Signal Processing LABORATORY

http://www.splab.cz

# Brno University of Technology

## Faculty of Electrical Engineering and Communication

## Department of Telecommunications

esf european social fund in the czech republic
EUROPEAN UNION
MINISTRY OF EDUCATION, YOUTH AND SPORTS
OP Education for Competitiveness
INVESTMENTS IN EDUCATION DEVELOPMENT

# Introduction

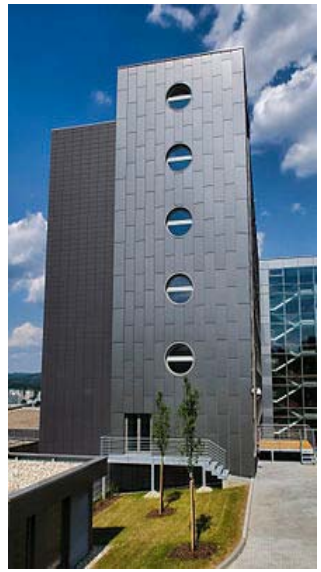
- BUT is the second *largest technical university* in the Czech Republic with 23,000 students currently studying.
- It was founded in 1849 and offers a wide array of technical sciences.
- It has 8 faculties.
- In 2009 ***The Times Higher Education Supplement*** in the area of engineering and IT 245$^{th}$ place world-wide.
- Awarded the European Commission's prestigious ECTS and DS Label certificates


## Faculties

- Faculty of Architecture
- **Faculty of Electrical Engineering and Communication**
- Faculty of Chemistry
- Faculty of Information Technology
- Faculty of Business and Management
- Faculty of Civil Engineering
- Faculty of Mechanical Engineering
- Faculty of Fine Arts

# Faculty of Electrical Engineering and Communication

- Consists of 12 departments with about 190 teachers, 360 PhD students, and approximately 4000 BSc and MSc students.
- **Departments**
  - Department of Control and Instrumentation
  - Department of Biomedical Engineering
  - Department of Electrical Power Engineering
  - Department of Electrical and Electronic Technology
  - Department of Physics
  - Department of Foreign Languages
  - Department of Mathematics
  - Department of Microelectronics
  - Department of Radio Electronics
  - **Department of Telecommunications**
  - Department of Theoretical and Experimental Electrical Engineering
  - Department of Power Electrical and Electronic Engineering




# Department of Telecommunications

- Professional education in telecommunication technology ranging from communication theory, communication networks and systems, data transmission and encryption, up to multimedia data processing
  Number of students: BSc: 520, MSc: 314, PhD: 63

- Bachelor, Master and PhD study programmes in Teleinformatics and Telecommunication and Information Technologies.

- Research mainly focuses on Telecommunication and Network Systems, Signal Processing and Analog Technique.


# Research Groups

- **DINES** (The Distributed Network Systems)
  - http://www.dinesgroup.org/
  - DINES focuses on communication in IP and wireless sensor networks. They particularly are interested in (geo)localization).

- **SeCReG** (Security and Cryptography Research Group)
  - http://secreg.utko.feec.vutbr.cz/en
  - Cryptology and Computer Security.

- **QoSip** (Quality of Service in IP Networks)
  - http://qosip.cz/en
  - QOSIP research group is interested mainly in QoS support mechanisms operation on the network (DiffServ) and data link layer (Ethernet, WiFi, WiMAX).

- **SPLab (Signal Processing Laboratory)**
  http://spl.utko.feec.vutbr.cz/en

Signal Processing LABORATORY

http://www.splab.cz

# Introduction of the Signal Processing Laboratory

There in nothing quite as practical as a good theory

esf european social fund in the czech republic
EUROPEAN UNION
MINISTRY OF EDUCATION, YOUTH AND SPORTS
OP Education for Competitiveness
INVESTMENTS IN EDUCATION DEVELOPMENT

