

One-semester projects for foreign students – Dept. of Mathematics – 13101

(<http://math.feld.cvut.cz>)

Preservers in Quantum Information Theory

Advisor: Prof. RNDr. Jan Hamhalter, CSc., hamhalte@math.feld.cvut.cz

Recently many new results on preservers of important quantities in quantum information theory such as mutual quantum information and entropy have appeared. However, many open and challenging questions in this area remain. In the project proposed we would like to concentrate on characterizing maps on quantum systems preserving important information metrics. The method will be based on studying existing methods in the literature and own investigation of the properties of quantum information for finite dimensional spaces. The work should result in a treatment and possibly in journal publication.

Requirements: Strong background in Linear Algebra and Calculus.

References (the project is closely related to work presented in the following papers):

- [1] Lajos Molnar, “Maps on states preserving the relative entropy”, Journal of Mathematical Physics 49, 032114, 2008.
- [2] Michael A. Nielsen and Isaac L. Chuang, “Quantum Computation and Quantum Information”, Cambridge University Press, 2000.
- [3] J. Hamhalter, “Quantum Measure Theory”, Springer 2003, Dordrecht, Boston, London.

Faculty of EE, CTU in Prague – Exchange project

Suitable for: Ph.D. student, (advanced MS. Student)

Exchange Project: Statistical model of line of sight shadowing of GNSS satellites

Supervisor: Pavel Kovar, Assoc. Prof. (kovar@fel.cvut.cz),

Department: Department of Radio Engineering, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (www.radio.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

The project aims is to develop a statistical model of a shadowing of a line of sight of the GNSS satellites for various realistic environments. The theoretical part will cover selection of an appropriate stochastic process for modeling of the satellite shadowing and its implementation to the MATLAB or MATLAB Simulink. The experimental part will cover extensive data collection campaign that will serve for model parameters adjustment and model verification. The developed model will serve for generation of the simulation scenario for the GNSS simulator.

Requirements/prerekvizities: Strong basics in mathematics, physic, signal processing, radio engineering, satellite navigation and knowledge of MATLAB and Simulink.

Recommended subjects to be studied at the Department of radio engineering:

Signal and systems

Communication systems

Radio systems

[1] Aloj, D.; Alsiety, M., Akos, D.: A Methodology for the Evaluation of a GPS Receiver Performance in Telematics Applications, IEEE Tans. Instrumentation and measurement, vol. 56, no. 1, Feb. 2007.

[2] Martin-Escalona, I., Barcelo-Arroyo, F., de la Fuente, A.: On the Availability of GNSS and Terrestrial Location Techniques: A Field Study. In Vehicular Technology Conference, 2008. VTC Spring 2008. IEEE , pp.2760,2763, 11-14 May 2008

[3] Lutz, E.: A Markov Model for Correlated Land Mobile Satellite Channels, International Journal of Satellite Communication, vol. 14, pp 333-339, 1996.

[4] Kovář, P., Seidl, L., Vejražka, F.: Availability of the EGNOS Service for a Land Mobile User. In Proceedings of the Position Location and Navigation Symposium - PLANS 2006. Piscataway: IEEE, 2006, p. 524-530. ISBN 0-7803-9454-2.

Implementation, simulation and performance evaluation of modulation, coding and synchronization algorithms in multi-node multi-user wireless networks

Supervisor: **prof. Ing. Jan Sykora**

Jan.Sykora@fel.cvut.cz, <http://radio.feld.cvut.cz/~sykora/>

Digital Radio Communications (DiRaC) research group

Required student profile: Ph.D. or advanced MS. student with good understanding of digital communication theory – PHY layer algorithms, modulation, coding, signal processing

Suitable supporting courses that can be studied at CTU:

Coding in Digital Communications (AE2M37KDK) (spring term)

Synchronization and Equalization in digital communications (AE0M37SEK) (fall term)

Duration of project: 1 term

The target of the project is an implementation, simulation and performance evaluation of PHY layer algorithms (modulation, coding and synchronization signal processing) with the focus on wireless network coding in multi-node and multi-user scenarios. The implementation is done either using MATLAB based simulation environment and/or implementing the algorithms into the experimental transceiver HW kit (Ettus). The implementation requires deep understanding of the principles of the communication theory, the signal processing and elements of the information theory. The project is expected to have also a theoretical output complementing the implementation work.

**Faculty of Electrical Engineering
Czech Technical University in Prague**

Student's Exchange Project

Automated Impedance Measurement and Model Fitting

Intended for: M.Sc. students

Supervisor: Štěpán Matějka

Duration: 1 semester

Affiliation: Department of Radioengineering (<http://radio.feld.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: The project is focused on the impedance measurement, analysis, and component model fitting. One part of the project consists in automated remotely controlled impedance measurement and data collection using the specialized measurement instrument equipped with GPIB. The second part engages in mathematical analysis of measurement results and fitting parameters of appropriate component model. Both the measurement & analysis are supposed to be implemented in the MATLAB programming language. The expected results are model numerical parameters and graphical plots.

Requirements: Basic skills in programming (MATLAB), circuit theory, mathematical optimization and regression analysis, automated measurements.

References: [1] Callegaro, L.: *Electrical Impedance: Principles, Measurement, and Applications*. CRC Press, 2013.
[2] Coombs, C. F.: *Basic Electronic Instrument Handbook*. McGraw-Hill Inc., US; 2nd edition, 1972.
[3] Yang, Xin-She: *Introduction to Mathematical Optimization. From Linear Programming to Metaheuristics*. Cambridge International Science Publishing, 2008.
[4] Singh, Y. K., Chaudhuri, B. B.: *MATLAB Programming*. PHI Learning Pvt., 2007.

Faculty of EE, CTU in Prague – Exchange project

Suitable for: Ph.D. student, (advanced MS. Student)

Exchange Project: Modal Analysis of Electrically Small Radiators)

**Supervisors: ass. Prof. Pavel Hazda, (hazdrap@fel.cvut.cz),
Prof. Milos Mazánek (mazanekm@fel.cvut.cz)**

Department: Department of Electromagnetic Field (DEF), Faculty of Electrical Engineering, Czech Technical University CTU in Prague (www.elmag.org)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is aimed on characteristic mode analysis of small antennas/radiators. These very illustrative elementary solutions are obtained by decomposition of the Method of Moments impedance matrix. DEF has number of in-house MATLAB codes including mesh generator, MoM code, characteristic mode analyzer etc. The challenging study will involve deep analysis of topological properties of small antennas related to radiation efficiency, radiation Q-factor, bandwidth and gain.

Requirements: Strong basics in the area of electromagnetics and antenna theory, knowledge of MATLAB and some EM simulation software (CST/HFSS/FEKO...)

Recommended subjects to be studied at the DEF:

Antennas and EMC in Radiowave Communication (available for spring semester)

Computer Aided Modeling of Fields (spring semester)

Terrestrial and Satellite Radio links (fall semester)

Antenna Design and Technology (fall semester)

Perspectives in Millimetre and Submillimetre Technology (spring semester)

Selected Chapters of Antenna Technologies and Propag. of Electromag. waves (PhD subject)

Electrodynamics (Ph.D. studies)

References (the project is closely related to work presented in the following papers):

[1] G. A. E. Vandenbosch, "Reactive energies, impedance, and Q factor of radiating structures," IEEE Trans. Antennas Propag., vol. 58, no. 4, pp. 1112–1127, Apr. 2010.

[2] A. D. Yaghjian and S. R. Best, "Impedance, bandwidth and Q of antennas," IEEE Trans. Antennas Propag., vol. 53, no. 4, pp. 1298–1324, April 2005

[3] R. F. Harrington and J. R. Mautz, "Theory of characteristic modes for conducting bodies," IEEE Trans. Antennas Propag., vol. 19, no. 5, pp.622–628, Sept. 1971.

[4] M. Capek, P. Hazdra, and J. Eichler, "A method for the evaluation of radiation Q based on modal approach," IEEE Trans. Antennas Propag., vol. 60, no. 10, pp. 4556–4567, Oct. 2012.

[5] Sievenpiper, D. F., et al., "Experimental validation of performance limits and design guidelines for small antennas," IEEE Trans. Antennas Propag., vol. 60, no. 1, pp. 8–19, Jan. 2012,

[6] Eichler, J., Hazdra, P., Čapek, M., Mazánek, M.: Modal Resonant Frequencies and Radiation Quality Factors of Microstrip Antennas. IJAP, Vol. 2012, 9 pages.

PhD theses of CTU in Prague, University of Valencia, University of Oulu (available at CTU)

Faculty of Electrical Engineering, CTU in Prague – Exchange project

Suitable for: Ph.D. student, (advanced MS. Student)

Exchange Project: Diversity techniques for Wireless Optical Networks

Supervisor: Associate Prof. Stanislav Zvanovec, (xzvanove@fel.cvut.cz),

Department: Department of Electromagnetic Field (DEF), Faculty of Electrical Engineering, Czech Technical University CTU in Prague (www.elmag.org)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is aimed on analyses and propagation modeling of single and multiple free space optical (FSO) links influenced by atmospheric phenomena. Along with theoretical part, measurements related to channel characterization will be carried out in laboratories of Czech Technical University in Prague and data from outdoor FSO network will be analyzed. The challenging study will involve deep analysis of topological properties of FSO networks and their implementation within ad-hoc networks.

