• Biochemistry and Molecular Medicine
• Humanities
• Education
• Science
• Medicine
• Technology
• Information Technology and Electrical Engineering (ITEE):
  – 12 Research Units
## ITEE Research Units - Twelve

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<td>CIRCUITS AND SYSTEMS</td>
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<td>CWC - NETWORKS AND SYSTEMS</td>
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<td>CENTER FOR MACHINE VISION AND SIGNAL ANALYSIS</td>
<td>PROF. OLLI SILVEN</td>
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<td>UBIQUITOUS COMPUTING</td>
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<td>EMPIRICAL SOFTWARE ENGINEERING IN SOFTWARE, SYSTEMS AND SERVICES</td>
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<td>OULU ADVANCED RESEARCH ON SERVICE AND INFORMATION SYSTEMS</td>
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<td>INTERACT</td>
<td>HUMAN COMPUTER INTERACTION AND HUMAN-CENTERED DEVELOPMENT</td>
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<td>PROF. KEIJO RUOTSALAINEN</td>
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ITEE Study Programmes - Several

Main Disciplines

Electronics and Communications Engineering
- Study programme (5 years)
- Master programme (2 years)
- International master programmes (2 years)

Computer Science and Engineering:
- Study programme (5 years)
- Master programme (2 years)
- International master programme (2 years)

Information Processing Science
- Study programme (5 years)
- Master programme (2 years)
- International master programme (2 years)

ITEE Units

Biomedical Engineering
- Master programme (2 y)
- International Master Programme (2 y)
  With Faculty of Medicine

Business Analytics
- International Master Programme (2 years)

EDUCATION EXPORT: Bachelor programme in Software Engineering with NJIT (3 y)
  With Nanjing Institute of Technology

International Degree Programme in Digitalization, Computing and Electronics (3 y)
ITEE Study Programmes

FIVE-YEAR PROGRAMS IN FINNISH BACHELOR + MASTER DEGREE

Computer Science and Engineering (120)
- Applied Computing
- Artificial Intelligence
- Computer Engineering

Electronics and Communications Engineering (105)
- Electronics Design
- Electronics, Materials and Components
- Communications Engineering
- Photonics and Measuring Technology
- RF Engineering

Information Processing Science (185)
- Information Systems
- Software Engineering

Master programmes (Finnish call)
- BME (23, with Faculty of Medicine)
- CSE (20)
- ECE (20)
- IPS (40)

INTERNATIONAL MASTER’S PROGRAMS

CSE  Computer Science and Engineering (50)
BME  Biomedical Engineering: Signal and Image Processing (30 with Faculty of Medicine)
BA   Business Analytics (15+15) (+ 20 in Business School)
SEIS  Software Engineering and Information Systems + DD-EMSE (45+15)
ELE  Electronics (30)
WCE  Wireless Communications Engineering + 2 DD-programmes (30+10)

INTERNATIONAL BACHELOR PROGRAM

DICE  International Degree Programme in Digitalization, Computing and Electronics (DICE) (48)

EDUCATION EXPORT

Software Engineering with NJIT (100 => 100)

Coming: BAS – Sustainable and Autonomous Systems
Key Figures of Centre for Wireless Communications (CWC)

• Founded 1995 as a research programme to improve collaboration between academia and industry.
• Basic operation model for the first 10-years: funding only through competition.
• Was later merged to the Faculty of ITEE as two research units:
  − CWC – Radio Technologies
  − CWC – Networks and Systems
• Research and teaching staff: ~ 200 (13 professors).
• Very international staff – more than half non-Finns.
• Total funding ~ 10 M€ / year (75% external funding).
• CWC – RT: 60 %, CWC – NS: 40 %
CWC Approach

Mission
• Research driven
• Graduates for research or business career
• New technology for real use
• Collaborate globally with companies

Objectives
• Forerunner
• Valued partner for research cooperation
• Research driven training and education
• Fast reacting
  - To the needs expressed by partners
  - Changes in the operation environment
• Interaction with the surrounding community
  - Projects realised with external funding
  - Through long-term national research partners
Wireless communications and networking
- Transceiver and radio frequency (RF) technologies
- Radio channels, antennas and propagation
- Optimization, ML, AI and algorithms
- System design, integration, verification and validation
- Wireless applications: industrial internet, medical and health, smart energy grids, security and defense
CWC’s Role in Technology Transfer

- **Spread Spectrum Technology Research**
  - 1986
  - Code Division Multiple Access Research
  - 1990

- **Multicarrier and MIMO Technology Research**
  - 1997
  - Ultra Wideband Technology Research
  - 1999

- **5G System Research**
  - 2007
  - Proposal for IEEE802.15.3a and related ASIC

- **(B)5G System & Technology**
  - 2014
  - First Cognitive network phone call utilising LTE network

- **5G Test Network**
  - 2017
  - 5G NR and System Proposals via METIS Project

- **6G Flagship Program**
  - 2017

=> See: https://www.oulu.fi/6gflagship/

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UOulu and CWC Ranking Performance

UOulu in Shanghai Ranking

UOulu in Shanghai Ranking – Telecommunications Eng.