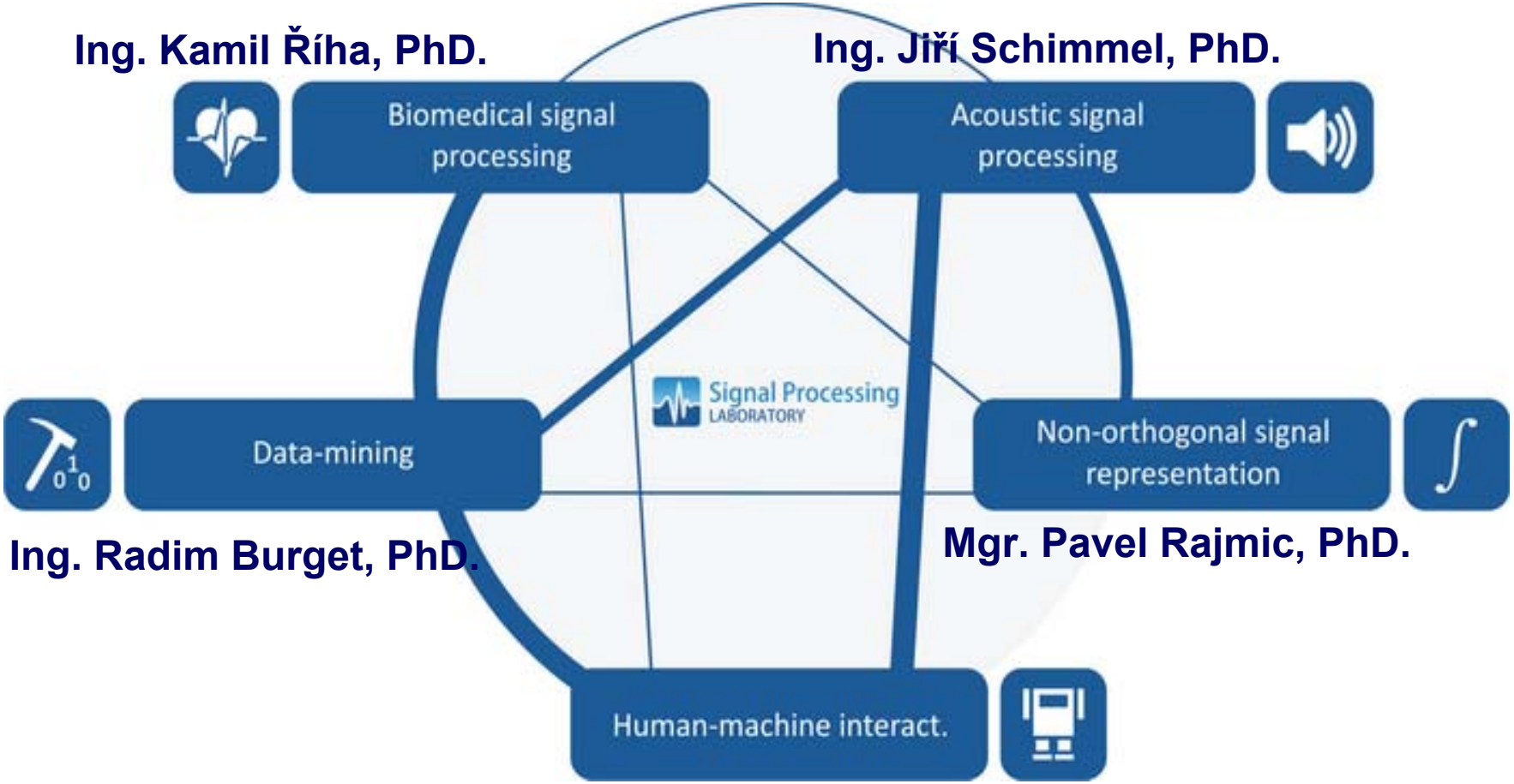
# Who we are

There in nothing quite as practical as a good theory

**Kurt Lewin**

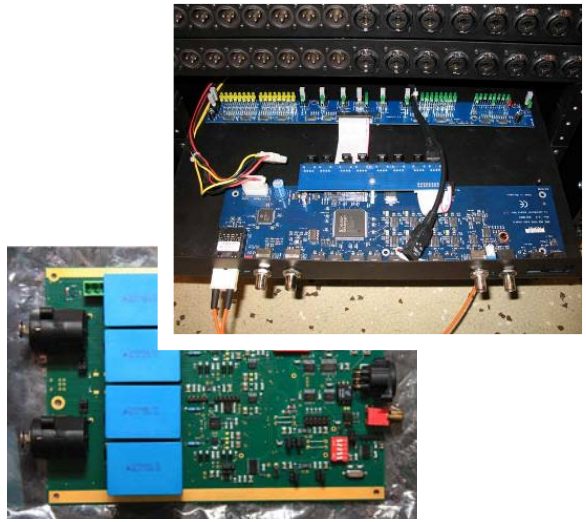
- Team leader: prof. Ing. Zdeněk Smékal, CSc.
  e-mail: smekal@feec.vutbr.cz
- 9 members
- 12 Ph.D. students

# Who we are


Ing. Kamil Říha, PhD.
Ing. Jiří Schimmel, PhD.
Biomedical signal processing
Acoustic signal processing
Signal Processing LABORATORY
Data-mining
Non-orthogonal signal representation
Ing. Radim Burget, PhD.
Mgr. Pavel Rajmic, PhD.
Human-machine interact.
Ing. Hicham Atassi

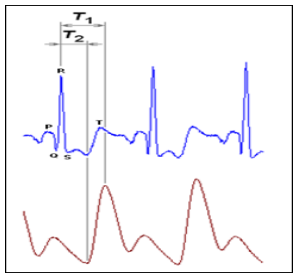
# Audio and Acoustic

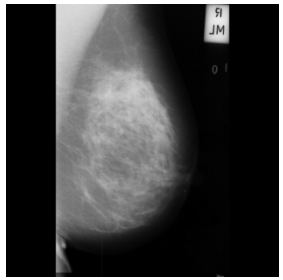