Requirements: Strong basics in the area of electromagnetics and optics, knowledge of MATLAB

Recommended subjects to be studied at the DEF:

Optical Communication Systems (available for fall semester)

Terrestrial and Satellite Radio links (fall semester)

Measurement of Fiber Optical Communications (fall semester)

Computer Aided Modeling of Fields (spring semester)

Perspectives in Millimetre and Submillimetre Technology (spring semester)

Optical Fibers (PhD subject)

Electrodynamics (Ph.D. studies)

Selected Chapters of Antenna Technologies and Propag. of Electromag. waves (PhD subject)

References (the project is closely related to work presented in the following papers):

- [1] A. Kashyap, et al., "Integrated topology control and routing in wireless optical mesh networks," *Computer Networks*, vol. 51, pp. 4237-4251, Oct 24 2007.
- [2] S. Zvanovec, J. Perez, S. Rajbhandari, J. Libich, Z. Ghassemlooy, Route diversity analyses for wireless optical links within turbulent scenarios, *Optics Express*, submitted, 2012
- [3] J. Libich, et al., "Mitigation of time-spatial influence in free-space optical networks utilizing route diversity," *Free-Space Laser Communication Technologies Xxiv*, vol. 8246, 2012.
- [4] S. Kaneko, et al., "Evaluation of a free-space optical mesh network communication system in the Tokyo metropolitan area," *J. Opt. Netw.*, vol. 1, pp. 414-423, 2002.
- [5] X. Yang, "Availability-differentiated service provisioning in free-space optical access networks," *J. Opt. Netw.*, vol. 4, pp. 391-399, 2005.
- [6] Z. Hu, et al., "Improved reliability of free-space optical mesh networks through topology design," *J. Opt. Netw.*, vol. 7, pp. 436-448, 2008.
- [7] M. N. Smadi, et al., "Free-Space Optical Gateway Placement in Hybrid Wireless Mesh Networks," *J. Lightwave Technol.*, vol. 27, pp. 2688-2697, 2009.

Faculty of Electrical Engineering, CTU in Prague – project for visiting student

Suitable for: Ph.D. student or advanced MSc. student

Exchange project: Optimization of Lead-Free Soldering Process

Supervisor: Karel Dusek (dusekk1@fel.cvut.cz), Pavel Mach (mach@fel.cvut.cz)

Department: Department of Electrotechnology, Faculty of Electrical Engineering, Czech Technical University in Prague

Duration: 1-2 semesters

Abstract

Lead-free soldering, which substituted tin-lead soldering in accordance with the RoHS EU Directive, is joined with many problems. Properties of joints differ for different types of surface finishes of joined parts, are strongly dependent on the type and parameters of a soldering process and on properties of lead-free solder alloys. The goal of the work is to optimize a soldering process (vapor soldering, soldering in a tunnel oven) parameters for more types of lead-free solders and three types of surface finishes to form a lead-free joint with electrical and mechanical properties comparable with properties of joints formed of tin-lead solders. The task is directed to:

1. Analysis of parameters of solders and soldering process, which dominantly influence parameters of soldered joints formed of lead-free solders.
2. Design of layout of test boards with three types of pads surface finishes (Cu, ENIC, HAL) for measurement of electrical parameters of soldered joints.
3. Forming of test samples of solder joints by SMT assembly of jumpers on the test boards. The joints will be formed of selected types of lead-free solders on three types of surface finishes (Cu, ENIC and HAL). Different parameters and types of a soldering process (vapor soldering, soldering in a tunnel oven) will be used.
4. Measuring of electrical and mechanical parameters of solder joints.
5. Discussion of results.

Requested knowledge: Packaging in electronics, electrically conductive jointing in electrical engineering.

Recommended subjects to be studied:

AE1B13VST – Power components and technology (summer semester)

AE1B13MVP – Materials for power electrical engineering (winter semester)

Literature

1. Dusek, K., Nahlik, V., Beshajova Pelikanova, I.: Solderability and aggression comparison of commonly used fluxes. Proc. RDS 2012, Brno, 2012
2. Henshall, G., Bath, J., Handwerker, C. A.: Lead-free solder process development. IEEE Press, 2011

Faculty of Electrical Engineering, CTU in Prague – project for visiting student

Suitable for: Ph.D. student or advanced MSc. student

Exchange project: Spark Plasma Sintering and Plasma Spray Technology of Silicates

Supervisor: Josef Sedlacek (sedlacek@fel.cvut.cz), Pavel Ctibor (ctibor@ipp.cas.cz)

Department: Department of Electrotechnology, Faculty of Electrical Engineering, Czech Technical University in Prague

Duration: 1 – 2 semesters

Abstract

Project is focused on comparison of two technologies, plasma spray coating and newly developed process spark plasma sintering (or field - assisted sintering technology). A set of silicate samples will be used for the comparison. Especially, the micro-structural and electric properties of prepared samples will be considered. The task is directed to:

- 1) Theoretical study of processes SPS and plasma spray technology and familiarization with production equipment
- 2) Sample fabrication of selected silicates.
- 3) Metallographic treatment, crystallographic assessment and XRD measurement of samples.
- 4) Sample preparation for the dielectric measurement.
- 5) Complex assessment of dielectric and transport properties of samples.
- 6) Comparison both technologies.

Requested knowledge: Chemistry of silicates, Solid states physics, Physics of dielectrics.

Recommended subjects to be studied:

AE1B13VST – Power components and technology (summer semester)

AE1B13MVP – Materials for power electrical engineering (winter semester)

Literature:

- 1) Chanthapan, S., Rape, A., Gephart, S., Kulkarni, A. K., Singh, J.: Industrial Scale Field Assisted Sintering an Emerging Disruptive Manufacturing Technology, Advanced Materials & Processes, July 2011.
- 2) Chanthapan, S., Rape, A., Gephart, S., Kulkarni, A. K., Singh, J.: Industrial Scale Field Assisted Sintering an Emerging Disruptive Manufacturing Technology: Applications, Advanced Materials & Processes, August 2011.
- 3) Welcome to the SPS World: SPS Syntex Inc. Presentation, 2011.
- 4) P. Ctibor, J. Sedláček: Spectroscopic and Dielectric Characterization of Plasma Sprayed Titanates, Advances in Ceramics - Characterization, Raw Materials, Processing, Properties, Degradation and Healing, C. Sikalidis, Ed., InTech, Wien, Austria, 2011, ISBN 978-953-307-504-4, pp. 19-38

Using anti-collision system data for radar-like visualization (ST, BT, DT)

- Intended for: B.Sc. or M.Sc. students
- Supervisor: [Miroslav Macík](#)
- Duration: 1 semester
- Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague
- Assignment: Small aircrafts or gliders are more and more likely equipped with anti-collision systems. In case of small aircrafts or gliders in EU are these systems typically based on GPS-data broadcasting and use soon-to-be standardized FLARM protocol. Another system that is typical for medium sized aircrafts and airlines is ADS-B. Analyze anti-collision systems and corresponding data protocols. Perform a feasibility study of usage of the provided data for ground based, radar like situation awareness system. Design and implement a prototype system that consists of a prototype FLARM (ADS-B) receiver and corresponding visualization system on a case of a small national airfield. Test the system in real environment and identify pros and cons of such a solution.



- Requirements: Basic skills in programming.

COLLADA Viewer in WebGL

Intended for: M.Sc. students

Supervisor: [Prof. Žára](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: Analyze existing software components for reading/parsing COLLADA format for 3D objects/scenes. Implement web-based COLLADA viewer on top of WebGL or other Javascript libraries. The viewer will display arbitrary COLLADA scene and allow camera manipulation using virtual trackball. Implement also the following functionalities: automatic 3D extent calculation, listing of components (triangles, primitives, textures).

Requirements: Basic skills in Javascript programming and computer graphics.

References:

Context model specification using sensors (ST, BT, DT)

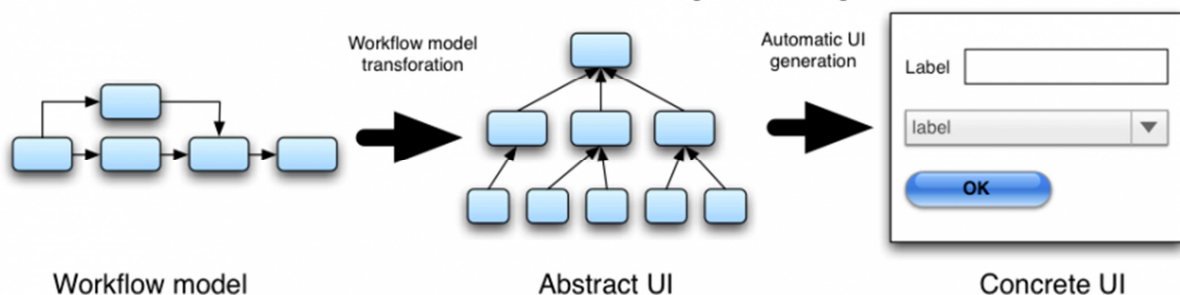
Intended for: B.Sc. or M.Sc. students

Supervisor: [Miroslav Macík](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: Perform an analysis of the platform for user interface generation and delivery (UIP platform), focus of specification of Context Model (CM). CM currently consists of four basic components: User Model, Device Model, Environment Model, and Assistive Technology model. Perform feasibility study of updating CM using sensors. It is possible to use computer-vision methods to estimate user's age, sex or presence of assistive technologies like glasses. Another sensors on smart devices can be used for estimation of the ambient light intensity or to estimate the situation where an interaction occurs (while walking, standstill, indoors, outdoors). Design context sub-model specification (update) using at least three sensor-involved scenarios. Test the implemented solution on relevant user audience and compare the results with manually-specified UI that respect context.



