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Centers of excellence in Optical Wireless Communications

COST ACTION 19111 NEWFOCUS





This presentation is based upon work from COST Action NEWFOCUS, supported by COST (European Cooperation in Science and Technology).



ΟΚΑΤΕΜ

- Activity:
 - Short and long range OWC
- Group leader: Prof. Murat Uysal
- Web: <u>faculty.ozyegin.edu.tr/muratuysal/</u>
- Key facilities
 - Athmospheric chamber
 - XYZ Table
 - Pointing error
 - Goniophotometer -
 - LED illumination pattern
 - Underwater tank of 8 m long
 - USRP and PXIs2



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• Signal generation, waveform design



Turkey









Wireless and Fiber Optics

- Activity:
 - FSO, VLC, Radio over optics
 - Optical fiber systems and sensors
- Web: <u>optics.elmag.org</u>
- Group leader: Prof. Stanislav Zvanovec
- Key facilities

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- 3 outdoor FSO links and 2 weather stations on roofs
- 6m turbulence chamber
- Fiber coupled 50-100m links
- Electrical and optical oscilloscopes
- Signal generators
- Cameras, LEDs, Optical Sources, Amplifiers, Photodetectors
- Optical modulators, Spectral/Vector Analizers, Optical collimators, Variable attenuator



Czech Technical University in Prague Czech Republic





Wireless and Fiber Optics

Czech Republic



SIX Research Centre/Dept. of Radio Electronics/OptaBro

group Activity

- Communication, information and sensor technology
- Web: <u>www.six.feec.vutbr.cz</u>
 - www.urel.feec.vutbr.cz/optabro/
- Group leaders: Dr. Lucie Hudcová, Dr. Peter Barcík
- Key Facilities

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- Atmospheric chamber
- Tunable Wavelength Laser
- Signal Quality Analyzer
- Laser Beamprofiler
- High Resolution Fiber Optic Spectrometer
- IR Fourier Spectrometer
- EDFA Fiber Amplifier
- Recorder Logoscreen

Czech Republic

SIX Research Centre/Dept. of Radio Czech Republic Electronics/OptaBro group

Research laboratory of optical communiations

Electronics and IoT

- Activity
 - Analogue and digital applications
- Group leader:
 - Prof. Frank Young Li
- Key facilities
 - Analogue and digital electronics

Fresnel Institute

- Activity
 - VLC, FSO, Underwater communication
- Web: <u>fresnel.fr</u>
- Group leader: dr. Ali Khalighi
- Key facilities
 - Water tank
 - Electrical and digital oscilloscopes
 - Signal generators
 - BiasT
 - LEDs
 - Laser diode, Laser diode controller
 - Photodetectors,
- NEWFOCUS
 - Broadband dielectric mirror, DC generator

Fresnel Institute

• Key facilities

France

Optical Communications Research Group

- Activity:
 - FSO, VLC, Radio frequency
 - Optical camera communications
- Web: <u>Optical_research_group</u>
- Group leader: Prof. Z. Ghassemlooy
- Key facilities
 - Indoor atmospheric chamber
 - Fog/smoke and turbulence generators
 - Traffic light
 - High spec test and measurement up to 30 Gbps
 - Precision Thermoelectric Temperature Controllers
 - Cameras, Photodetector, Optical receover, Optical power meter
 - 3D printers, Circuit simulators, FPGA Boards
- OLEDs, Optics, Optical attenuators

United Kingdom

Optical Communications Research Group

United Kingdom

XLIM UMR 7252/ SRI axis /SYCOMOR group

- Activity
 - Optical wireless communications (OWC);
 - Channel modeling; Channel coding
 - Wireless Body area networks;
 - Software defined radio; Energy harvesting and OWC

Application domains:

• e-health, smart cities, smart buildings, smart factory, aeronautical The SYCOMOR team has developed different testbed to illustrate the main activities and compare with theoretical and simulated environment results for both IR and VLC links.