2020 51-75
2019 48
2018 47
2017 51-75

University of Oulu

Performance in Academic Ranking of World Universities
CWC’s Research Groups

Radio Access Techniques (RAT)
Matti Latva-aho, N. Rajatheva, Hirley Alves, Onel Lopez

Communications Signal Processing (CSP)
Markku Juntti, Antti Tölli, Janne Lehtomäki

RF Engineering (RFE)
Aarno Pärssinen, Markus Berg, Marko Leinonen

Intelligent Connectivity & Networks (ICON)
Mehdi Bennis, Sumudu Samarakoon

Wireless Systems (WS)
Ari Pouttu, Marcos Katz, Jussi Haapola, Konstantin Mikhaylov

Critical Communications Systems (CCS)
Harri Posti, Harri Saarnisaari, Tuomo Hänninen

Networking (NET) & Network Security and Softwarization (NSOFT)
Mika Ylianttila, Tarik Taleb

Wireless Medical Communications (WiMeC)
Jari Iinatti, Matti Hämäläinen, Erkki Harjula
CWC-RT Personnel

• Professors:
  - Markku Juntti: Commun. Eng. and Signal Processing
  - Matti Latva-aho: Digital Communications, 6G
  - Aarno Pärssinen: Radio Frequency Engineering

• Tenure Track:
  - Mehdi Bennis (Associate Professor): Wireless Commun. Eng., Machine Learning
  - Antti Tölli (Associate Professor): Commun. Eng. and Signal Processing
  - Jack Ping Soh (Associate Professor): RF and Antenna Technologies (June 2021–)
  - Onel Lopez (Assistant Professor): Sustainable Commun. Eng.

• Professors of Practice
  - Kari Leppänen (Adjunct Professor)
  - Seppo Yrjölä (Adjunct Professor)

• University Researchers/University Lecturers
  - Italo Atzeni (Adjunct Professor)
  - Markus Berg (Adjunct Professor)
  - Marian Codreanu (Adjunct Professor)
  - Nurul Huda (Adjunct Professor)
  - Zaheer Khan (Adjunct Professor)
  - Kari Kärkkäinen (Adjunct Professor)
  - Janne Lehtomäki (Adjunct Professor)
  - Marja Matinmikko-Blue (Adjunct Professor)

• Manager Posts:
  - Pekka Kyösti, Research Director
  - Marko Leinonen: Research Manager
  - Juha-Pekka Mäkelä: Laboratory Manager
CWC-NS Personnel

• **Professors:**
  - Jari Iinatti: Communications Theory
  - Marcos Katz: Communications Engineering
  - Ari Pouttu: Dependable Wireless Systems
  - Tarik Taleb (30%): Wireless Communications Networks

• **Tenure Track:**
  - Mika Ylianttila (Associate Professor): Security in Wireless Networks
  - Konstantin Mikhaylov Convergent IoT Communications for Vertical Systems
  - Erkki Harjula (Assistant Professor): Wireless System Level Architecture for Future Digital Healthcare

• **Manager Posts:**
  - Tuomo Hänninen: Research Manager
  - Harri Posti: Research Manager
  - Olli Liinamaa: Project Manager
  - Esa Posio: Project Manager
  - Hanna Saarela: Development Manager
  - Jari Sillänpää: Laboratory Manager

• **University Researchers/University Lecturers**
  - Jussi Haapola (Adjunct Professor)
  - Matti Hämäläinen (Adjunct Professor)
  - Matti Isohookana
  - Harri Saarnisaari (Adjunct Professor)

• **Post-Doctoral Researchers/University Teachers:**
  - Timo Bräysy
  - Abdelquoddouss Laghrissi
  - Ville Niemelä
  - Johanna Vartiainen
  - Tanesh Kumar
  - Madhusanka Liyanage (20%) (Adjunct Professor)
  - Pedro Nardelli (10%) (Adjunct Professor)

• **Varying amount of**
  - Doctoral Students (y ~25)
  - Project Researchers (~5)
  - Trainees

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### Wireless Systems
- Various (new) application areas of wireless communications
- Industries, Smart grids, Autonomous mobility, Machine-type connectivity in verticals
- Test network for B5G
- Cross-vertical IoT & Light-based IoT (LIoT)

### Critical Communications Systems
- Critical and military communications
- Tactical communications
- Hybrid commercial-dedicated solutions based on LTE, 5G and B5G
- Communications waveforms and architectures for military applications

### Wireless Networks
- Network architectures
- Network Functions Virtualization (NFV)
- Mobile Edge Computing (MEC)
- Network softwarization (SDN) and security

### Wireless Medical Communications
- 5G for Hospitals
- WBAN (Wireless Body Area) Networks
- System Level Architecture for Healthcare
- Visible light communications (VLC) for medical ICT
Welcome and Good Luck!