Requirements: Basic skills in user interface design, context models, and computer vision .

Constructive Solid Geometry on GPU

Intended for: B.Sc. or M.Sc. students

Supervisor: [Ladislav Čmolík](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: Constructive Solid Geometry (CSG) is geometry modeling technique that takes as an input set of primitive objects (e.g., sphere, box, cylinder and cone) and binary tree build upon the primitive objects. Each interior node of the binary tree represents one Boolean operation (union, intersection, difference) on the input objects. Analyze existing methods for rendering CSG on GPU and based on the analysis implement application that will display CSG in real time. Implementation in C/C++ or Java using OpenGL

Requirements: C/C++ or Java and OpenGL CSG modeling.

GridCut integration

- Intended for: M.Sc. students
- Supervisor: [Dr. Sýkora](#)
- Duration: 1 semester
- Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague
- Assignment: Study an existing software library GridCut for efficient computation of maximum flow on graphs with grid-like topology. Integrate GridCut into the following software packages: Matlab, OpenCV, and GCO. Compare its performance against built-in solvers on the following practical applications: image segmentation, digital photomontage, stereo reconstruction, and multi-label optimization.
- Requirements: Basic skills in Matlab, OpenCV, and GCO.

Perfect group foto

- Intended for: B.Sc. or M.Sc. students
- Supervisor: [David Sedláček](#)
- Duration: 1 semester
- Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague
- Assignment: Study methods for image segmentation, multi-label optimization and seamless image composition. Design and develop an application for a composition of several photos together to build up one photo containing best face for each person from the photo collection. Assume that all photos of people group were taken from tripod. The faces can be inaccurately selected by user.
- Requirements: Image processing and segmentation.

Database for IVE tool

Intended for: B.Sc. or M.Sc. students

Supervisor: [Ivo Malý](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: IVE tool is integrated visualization environment for analysis of usability test data. It allows analysis of data sets from different types of data sources using various visualization plugins. Data sets are currently stored in local object database. Analyze formats of data sets and types of databases and suggest new type of database for client-server solution and implement the solution. IVE tool is based on NetBeans Platform and implemented in Java.

Requirements: Java, databases.

Visualization of milling simulation errors

Intended for: M.Sc. students

Supervisor: [Petr Felkel](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: Study typical errors of 3-axis milling. Propose and implement methods suitable for visualization of trajectory and deviation of local normal, errors of the surface shape, differences in cut material amount, and variance in the shape of the gouge. Perform usability test with a group of users.

Requirements: Basic skills in visualization, user testing, and programming in C++.

Automatic movie generation using flight-logs (ST, BT, DT)

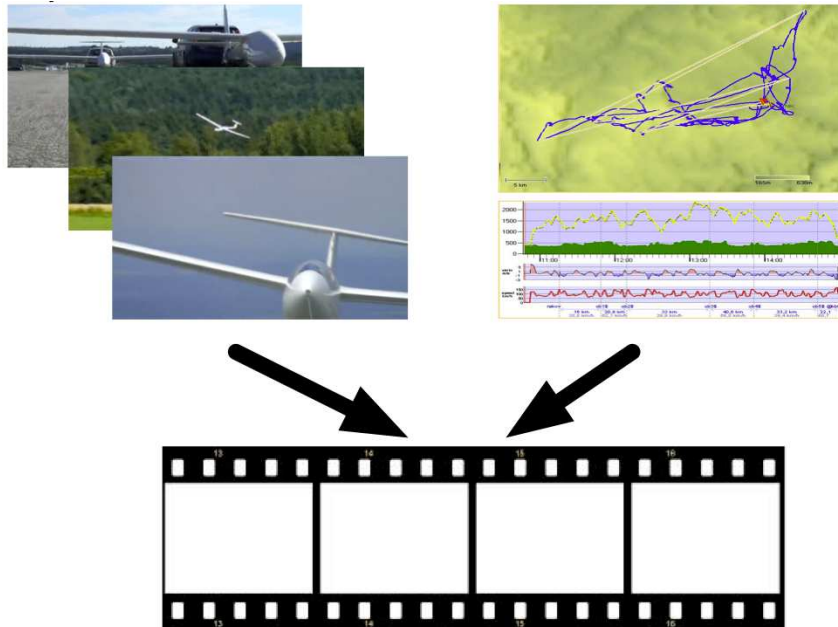
Intended for: B.Sc. or M.Sc. students

Supervisor: [Miroslav Macík](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: Small aircraft or gliders are usually equipped with flight logger that stores log of GPS-data as well as other data provided by specific sentences in the NMEA protocol (climb/sing, magnetic course, data about another aircrafts in the vicinity from anti-collision system etc.). An aircraft can be equipped by one or more small camcorders like Go-Pro. It is challenging to annotate and process hours of video files to produce short movie that show the most interesting parts of a flight (take-off, task-start, reaching of turn-points, low-altitude flight, out-landing or situation when other aircrafts are near etc.). Analyze current systems that provide relevant information. Perform a feasibility study of (semi)automatic video generation/annotation. On basis of the analysis design and implement a system that (semi)automatically generates videos using a set of recorded videos and flight-log data. Test the implemented solution using comparison with manually generated videos.



Requirements: Basic skills in programming of video processing.

Multimodal tablet application for exploration of small indoor spaces for visually impaired children

Intended for: B.Sc. or M.Sc. students

Supervisor: [Jan Balata](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: Analyze research dealing with orientation and spatial memory of blind children. Design and develop a multimodal application for touch screen tablets which helps blind children to explore and learn small indoor spaces (e.g. new nursery school). Use voice, sound, touch, gestures, etc. for interaction.

Requirements: Basic skills in user interface design.

Efficient Nearest-neighbour Fields Computation

Intended for: M.Sc. students

Supervisor: [Michal Lukáč](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: Analyze methods for efficient nearest neighbour fields computation, including PatchMatch, Coherency-sensitive Hashing, and Propagation Assisted kD-trees and implement them polymorphously into a provided C++ framework.

Extend the base methods to support search on rotation space, scale space and to allow dynamic masking of patches. Compare their performance against a naive solution, against each other, and against performance figures in the original papers.

Requirements: Basic skills in C++ and data structures.

Simulation of snow accumulation

Intended for: M.Sc. students

Supervisor: [Jaroslav Sloup](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: Explore existing methods for the simulation of the snow accumulation in outdoor scenes. Design and implement a suitable data structure that will be able to represent inhomogeneous structure of the accumulated snow. Use this data structure in a simulation of snow accumulation and its melting. Implemented approach has to be tested on at least three scenes with different geometric complexity.

Requirements: Natural phenomena modeling, C++.

Comprehension of Text Entry Methods on Interactive TV by Elderly Users

Intended for: B.Sc. or M.Sc. students

Supervisor: [Ondřej Poláček](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: Current research on evaluation of text entry methods is focused mainly on measuring performance of text entry methods in terms of speed and error rate. Text entry methods are almost always designed to be optimal for an expert user and the ultimate goal is an increased speed of typing with a novel method. In order to achieve this goal, researchers employ relatively complicated algorithms and prediction models. This may, however, hinder novice users from using a previously unseen text entry method, which were not correctly explained to them.

The usability of text input for first-time users is not discussed much in current research. But this is vital for successful adoption of a novel text entry method. For example, people writing on their 12-keypad mobile phones have never fully adopted T9 method, even though it is faster than Multitap. One of the reasons was too complicated typing procedure that prevented first-time users from using it. With emergence of interactive TV, it is vital to provide an intuitive method for entering text, otherwise the users will not use features requiring entering a text, such as search, message writing, social media, etc. Even more interesting is inclusion of elderly people, who use their TV on daily basis, but are not entirely familiar with text input on 12-keypad mobile phones.

The objective of the project is to investigate first-time usability of text entry methods on ITV for elderly users. Select and implement at least four entry methods based on literature research. Conduct a usability study with elderly users in an ITV environment. Prepare a sequence of hints for each entry method and show it to the participants when they struggle with the examined method. The outcome of the study should be the identification of correct hint for elderly users corresponding to given text entry method.

Requirements: Usability studies, user interface design.

Texture Parameterization for Large Polygonal Model

- Intended for: M.Sc. students
- Supervisor: [Vlastimil Havran](#)
- Duration: 1 semester
- Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague
- Assignment: Study the methods and applications used for mapping of 2D coordinates to 3D polygonal models. Select the suitable and efficient approach for texture mapping of large model. Provide the texture mapping for a particular model of MPI Informatics Building Model and render example images in PBRT to verify the correctness of the resulting parameterization.
- Requirements: Basic skills in computer graphics and texture mapping.