- Web: <u>xlim.fr</u>
- Group leaders: Pr. Anne Julien-Vergonjanne, Dr. Pierre Combeau

XLIM UMR 7252/SRI axis /SYCOMOR group

France

- Key facilities:
 - RAPSOR software Channel modeling by simulation for IR and VLC
 - SDR optical testbed Bidirectional SDR based IR links LOS and NLOS
 - IR wearable testbed Optical WBAN testbed: Off-body uplink
 - VLC testbed

Kista High-Speed Transmission Lab (Kista HST-Lab)

- Owned by:
 - KTH Royal Institute of Technology
 - RISE Research institute of Sweden
- Activity
 - Fiber-Wireless (Fi&Wi) in THz and mid-IR ranges
 - High-speed short-reach communications and devices
 - Coherent optical communications
 - Digital and photonic-assisted signal processing techniques
 - Quantum communications for secure Datacenter interconnects
 - Resource efficiency and TCO analysis for fiber-wireless networks
- Web: <u>aphys.kth.se</u>
- Group leader: Dr. Xiaodan Pang

Sweden

Sweden

Kista HST-Lab

- Key facilities
 - RF synthesizer
 - BIT-pattern generator and error detector, 2 synchronized units of arbitrary waveform generator (AWG), Real time oscilloscope
 - Mid-infrared quantum cascade lasers at 4- μm and 9- μm
 - Mid-infrared detector, Probe station, Simulation Software MATLAB

Department of Telecommunications Faculty of electrical Engineering University of Banja Luka

Bosnia and Herzegovina

- Activity
 - Wireless sensor networks and Internet of Things protocols and applications
 - Mobile wireless communication systems of the next generation
 - Positioning in wireless telecommunication networks
 - Conventional wired and wireless telecommunications
 - Antennas, radio-communications and modern RF/Microwave engineering
 - Voice communications
 - Nano-scale and molecular communications.
- Web: etf.unibl.org; communications.etfbl.net
- Group Leader: Prof Gordana Gardašević

Department of Telecommunications

Bosnia and Herzegovina

• Key facilities

- IoT testbed is based on industrial OpenMote WSN hardware devices
- OpenMote open-hardware platforms that is particularly adapted to Industrial Internet of Things (IIoT) aplications
- Heterogeneous IoT testbeds includes:
 - IEEE 802.15.4 sensor nodes, LoRa nodes, NB-IoT nodes, Raspberry Pi and Arduino kits

The testbed consists of:

host computer running Ubuntu with OpenWSN (latest release 1.22.0) and OpenVisualizer (OV)
one 10/100Mb Ethernet switch
four Raspberry Pi 3 devices
16 OpenMote-B devices

- 5 Ethernet cables (cat 5e)
- 16 USB2.0 cables

TI CC2538 SoC (32kb RAM, 512kb Flash)

- □ Simultaneous dual-radio operation (868 MHz and 2.4 GHz)
- Atmel AT86RF215 SubGHz radio (868/915MHz), supports all IEEE 802.15.4g modulation
- First board that fully supports the IEEE 802.15.4g standard including MR-OFDM modulations for robust communications
- 4x Leds indicators
- 2xAA Battery placeholder
- 2.4GHz SMA Antenna
- SubGHz SMA Antena
- Programming over BSL

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Department of Communications and Networking

- Activity
 - Wireless communications,
 - Information and communications theory
- Web: <u>https://www.aalto.fi/en/department-of-communications-and-networking</u>
- Group Leader: Dr. Alexis Dowhuszko <u>alexis.dowhuszko@aalto.fi</u>

Fig. 1: Overview of the software defined VLC link using off-the-shelf LEDs and Photodetectors.

Fig. 2: Sample layout of a software-defined demo for VLC-based ranging and object identification

Finland

Department of Communications and Networking

Finland

• Key facilities

	Equipment /	Description	Use for OWC
	device/software		
	Software-defined VLC demonstrator	USRP-based demonstrator for fast prototyping of signal processing algorithms. Includes LED drivers, Photodetectors, and Low-frequency TX/RX daughterboards for the USRPs.	 Implementation of OFDM-based waveforms. Pre-distortion and post-distortion compensation of non-linear and memory effects introduced by LEDs Channel state information acquistion for VLC-based indoor monitoring
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Centers of excellence in Netherlands

- TU/e Electro-optical Communication Group
 - Web: tue.nl
 - Group leader: Dr. Ir Joanne Oh
- TU Delft Space Institute
 - Web: spaceinstitute.tudelft.nl
 - Group leader: Prof. Eberhard Gill
- Photondelta Eindhoven private partner
 - Web: photondelta.com
 - Group leader: Ewit Roos
- TU/e Signal Processing Systems Group & Signify Company
 - Web: signify.com
 - Group leader: Dr. Ir. Jean-Paul Linnartz

Where innovation starts