- Sound source localization, blind source separation
- Digital audio processing for music (audio effects)
- Noise cancellation in speech or other signals
- Real-time audio processing on PC and DSP
- Nonlinear audio system modeling
- Multichannel audio applications

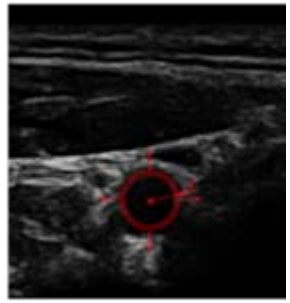



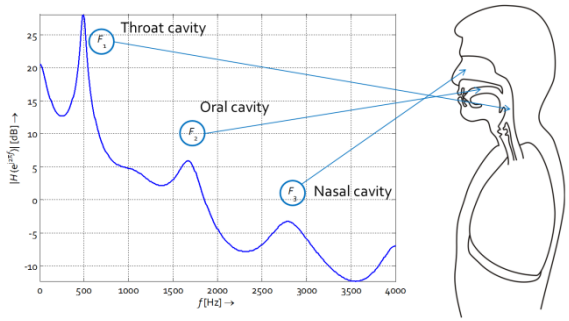
# Biomedical Signal Processing

- Biomedical sensors design and signal processing
- Signal processing for computer tomography and magnetic resonance 3D data
- Ultrasound images and video sequences processing
- Medical hardware designing (specialized microprocessor controlled equipment)
- Diagnosis of nervous system disorders from speech