UIP Visual Editor (ST, BT)

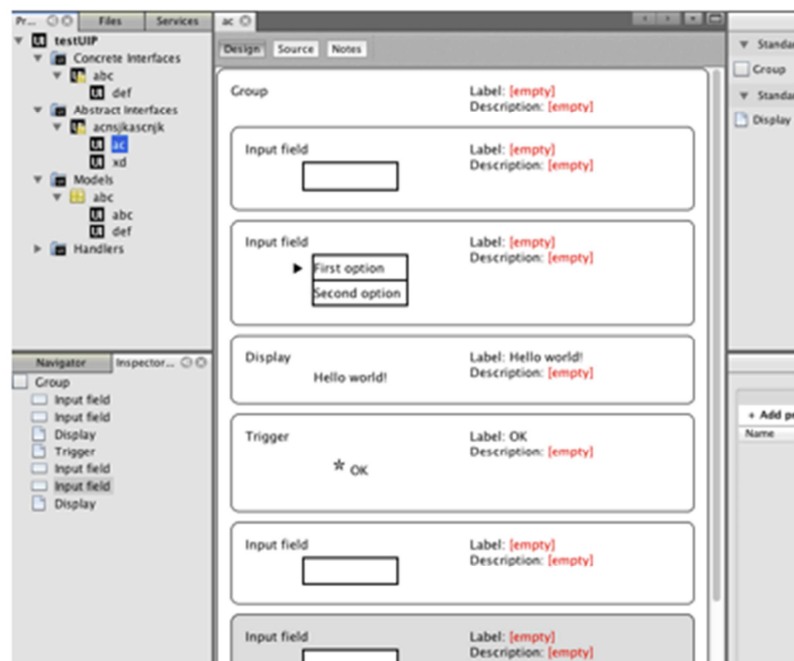
Intended for: B.Sc. or M.Sc. students

Supervisor: [Miroslav Macík](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

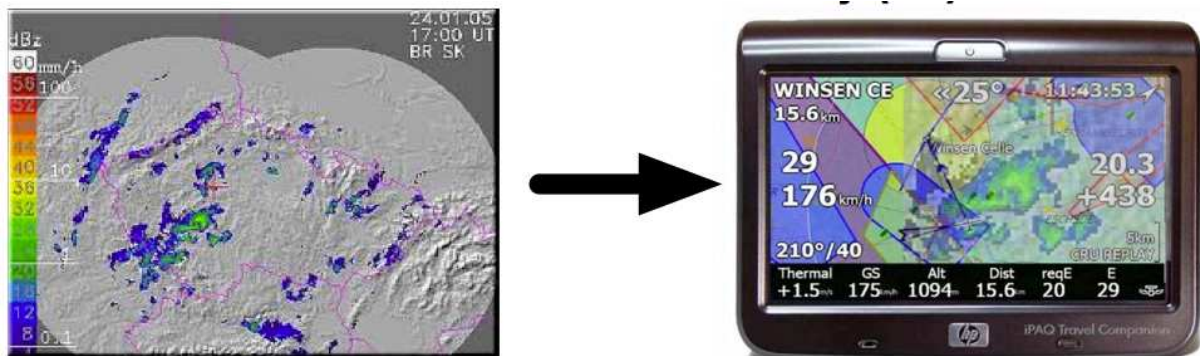
Assignment: Perform an analysis of the platform for user interface generation and delivery (UIP platform). Perform analysis of current version of UIP Visual Editor. Design enhancements of the UIP Visual Editor to conform requirements of the current specification of UIP. Focus on editor of Abstract User Interfaces, life preview, automatic UIP application deployment, and visualization of so-called restriction properties. The implemented solution should be functionally verified and verified using standard usability test on target user audience.



Requirements: Basic skills in computer graphics and texture mapping.

Data-efficient weather situation delivery (ST)

- Intended for: B.Sc. or M.Sc. students
- Supervisor: [Miroslav Macík](#)
- Duration: 1 semester
- Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague
- Assignment: Small aircrafts or gliders can be equipped by air-ground duplex data communication. These systems are typically based on current GSM/CDMA/3G networks. Because of the directional characteristics of the ground base-station antennas, the signal reception is not reliable and the typical bit-rates are rather low. During the flight it is vital to have as good awareness about the situation in the planned flight path as possible. Most importantly information about the weather conditions and air-space restrictions. It is possible to get some information using VHF radio, but more complex information like weather-radar data is typically not accessible. Perform an analysis for data-transmission systems used in small-aircrafts. Design and implement solution to data-efficiently deliver and visualize information like weather-radar data. The information can be pre-processed using a ground-based server. The information visualization can be implemented as a plug-in to a state of the art navigation system like LK8000 or XCSoar, alliteratively as a specific smart-phone application.



- Requirements: Basic skills in programming, interest in navigation systems.

Weather station user interface (ST, BT)

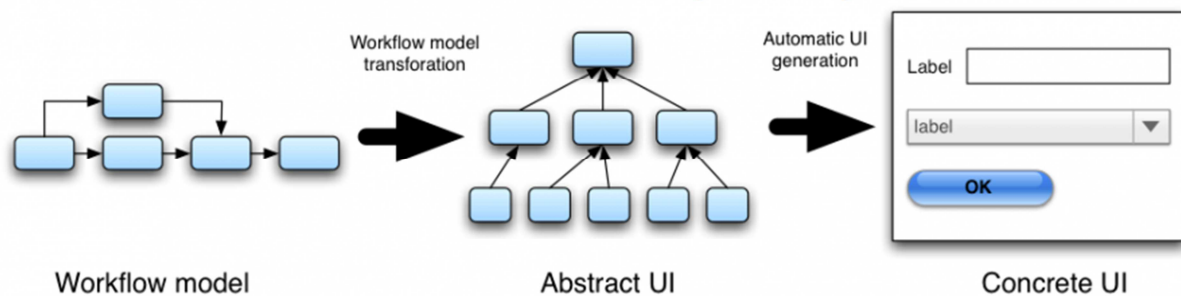
Intended for: B.Sc. or M.Sc. students

Supervisor: [Miroslav Macík](#)

Duration: 1 semester

Affiliation: Department of Computer Graphics and Interaction (<http://dcgi.fel.cvut.cz>)
Faculty of Electrical Engineering
Czech Technical University in Prague

Assignment: There are several weather-stations around the world. Currently there are web-services that provide data gathered from various weather stations. On the other hand, in some cases there are specific requirements to user interfaces and data-visualization. E.g. if there is a weather station on a national airport, it is good to provide data in a standard format (e.g. METAR), provide voice output, and weather-situation history. An image from web camera can be extended by visualization of the weather data. Perform analysis and feasibility study of data visualization as described herein before using provided data-format. Design and implement solution on a use-case of national airfield. The system can be enhanced using information about current operation on an airfield and information from the aircraft-reservation system. Test the implemented solution on relevant target user audience using standard usability test.



Requirements: Basic skills in user interface design, feasibility studies and usability testing.

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Aspects of Conversational Quality Measurements

Advisor: Assoc. Prof. Jan Holub, holubjan@fel.cvut.cz

Measurement of Conversational Quality as studied by Q15/SQ12 ITU-T is standardized when performed subjectively, e.g. in ITU-T P.800 and ITU-T P.805. However, except of traditional planning algorithm E-model ITU-T G.107, no objective method is standardized or at least widely accepted. Several proprietary algorithms are available, however, some aspects still remain a subject for further study. One of those aspects (echo perception, background noise influence, psophometrical signal level, one-way delay, asymmetrical delay etc.) will be chosen as a topic for the project, short review of available results will be elaborated and proposal for the final algorithm will be given."

References (the project is closely related to work presented in the following papers):

- [1] ITU-T, Question 15/12 – Objective assessment of speech and sound transmission performance quality in networks: <http://www.itu.int/en/ITU-T/studygroups/2013-2016/12/Pages/q15.aspx>, Geneva 2013
- [2] Takahashi, A., Kurashima, A.; Yoshino, H.: Objective Assessment Methodology for Estimating Conversational Quality in VoIP, IEEE Transactions on Audio, Speech, and Language Processing, vol.14, no. 6, pp. 1984-1993, Nov. 2006

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Visualization of a 3D Motion Capture Sensor Network

Advisor: Ing. Pavel Pačes, Ph.D., pacesp@fel.cvut.cz

The project aims to process and visualize data provided by a set of wirelessly connected sensors which measures movement of different parts of a human body. Every part of the human body is assembled by a sensor which consists of a three-axial accelerometer, a three-axial angular rate sensor, and a magnetometer. The student is supposed to process data from these sensors (there can be up to twelve sensors) and, with known limitations provided by human body joints, reconstruct the captured movement. There should be a program which will show a simple figure which will repeat movement captured by the system. The literature research should include methods of movement reconstruction and description of interfaces used by the current 3D Motion Capture Systems. The summary of the work should be published as a scientific article.

Requirements: Interests in sensors, electronics, wireless technology, programming and motion capture are required. Basic knowledge about Matlab environment is essential.

References (the project is closely related to work presented in the following papers):

[1] Mason Inman, "Cheap sensors could capture your every move," *New Scientist*, Nov. 2007.

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Small Satellite Platform Electronic and Control

Advisor: Ing. Pavel Pačes, Ph.D., pacesp@fel.cvut.cz

The student is supposed to work on a remote controlled platform which illustrates principles of spacecraft stabilization - Small Satellite Platform. The work is composed from evaluation of the sensor system performance needed for the spacecraft stabilization and replacement of the current flywheel speed of rotation sensor and magnetometer with more precise sensors. The existing controller still lacks its expected performance and so the second part of the task will be aimed on the platform stabilization in one axe with help of the new sensors.

Requirements: Interests in sensors, electronics, wireless technology, programming and satellite technology are required. Basic knowledge about Matlab environment is essential.

References (the project is closely related to work presented in the following papers):

- [1] Pačes, P. - Popelka, J. - Marchitto, Emidio - Levora, T.: Smart Sensor Data Processing for Aerospace Applications in Education Illustrated by a Small Satellite Platform Demonstrator In: DASC 2012 - 31th Digital Avionics System Conference - Proceedings [CD-ROM]. Piscataway: IEEE Operations Center, 2012, p. 1-8. ISBN 978-1-4673-1698-9.

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Full-Motion Simulator Control Interface and Flight Evaluation

Advisor: Ing. Pavel Pačes, Ph.D., pacesp@fel.cvut.cz

The project consists of software intended to control a full-motion flight simulator, e.g. start/stop the simulation through a remote interface (RPC) and software which will allow evaluating results from the simulated flight. The evaluation will be performed on the flight data which will be compared with airplane envelope, position, airspaces etc. The software should be able to provide a list of events describing situation where rules were violated. The summary of the work should be published as a scientific article.

Requirements: Interests in sensors, electronics, wireless technology, programming and satellite technology are required. Basic knowledge about MS Visual Studio environment is essential.

References (the project is closely related to work presented in the following papers):

- [1] Pačes, P. - Levora, T. - Bruna, O. - Popelka, J. - Mlejnek, J.: Integrated Modular Avionics Onboard of Small Airplanes - Fiction or Reality? In: 30th DASC Digital Avionics Systems Conference [CD-ROM]. Piscataway: IEEE, 2011, p. 7A1-1-7A1-12. ISBN 978-1-61284-796-2

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Monitoring of humidity in building insulation

Advisor: Prof. Pavel Ripka, ripka@fel.cvut.cz; Ing. Jan Včelák, Ph.D., vcelakj1@fel.cvut.cz

The methods used to measure soil humidity could be adopted to measure water content in mineral insulation. Most of the methods are based on large permittivity of water. The detection principle is either capacitive or microwave. TDR and GPR is available for experiments. The result is a concept of portable practical instrument using contactless or minimum invasive method.

Requirements: The project requires knowledge of the basics of electromagnetic field theory, sensors and instrumentation plus some experience in measurement techniques

References:

- [1] Ripka, P., Tipek, A.(ed.): Modern Sensors Handbook. ISTE 2007, ISBN 978-1-905209-66-8
- [2] Fraden J.: Handbook of Modern Sensors. Springer 2010
- [3] Sabrie Soloman. 2009. Sensors Handbook (2 ed.). McGraw-Hill, Inc., New York, NY, USA
- [4] Al-Homoud, M. S.: Performance characteristics and practical applications of common building thermal insulation materials, Building and Environment 40 (2005), 353-366

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Comfort monitor for sick building

Advisor: Prof. Pavel Ripka, ripka@fel.cvut.cz; Ing. Jan Včelák, Ph.D., vcelakj1@fel.cvut.cz

Many reconstructed and some new buildings have degraded internal climate which causes discomfort of their inhabitants and users. We are talking about a complex of objective and subjective symptoms often called sick building syndrome. This syndrome is connected with radical change of lighting, ventilation, humidity regime and thermal comfort in the building. The healthy building can be simulated by proper control of the ventilation, humidity, lighting and shadowing. Large sensor network should be installed for this purpose and algorithms for effective communication and energy management should be developed. The target of this project is to design a sensor system to monitor environment comfort in one room.

Requirements: The project requires knowledge of the basics of sensors and instrumentation plus some experience in measurement techniques

References:

- [1] Ripka, P., Tipek, A.(ed.): Modern Sensors Handbook. ISTE 2007, ISBN 978-1-905209-66-8
- [2] Fraden J.: Handbook of Modern Sensors. Springer 2010
- [3] Sabrie Soloman. 2009. Sensors Handbook (2 ed.). McGraw-Hill, Inc., New York, NY, USA
- [4] PS Burge: Sick building syndrome, Occup Environ Med 2004;61:185-190
doi:10.1136/oem.2003.008813

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Intelligent detection frame

Advisor: Prof. Pavel Ripka, ripka@fel.cvut.cz;

Detection frames are used to check persons and their luggage at the entrance to protected areas. New measurement and signal processing methods should be found to increase their feedthrough rate and detectivity. New algorithms should be developed for fusion of magnetic sensors (DC and AC, passive and active), optical cameras, thermal cameras, microwave and ultrasound sensors. These algorithms should be implemented and tested not only on models, but also in real situations. The target of this project is to develop magnetic detection frame with AMR sensors.

Requirements: The project requires knowledge of the basics of electronics, electromagnetic field theory, sensors and instrumentation plus some experience in measurement techniques

References:

- [1] Ripka: Magnetic sensors and magnetometers, Artech 2001
- [2] Zhang Y., et al.: Dual-mode, Fluxgate-Induction Sensor for UXO Detection and Discrimination, Journal of Environmental and Engineering Geophysics, June 2010, Vol.15, Issue 2, pp. 51–64
- [3] Agurto, A. Yong Li; Gui Yun Tian; Bowring, N.; Lockwood, S. A Review of Concealed Weapon Detection and Research in Perspective, Networking, Sensing and Control, 2007 IEEE International Conference on, pp. 443 - 448

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Comparison between noise of orthogonal fluxgate and off diagonal GMI

Advisor: Ing. Mattia Butta, Ph.D. buttamat@fel.cvut.cz

There are two sensors which are very similar: orthogonal fluxgate in fundamental mode and off-diagonal GMI. The signal is extracted in a different way for the two sensors. In both cases you have advantages and disadvantages. So far nobody made a complete study of disadvantages and disadvantages of both method, so we don't know which is the optimum.

The student will analyze both methods, create simple circuits and measure different noise sources and finally compute the best solution.

Requirements: The project requires knowledge of the basics of magnetism and physics and lab's skills. The student must be able to perform measurement under advisor's guidance.

References:

- [1] Sasada I., Orthogonal fluxgate mechanism operated with dc biased excitation - J. Appl. Phys., vol. 91, no. 10, 2002. - pp. pp. 7789-7791.
- [2] M. Butta, I. Sasada and Y. Yamashita, "Reduction of Noise in Fundamental Mode Orthogonal Fluxgates by Optimization of Excitation Current," IEEE Trans. Mag., vol. 47, Iss. 10, pp. 3748 - 3751, Oct. 2011

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Magnetic gradiometer based on orthogonal fluxgate

Advisor: Ing. Mattia Butta, Ph.D. buttamat@fel.cvut.cz

So far orthogonal fluxgate in fundamental mode has been used to measure the magnetic field produced by human heart because it has very low noise and it can measure very tiny field. However, it has been always used in a configuration of uniform field sensor. This is not ideal, because magnetic field produced by human heart is not uniform at all, it is a gradient. Therefore, it is better to use the sensor as gradiometer, but nobody has done it yet. The student will make some simulation with finite elements method to understand, what is the best configuration for the coils in gradiometric structure, and then he will measure the noise and characterize the real sensor.

Requirements: The ideal student should feel comfortable in working with FEM simulation, even if previous experience is not strictly required (however the student should manage to self-learn usage of FEM software)

References:

- [1] Sasada I., Orthogonal fluxgate mechanism operated with dc biased excitation - J. Appl. Phys., vol. 91, no. 10, 2002. - pp. pp. 7789-7791.
- [2] Janosek M., Ripka, P., Ludwig F. et al., Single-core fluxgate gradiometer with simultaneous gradient and homogeneous feedback operation, Journal of Applied Physics, Vol. 111, Iss. 7, Article Number: 07E328 DOI: 10.1063/1.3676238, Apr. 2012

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Topic: Orthogonal fluxgate in fundamental mode with magnetic tapes

Advisor: Ing. Mattia Butta, Ph.D. buttamat@fel.cvut.cz

So far everybody used magnetic wires as core for orthogonal fluxgate in fundamental mode. However, nobody has tried to use magnetic tapes for this purpose yet. Mainly because they are larger, but there are some applications where the width is not a big deal. The student will build some sensors with tapes and he will characterize their behavior to understand if tapes are a valid alternative to wires.

Requirements: The project requires knowledge of the basics of magnetism and physics and mainly lab's skills because it will mostly be a lab based project; the student must be able to build simple sensor and characterize them following the suggestions of the advisor.

References:

- [1] Sasada I., Orthogonal fluxgate mechanism operated with dc biased excitation - J. Appl. Phys., vol. 91, no. 10, 2002. - pp. 7789-7791.
- [2] M. Butta, I. Sasada and Y. Yamashita, "Reduction of Noise in Fundamental Mode Orthogonal Fluxgates by Optimization of Excitation Current," IEEE Trans. Mag., vol. 47, Iss. 10, pp. 3748 - 3751, Oct. 2011

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Non-conventional energy supply and communication protocols for contactless indoor/outdoor sensor nodes.

Advisor: Ing. Jan Včelák, Ph.D., vcelakj1@fel.cvut.cz

Wireless sensor network are quite common in new as well as in reconstructed buildings. Sensors nodes are used also in other constructions such as tunnels or bridges. Power of the sensor nodes is the problem since battery operated modules are hard to maintain, increase cost and for inaccessible nodes cannot be used at all. The aim of the work is to design wireless sensor node that would use energy harvesting and advanced energy saving communication protocols. The possible energy harvesting technologies will be evaluated and 1 or 2 most promising will be further developer and implemented depending on final application.

Requirements: Project assumes advanced knowledge in HW/SW and mixed electronics circuit design

References:

Wang, W. S.; O'Donnell, T.; Wang, N.; et al., Design Considerations of Sub-mW Indoor Light Energy Harvesting for Wireless Sensor Systems, ACM JOURNAL ON EMERGING TECHNOLOGIES IN COMPUTING SYSTEMS

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Sensor node for the NDT of building structures

Advisor: Prof. Pavel Ripka, ripka@fel.cvut.cz; Ing. Jan Včelák, Ph.D., vcelakj1@fel.cvut.cz

Failure precaution in civil engineering is fast developing industry. Sensor nodes are placed in the concrete to monitor health of the structure, They placed in the insulation material to monitor humidity and temperature etc.. The goal is the early prevention of possible collapse or deterioration of materials or structures. The aim of the work is to design sensors that can be placed directly into the tested material and operated remotely. The core of the work is to test new types of sensors (e.g. fiber Bragg) of displacement, stress, and humidity. The applicability of the sensors will be verified.