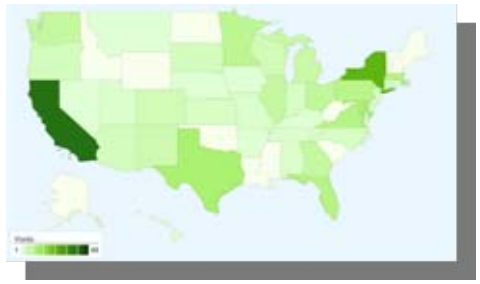



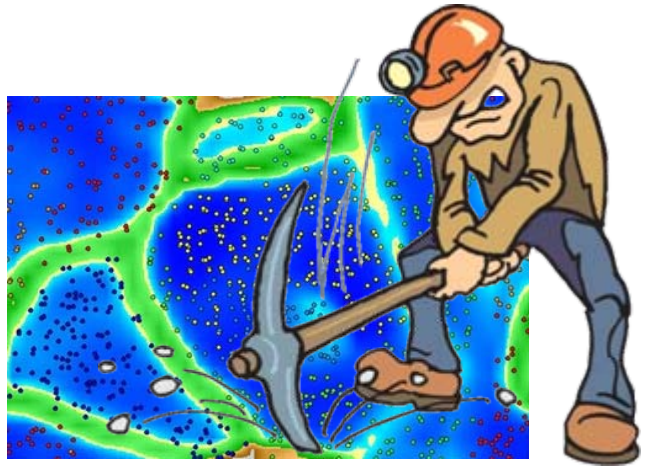




# Data-Mining

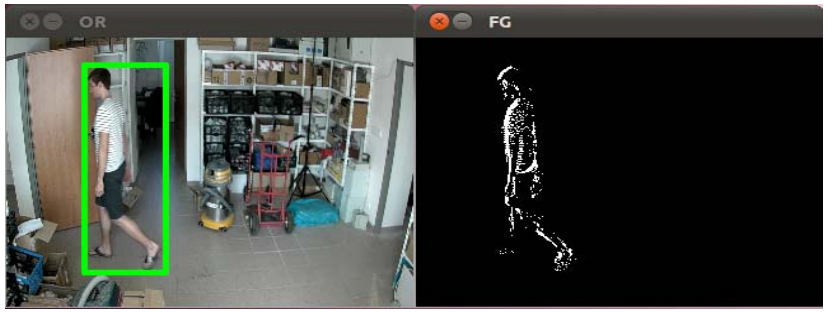
- Open-source tool for Image mining and Image Processing
- Image Mining Extension with OpenCV and ImageMining
- Genetic algorithms and genetic programming
- Evolutionary optimization techniques





# Human-Machine Interaction

- Speech and speaker segmentation
- Speech disorders detection and recogntion
- Multimodal emotion recognition, gesture recognition
- Text processing (helpdesk analysis)
- Body detection, gait recognition, face detection and recognition
- Image processing in the infrared and thermal spectrum
- 3D scene acquisition and spatial displaying




# Non-Orthogonal Signal Representation

- Orthogonal and non-orthogonal representing systems
- Wavelets
  - Segmentwise wavelet transform (1D, 2D)
  - Image compression (modifications to SPIHT via SSIM)
- Curvelets, Contourlets, Shearlets etc.
  - Audio and image inpainting
  - Extrapolation of signals
  - Image interpolation for resizing
- Sparse signal processing
- Compressed sensing
- Advanced mathematical background for other groups

# Laboratories

- Laboratory of Signal Processors
- Laboratory of Audio Systems
- Acoustic Laboratory
- Anechoic Chamber
- Multimedia Laboratory
- …