Requirements: Project assumes advanced knowledge in HW/SW and sensor applicability

References:

- [1] Min, J (Min, Jiyoung); Park, S (Park, Seunghee); Yun, CB (Yun, Chung-Bang); Song, B (Song, Byunghun), Development of multi-functional wireless impedance sensor nodes for structural health monitoring, SENSORS AND SMART STRUCTURES TECHNOLOGIES FOR CIVIL, MECHANICAL, AND AEROSPACE SYSTEMS 2010
- [2] Ripka, P., Tipek, A.(ed.): Modern Sensors Handbook. ISTE 2007, ISBN 978-1-905209-66-8
- [3] Fraden J.: Handbook of Modern Sensors. Springer 2010
- [4] Chintalapudi, K.Fu, T.; Jeongyeup Paek; Kothari, N.; Rangwala, S.; Caffrey, J.; Govindan, R.; Johnson, E.; Masri, S.: Monitoring civil structures with a wireless sensor network, IEEE Internet Computing 10 (2006) Iss. 2, 26-34

Project for visiting student

(Suitable for Ph.D. student or advanced MS. Student)

Department of Measurement, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (measure.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Adaptive load control in PV(Photovoltaic) island systems

Advisor: Ing. Jan Včelák, Ph.D., vcelakj1@fel.cvut.cz

Maximal power generation together with load control in photovoltaic island systems is a key to safely increase efficiency of the island PV system consisting of photovoltaic panels, solar charger, batteries, inverter and load. There are several electric loads in the system. Load can be prioritized with respect to remaining power in the batteries or instant generated solar power. The aim is to design module which will monitor generated and consumed power and according the state of the panels, batteries and load priorities will decide which load will be switched on and which will be switched off (PV microgrid). Project requires knowledge of mixed circuit design and embedded SW design.

Requirements: Project assumes basic knowledge in HW/SW electronic circuit design

References:

Venayagamoorthy, GK (Venayagamoorthy, Ganesh Kumar)^[1]; Welch, RL (Welch, Richard L.), Energy dispatch controllers for a photovoltaic system, ENGINEERING APPLICATIONS OF ARTIFICIAL INTELLIGENCE

Extensive-form games solution concepts

Branislova Bosansky, Michal Pechoucek

Nash equilibrium (NE) is the best known solution concept in game theory, however, NE does not exactly correspond to the way people make their decisions in competitive scenarios. Therefore, a number of alternative solution concepts was designed, such as quantal response equilibrium, or cognitive hierarchy models. Until now, only a limited focus has been given on studying these solution concepts in the domain of extensive-form games together with the computational aspect. Therefore, the task is to:

- 1) Study alternative behavioral game-theoretic solution concepts in the domain of extensive-form games.
- 2) Investigate existing algorithms for finding these solution concepts in extensive-form games.
- 3) Analyze and design a modification of existing algorithms using an iterative double-oracle approach that is successfully used for computing NE.
- 4) Implement designed algorithms and experimentally evaluate the performance against human participants.

Multiagent planning

Antonin Komenda, Michal Pechoucek

The principles of local search in planning graphs was used in top performing planner LPG in International Planning Competition 2004. Nowadays most efficient

single-agent planners use the planning graph structure for relaxation heuristic estimation. Particular ways of usage of planning graph for local search in multi-agent setting is an interesting unanswered research question currently.

In the assignment,

- 1) study the principle of local search in planning graph,
- 2) extend the work on LPG towards distributed search,
- 3) reuse parts of LPG and complete an implementation of a multi-agent LPG
- 4) experimentally verify and validate efficiency of the planner against state-of-the-art solutions (e.g., multi-agent A* and multi-agent GraphPlan)

ADCS system for a CubeSat

Supervisor: Ing. Martin Hromcik, Ph.D.
Department of Control Engineering

Required student profile: Bc. or MSc. student with background in systems and controls

Suitable supporting courses at CTU: Control Systems for Aircraft and Spacecraft (CSAS), Automatic Control (ARI)

Duration of project: 1 term

The project is devoted to development and testing of an ADCS for a developed CTU CubeSat (CzechTechSat). DCE is responsible for the control laws development and verification, and for related HW and SW problems, and also for sensors fusion and processing tasks. The student would join an existing small team and depending on his or her preferences, and also on the status of the project, shall work on simulation and verification problems, new algorithms for data processing, target platform implementation of selected procedures, design of new control algorithms, etc.

Topic: **Camera-based guidance of a six-axis robot**

Supervisor: Pavel Burget, Ph.D.

Annotation: An industrial camera is connected to a robotic system, where a PLC and a six-axis robot are connected in a Profinet network, and the image recognition algorithms are part of the camera system. The aim of this one-term project is to program the camera and the robot to search for given objects laying on the ground and have them collected by the robot at one place. This task is going to be extended in such a way that the robot follows the movements of a human in front of itself.

Combinatorial algorithms acceleration on GPUs

Supervisor: Šůcha Přemysl, Ing., Ph.D.

suchap@fel.cvut.cz; <http://dce.felk.cvut.cz/sucha/>

Required student profile: A Ph.D. or MS. student with knowledge of C language and algorithm development.

The aim of the project is development of parallel algorithms for a combinatorial problem (e.g. Resource Constraint Project Scheduling Problem) using the GPU (Graphics Processing Unit). The algorithm design will be done using CUDA framework. The particular aim would be to find the optimal solution of the problem (e.g. by branch and bound method) using several GPU cards within a single host. Therefore significant part of the work is design of a suitable GPU – GPU communication allowing efficient solution space searching.

Continuous testing of CAN bus support in Linux
=====

Supervisor: Ing. Michal Sojka, Ph.D.

Required student profile: Advanced Linux user with knowledge of C language and scripting.

The goal of this project is to build an automated testbed for continuous testing of CAN bus support in Linux kernel. Besides basic functionality tests, we are also interested in performance tests with the aim of finding performance regressions. It is expected that the student will use a PC computer and several boards running embedded Linux to perform the testing and measurement. The outputs will be publicly available to the Linux CAN community.

Evaluation of methods for measurement of a position on a planar surface

Supervisor: Ing. Zdeněk Hurák, Ph.D.

Email: hurak@fel.cvut.cz

Advanced algorithms for control and communications (AA4CC), Dept. of Control Engineering

Web: <http://aa4cc.dce.fel.cvut.cz>, <http://dce.fel.cvut.cz>

Student profile: senior undergraduate or graduate student in electrical engineering. The task needs a creative student with some modest hobby-level skills in electronics. These could be developed while working on the project, of course. The willingness to learn these hardware oriented skills is crucial.

Duration of project: 1 semester

Description of the course:

The goal of this student project is to investigate and evaluate several methods for measurement of a position of a single or multiple objects in a small planar arena (say, up to 1m²). The task is motivated by the currently ongoing research in planar feedback manipulation such as positioning an iron ball on top of a rectangular array of electromagnets.

The particular list of methods that should be studied, evaluated and compared is:

- processing the images taken by a camera observing the global scene (from above)
- resistive foil
- LED matrix
- set of IR sensors
- capacitive sensors
- magnetic sensors .

As a continuation of this task, some development of algorithms for the chosen hardware platform is expected.

Modelling of dispatch control of the electricity transmission system

Supervisor: Ing. Ondřej Novák
Department of Control Engineering

Required student profile: Bc. or MSc. student

Suitable supporting courses at CTU: Dynamic System Modelling and Simulation (MSD),
Automatic Control (ARI)

Duration of project: 1 term

The aim of the project is to develop model of dispatch control of the electricity transmission system. The model should be implemented in free or easy to develop and debug environment. Python programming language or .Net framework is preferred. Solution of the project should comprise several steps. The first step should be survey of relevant frameworks or libraries for discrete-time simulations. Next part of the project is design of dispatch control model based on the existing simulation scheme in Simulink environment. Final steps are implementation and comparison of the current and the new implementation by means of benchmarks. Project should be assign to one or two students.

Topic: **Programming of Profinet diagnostics**

Supervisor: Pavel Burget, Ph.D.

Annotation: Write communication functions in Ruby to read diagnostics information from Profinet IO devices. Create filters to get only selected information from the devices. Design algorithm to analyse the obtained data and provide the status of the devices (good/bad IO data, diagnostics available, etc.), IO data cycle, etc.

Robotic table football

Supervisor: Pavel Burget, Ph.D.

Annotation: The aim of this project is to equip a table football with motors and a motion control system to create a platform for testing of algorithms that allow the motion control system to play football automatically against a human player. The outcome of this project is going to be analysis of the movements, requirements specification and project design description. Additionally the mechanical platform to be fit on the table football will be created and basic configuration of the motion control system will be done.

Topic: **Simulation in digital factory**

Supervisor: Pavel Burget, Ph.D.

Annotation: Design, create and test simulation of a production line in Tecnomatix digital factory. The production line is inspired by a welding line in a car factory and contains four industrial robots with grippers and welding units. There are also conveyors transporting the products. One of the robot is a real six-axis welding robot. The tools of two of the robots are changeable. After testing the production line in simulation create a PLC program to control the line in digital factory and then transfer the robotic program to the real robot.

Subsystems and solutions for small UAV: development and verification

Supervisor: Ing. Martin Hromcik, Ph.D.
Department of Control Engineering

Required student profile: Bc. or MSc. student with background in systems and controls

Suitable supporting courses at CTU: Control Systems for Aircraft and Spacecraft (CSAS), Automatic Control (ARI)

Duration of project: 1 term

The project is focused on further development of a students' UAV platform developed at DCE. Depending on the student's knowledge, skills and interests, a task related to mathematical model construction and refinement can be assigned, as well as advanced control laws design problems, or, for more HW and SW oriented applicants, related programming or construction issues can be addressed (user interface development, ground station components, new sensors and boards incorporation).

Task mapping and scheduling using column generation

Supervisor: Šůcha Přemysl, Ing., Ph.D.

suchap@fel.cvut.cz; <http://dce.felk.cvut.cz/sucha/>

Required student profile: A Ph.D. or MS. student with knowledge of mixed integer linear programming and C++ language.

This project deals with off-line mapping and scheduling of tasks on a network of computational nodes. Specifically, the issue is the optimal mapping of a task-graph representing an algorithm on a network of distributed nodes. The goal of this project is to propose a mathematical model of the problem and solve it using column generation, i.e. a method able to solve large-scale integer linear programming models.

The use of symbolic execution for testing of safety-related software
=====

Supervisor: Ing. Michal Sojka, Ph.D.

Required student profile: Proficiency and experience in programming,
good knowledge of C language.

The goal of this project is to examine the use of symbolic execution
technique to verify the properties of software used in safety-related
(and real-time) systems in automotive application domain. The task
will be to use an existing symbolic execution tool such as KLEE to
execute the existing control software to discover potential bugs.
Based on the results of this experiment, new experiments will be
developed with the aim of finding a good strategy of how to
effectively find bugs in generic real-time control software.

Topic: **Usage of the IQRF technology to control photo lenses**

Supervisor: Ondřej Nývlt

Annotation: Design and implement basic electronic interconnection of a wireless IQRF unit with a tested lens using SPI communication. Design and implement basic software for the IQRF unit, which will control focusing and aperture of the lens using SPI commands. Design and implement software for the second IQRF unit, which should wirelessly control the lens (e.g. from a PC). Design an extension tube equipped by electronics for the interconnection of the IQRF chip with a lens.

Faculty of FEE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student or advanced MSc. Student

Exchange Project: Capacitor-less low drop out regulator in CMOS technology

Supervisors: [Jiří Jakovenko, \(jakovenk@fel.cvut.cz\)](mailto:jakovenk@fel.cvut.cz),

Department: Department of Microelectronics, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (micro.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is focused on the design of capacitor-less Low Drop Out (LDO) voltage regulator aimed for SOC (System On Chip) applications. Increasing priority of optimized power management and consequently extending battery life of mobile devices is one of the key reasons for chip design changes towards SOC solutions where power management circuits plays a key role. Conventional regulators use external capacitors for stabilizing of AC transient characteristics. However, those capacitors consume valuable space and occupy pins of a chip. The main goal of the project is to find solution for LDO regulator without usage of external capacitor.

Requirements:

Robust fundamentals in analogue IC design and analogue circuit's theory, good knowledge of Cadence or Mentor Graphics simulation environment, Spice or Spectre circuit simulators and tools for IC layout composition (Cadence Virtuoso, etc.)

Recommended subjects to be studied at the DEF:

Integrated System Structures AE2M34SIS (available for fall semester)

Integrated Systems Design AE2M34NIS (available for spring semester)

Implementation of Analog Systems AE2M31IAS (available for fall semester)

References (the project is closely related to work presented in the following papers):

[1] OR, P.Y., and LEUNG, K.N. An output-capacitor-less low-dropout regulator with direct voltage-spike detection, IEEE Journal of Solid-State Circuits, 2010, vol. 45, no. 2, pp. 458-466

[2] KIM, Y. I., LEE, S. S. Fast transient capacitor-less LDO regulator, Electronics Letters, 2012, vol. 48, no. 3

[3] MOLATA, V. Design of capacitor-less LDO regulator in CMOS technology. Diploma thesis, Czech Technical University in Prague - FEE, June 2011.

[4] LEUNG, K., NG, Y.S. A CMOS low-dropout regulator with a momentarily current-boosting voltage buffer, IEEE Transactions on Circuits and Systems I, 2010, vol. 57, pp. 2312–2319.

[5] OH, W., BAKKALOGLU, B. A CMOS low-dropout regulator with current-mode feedback buffer amplifier, IEEE Transactions on Circuits and Systems II, 2007, vol. 54, pp. 922–926

Faculty of FEE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student or advanced MSc. Student

Exchange Project: Gas sensor with surface acoustic wave (SAW)

Supervisors: [Miroslav Husák, \(husak@fel.cvut.cz\)](mailto:husak@fel.cvut.cz)

Department: Department of Microelectronics, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (micro.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is focused on the design of gas sensor with surface acoustic wave (SAW): The design of the basic topology of the structure SAW on the piezoelectric material. The design of the SAW sensor model. The description of the model by the fundamental equations. Creating a 3D model of the structure. The design of the heating system. Comb electrode structures design on the material surface. Design of SAW oscillator, determine the operating frequency. Measuring circuit for the characterization of SAW sensors is based on the method of measuring response of the sensor, which is connected to the oscillator feedback i.e. positive feedback amplifier, providing an oscillator oscillating at the resonant frequency of the sensor.

Requirements:

Basic knowledge and principles of chemical sensors, basic knowledge of electronic circuits, work with ANSYS or Coventor software.

Recommended subjects to be studied at the DEF:

Nanoelectronics and Nanotechnology AE2M34NAN (available for spring semester)

Integrated System Structures AE2M34SIS (available for fall semester)

Integrated Systems Design AE2M34NIS (available for spring semester)

References (the project is closely related to work presented in the following papers):

- [1] Laposá, M. Husák, J. Kroutil: Gas sensor with SAW structures, proc. of the 2012 NSTI Nanotechnology, Santa Clara, 18.06.2012 - 21.06.2012, pp. 547-577, ISBN 978-1-4665-6275-2
- [2] W. Wang, Ch. Lim, K. Lee, S. Yang: Wireless surface acoustic wave chem. sensor for simultaneous meas. of CO₂ and humidity, J. of Micro/Nanolithography MEMS MOEMS 8, 3, (2009), 031306.
- [3] W. Shih, T. Wang, H. Wang, M. Wu: Effect of Alumina Film on Surface Acoustic Wave Properties of ZnO Thin Film Surface Acoustic Wave Devices, Japanese J. of Appl. Phys. 49 (2010) 09MD15.
- [4] L. Fan, S. Zhang, H. Ge, H. Zhang: „Theoretical optimizations of acoustic wave gas sensors with high conductivity sensitivities“, Sens. and Act. B: Chemical, (2012).
- [5] R. Ruby: Rev. and comp. of bulk acous. wave FBAR, SMR, IEEE Ultras. Symp., (2007), 1029–40.

Faculty of FEE, CTU in Prague - project for a visiting student

Suitable for: Ph.D. student or advanced MSc. student

Exchange project: Switched-mode high power current source

Supervisor: Julius Foit, (foit@fel.cvut.cz)

Department: Department of Microelectronics, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (<http://micro.feld.cvut.cz>)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is focused at the design of a high-efficiency overvoltage-protected high-power current source: nominal output current should be 10 A $\pm 5\%$; operating temperature range -10 to +55 °C; relative humidity 0 to 100% (splashing fresh-water resistant); switched-mode operation should be used, targeted at highest possible efficiency at output voltages from 5.5 to 14.50 V; the output current should not exceed 25 mA at output voltages over 14.60 V; open-circuit output voltage (i.e. at zero output current) should not exceed 14.8 V; output current ripple less than 10% peak to peak at all output voltages up to 14.5 V; external power source: standard 230 V $\pm 10\%$, 50-60 Hz mains; indicator lights should be provided, signaling: “power on”, “excessive output voltage”, “operation failure”.

Requirements:

Knowledge of basic operational principles of switched-mode power sources, of the properties of small-signal and high-power semiconductor devices including IC's, principles of design of pulse power transformers, principles of application of temperature-independent reference voltage sources, principles of voltage-to-current conversion.

Recommended subjects to be studied at the DEF:

Design of Power Supplies for Electronics AE0M34NNZ (available for fall semester)

Electron devices AE2B34ELP (available for spring semester)

Smart Electronics AE2B34IAA (available for fall semester)

References (recommended literature related to the project):

[1] P. Horowitz, W. Hill: *The Art of Electronics*; Cambridge University Press

[2] J. Foit: *Electronics Fundamentals*; Česká technika – nakladatelství ČVUT (CTU Press)

further literature according to consultation with the supervisor.

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student, (advanced MS. Student)

Exchange Project: Radiation Effects on SiC Power Devices

Supervisors: [Prof. Pavel Hazda \(hazdra@fel.cvut.cz\)](mailto:hazdra@fel.cvut.cz)

Department: Department of Microelectronics (DM), Faculty of Electrical Engineering, Czech Technical University in Prague (www.micro.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Abstract:

The aim of the project is the investigation of the effect of radiation on silicon carbide (SiC) power devices performance. Advanced SiC power devices (SB or MPS diodes, MOSFETs, JFETs) will be irradiated with different particles (protons, alphas, electrons or neutrons). The effect of irradiation on device characteristics will be then investigated for particular projectiles. It is expected that the applicant will characterize introduced defects, evaluate their influence on device characteristics and develop adequate models, which allow prediction of SiC device performance in radiation environment. The project will focus on particular combination of SiC device and irradiation particle.