# Laboratories

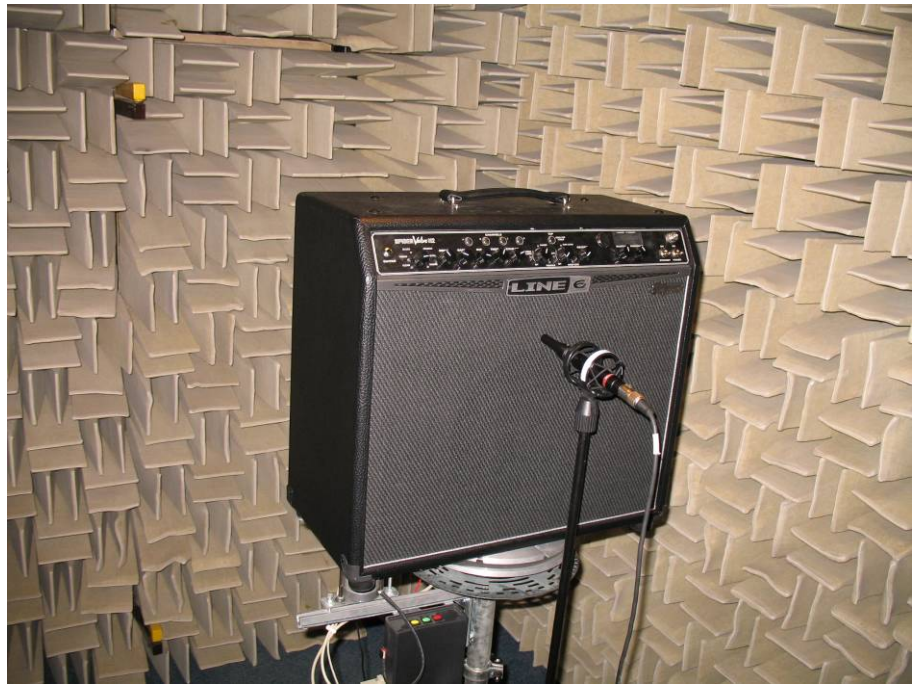
- Laboratory of Signal Processors
- Laboratory of Audio Systems
- Acoustic Laboratory
- Anechoic Chamber
- Multimedia Laboratory
- …

# Laboratories

- Laboratory of Signal Processors
- Laboratory of Audio Systems
- Acoustic Laboratory
- Anechoic Chamber
- Multimedia Laboratory
- …

# Laboratories

- Laboratory of Signal Processors
- Laboratory of Audio Systems
- Acoustic Laboratory
- Anechoic Chamber
- Multimedia Laboratory
- …

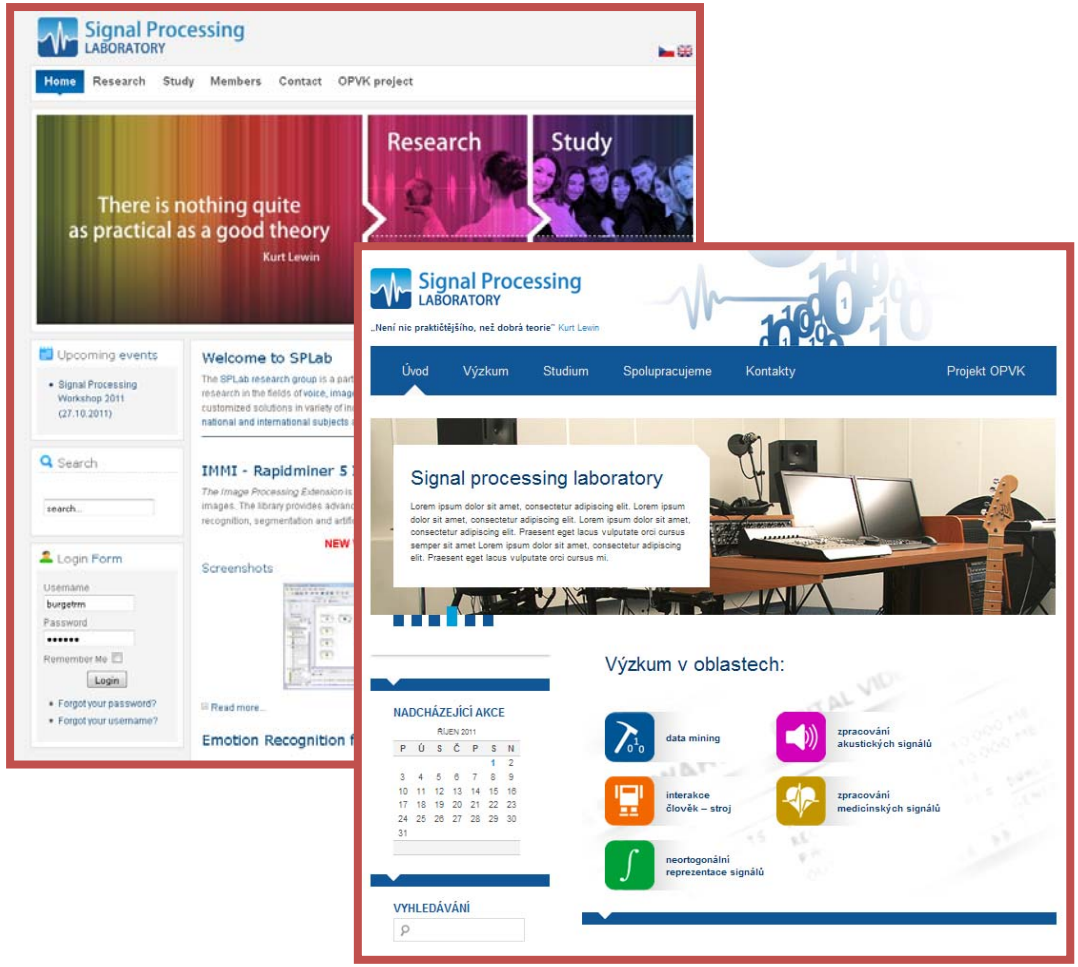


# Laboratories

- Laboratory of Signal Processors
- Laboratory of Audio Systems
- Acoustic Laboratory
- Anechoic Chamber
- Multimedia Laboratory
- …

# Website

- **Old Website**
  **http://spl.utko.feec.vutbr.cz**
- **New Website**
  **http://www.splab.cz**



# Funding

- Spatial Acoustics Effects for Systems of Multi-Channel Digital Audio Processing (Ministry of Industry and Trade, 2006-2009, 440K EUR)
- Manifold System for Multimedia Digital Signal Processing (Ministry of Industry and Trade, 2009-2012, 520K EUR)
- Media-informatics system for support of advanced multimedia services (Ministry of Industry and Trade, 2010-2013, 667K EUR)
- Research and development system for product processes optimization (Ministry of Industry and Trade, 2009-2013, 649K EUR)
- The Research of Algorithms for Processing of Digital Images and Image Sequences (Ministry of Education,Youth and Sports, 2010-2012, 100K EUR)
- Improvement of risk area security using combined methods for biometrical identification of subjects (Ministry of Interior, 2010-2014, 900K EUR)
- Advanced speech analyses technology for call centers and security services, (Ministry of Industry and Trade, 2009-2011, 500K EUR)

# Cooperation with Industry












# European Social Fund Project

- **Project title:** Support for incorporating R&D teams in international cooperation in the area of image and audio signal processing
- **Duration planned:** 3 years, beginning on 1st May 2011
- **Number:** CZ.1.07/2.3.00/20.0094
- **Project purpose:** The project will serve as a basis for preparing international collaboration of academic staff and students in the field of signal processing.
- **Project activities:** Reciprocal short time stays for representatives of the academic community and students, lectures of foreign experts at the Brno University of Technology, education training of academic and students in the use of modern-trend tools in the area of digital signal processing, workshops, and more.

esf european social fund in the czech republic
EUROPEAN UNION
MINISTRY OF EDUCATION, YOUTH AND SPORTS
OP Education for Competitiveness
INVESTMENTS IN EDUCATION DEVELOPMENT

# Signal Processing Workshop

- The objectives of the workshop are:
  - to introduce research activities of the participating groups,
  - to share knowledge,
  - to discuss possible areas of further cooperation,
  - to strengthen links between the participants.
- Another two bigger meetings are planned for Octobers 2012 and 2013.
- We hope that the workshops will continue after that and last forever ☺

esf european social fund in the czech republic
EUROPEAN UNION
MINISTRY OF EDUCATION, YOUTH AND SPORTS
OP Education for Competitiveness
INVESTMENTS IN EDUCATION DEVELOPMENT

# Thank you for your attention


http://www.splab.cz