Requirements: Strong basics in the area semiconductor devices and physics, knowledge of TCAD simulation tools like ATLAS or Synopsys is an advantage

Recommended subjects to be studied at the DM:

Electronics and Microelectronics AE4B34EM
Electron Transport in Semiconductors XP34ETS
Modern Power Devices and Integrated Circuits - XP34APD
VLSI Structures and Technologies - XP34STV

References (the project is closely related to work presented in the following papers):

- [1] P. Hazdra, V. Záhlava, J. Vobecký, M. Berthou, A. Mihaila, Radiation defects produced in 4H-SiC epilayers by proton and alpha particle irradiation, Materials Science Forum, 740-742, 2013, pp. 661-664.
- [2] G. Alfieri, E.V. Monakhov, B.G. Svensson, A. Hallén, Defect energy levels in hydrogen-implanted and electron-irradiated n-type 4H silicon carbide, Journal of Applied Physics, 98, 2005, 113524.

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student, (advanced MS. Student)

Exchange Project: Design, fabrication and investigation properties of polymer optical multimode planar waveguides

Supervisors: Ing. Václav Prajzler PhD. (xprajzlv@feld.cvut.cz),

Department: Department of Microelectronics (DM), Faculty of Electrical Engineering, Czech Technical University CTU in Prague (<http://www.micro.feld.cvut.cz/>)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is aimed to the design, fabrication and investigation properties of polymer multimode planar optical waveguides. The polymer waveguides will be used for design fabrication and measurement of polymer 1 x 2 multimode optical power splitter with input/output standard plastic optical fiber. This component has huge potential in short-distance communication for applications such as in automobile networks, private office and home network.

Requirements: Experience with Beam Propagation method and Ray tracing advantage but no necessity.

Recommended subjects to be studied at the CTU:

Optical Systems and Networks

Optical Radiation Detection and Detectors

Technology of Optical Devices

References (the project is closely related to work presented in the following papers):

[1] KLOTZBUECHER, T., BRAUNE, T., DADIC, D., SPRZAGALA, M., KOCH, A. Fabrication of optical 1x2 POF splitters using the Laser-LIGA technique, *In Proceedings Laser Micromachining for Optoelectronic Device Fabrication*, 2003, vol. 4941, p. 121-132.

[2] MIZUNO, H., SUGIHARA, O., JORDAN, S., OKAMOTO, N., OHAMA, M., KAINO, T. Replicated polymeric optical waveguide devices with large core connectable to plastic optical fiber using thermo-plastic and thermo-curable resins. *Journal of Lightwave Technology*, 2006, vol. 24, no. 2, p. 919-926.

[3] PARK, H.J., LIM, K.S., KANG, H.S. Low-cost 1x2 plastic optical beam splitter using a V-type angle polymer waveguide for the automotive network. *Optical Engineering*, 2011, vol. 50, no. 7, p. 075002-075004.

[4] KWANG, T.K., MIN, K.K. Low-loss 1 x 2 plastic optical fiber coupler incorporating a tapered polymeric waveguide and plastic optical fiber transition Regions. *Japanese Journal of Applied Physics*, 2012, vol. 51, no. 9, p. 8504-8506.

[5] PRAJZLER, V., PHAM, N.K., ŠPIRKOVÁ, J. Design, fabrication and properties of the multimode polymer planar 1 x 2 Y optical splitter. *Radioengineering*, 2012, vol. 21, p. 1202-1207.

Topic: 3D Reconstruction of Mars & Moon

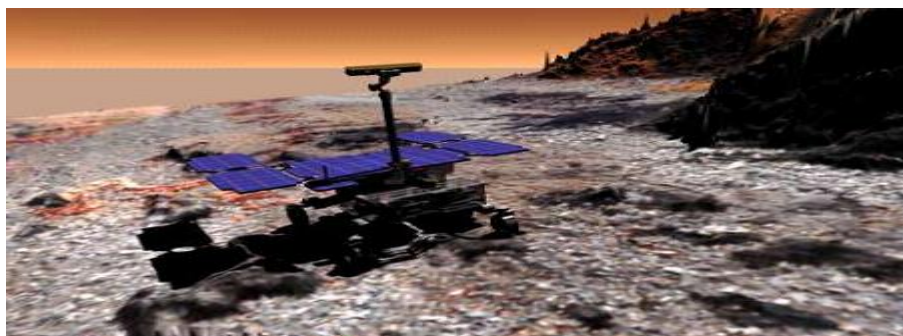
Department: Department of Cybernetics

Supervisor: Ing. Tomáš Pajdla Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Examiner: Tomas Krajnik

Description:



Review the state of the art in 3D reconstruction from images. Get acquainted with methods at ptak.felk.cvut.cz/sfmservice. Carry out experiments with reconstructing the Mars and Moon surface from data acquired MER and Lunokhod rovers. Suggest and implement an improvements of the standard technology of 3D reconstruction from images to be applicable for the Mars and Moon conditions.

Bibliography: Will be provided by the supervisor.

Realization form Thesis, Matlab & C++ code

:

Date: 16.09.2013

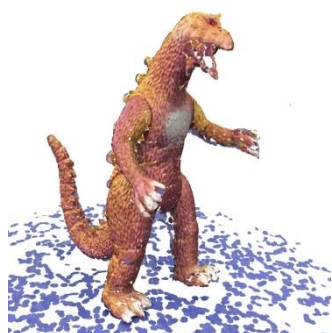
Topic: 3D Reconstruction on GPU

Department: Department of Cybernetics

Supervisor: Ing. Tomáš Pajdla Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Description:



Review the state of the art in 3D reconstruction from images. Get acquainted with methods at ptak.felk.cvut.cz/sfmservice. Propose and implement improvements for 3D reconstruction to work with more difficult indoor situations and with gradually changing environments using

GPU.

Bibliography: Will be provided by the supervisor.

Date: 16.09.2013

Topic: 3D reconstruction on iPhone

Department: Department of Cybernetics

Supervisor: Ing. Tomáš Pajdla Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Description:



Review the state of the art in 3D reconstruction from images. Get acquainted with methods at ptak.felk.cvut.cz/sfmservice. Suggest and implement an

improvements of the standard technology of 3D reconstruction from images on a GPU.

Bibliography: Will be provided by the supervisor.

Date: 16.09.2013

Topic: Microscopy image processing and digital pathology

Department: Department of Cybernetics

Supervisor: Doc. Ing. Jan Kybic Dr.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Description: There is a wide range of possible problems to be solved. The final aim is to combine gene expression, clinical and imaging features to complement the standard pathology assessment. The subtasks include developing and implementing algorithms for the detection of tissue cells, identification of tumor cells, identification of the tumor region, detection of the nuclei and measurement of their shape, spatial distribution and other parameters. See <http://cmp.felk.cvut.cz/~kybic/proposed.html> for more details.

Realization form: software implementation, method description

Date: 21.08.2013

Topic: Multimodal recognition of objects and victims

Department: Department of Cybernetics

Supervisor: Doc. Ing. Tomáš Svoboda Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project, Voluntary technical project, Semestral project

Description:

Center for Machine Perception, Department of Cybernetics, contributes to the EU project NIFTi by developing visual algorithms for object/victim detection and robot localization. Among many other sensors, The robot carries an omnidirectional camera, a thermo camera, rotating 3D lidar, and optionally also RGB-Depth sensor on board.

During a search and rescue mission the robot is expected to locate victims and objects and computer their positions in 3D. CMP developed several methods. The goal of this work is mainly robustifying algorithms by combinigng multiple data (thermal, visual, depth, ...)

Instruction: Contact: Tomáš Svoboda

<http://cmp.felk.cvut.cz/~svoboda>

Recommended courses: Computer Vision Methods, Pattern Recognition and Machine Learning, ...

Bibliography: K. Zimmermann, D. Hurych, T. Svoboda. Exploiting Features -- Locally Interleaved Sequential Alignment for Object Detection. In 11th Asian Conference on Computer Vision - ACCV 2012
T. Petricek, T. Svoboda. Area-weighted Surface Normals for 3D Object Recognition. In 21st International Conference on Pattern Recognition - ICPR 2012
E. Derner. Car Detection on a Mobile Robot by Fusing Visual and 3D Lidar Data. BSc Thesis CTU--CMP--2012--10

Realization form: codes C/C++; Python

Date: 04.04.2013

Topic: Advanced signal processing for health care (CTG)

Department: Department of Cybernetics

Supervisor: Doc. Ing. Lenka Lhotská CSc., Ing. Václav Chudáček Ph.D.

Announce as: Diploma thesis, Individual project

Description: The main aim of the project is design and implementation of advanced methods of biomedical signal preprocessing and processing. The work will be performed using CTG recordings provided by cooperating university hospital. New approaches will be studied, as for example application of speech processing algorithms or morphological analysis. The task will be to study and compare several methods, successively implement restricted set of methods and test their functionality and quality of processing on real signals. It is expected that finally there will be new modules for the library of biological signal processing methods.
Used hardware and software: PC/laptop (options Linux/Windows OS), MatLab, possibly Java programming language (if necessary)

Phases of the project

Study of applications of signal processing methods in biomedical signal processing

Study of CTG recordings, including detection and separation of artefacts

Study and implementation of selected methods for signal preprocessing and processing:

- Defining the task (detection of noise and artefacts, feature extraction and classification)
- Design of individual methods
- Implementation of selected methods
- Experiments and their evaluation

Final report

Bibliography: Acharya, U.R.; et al.: Advances in Cardiac Signal Processing. Springer, 2007 Kamath, Markad V.: Heart Rate Variability (HRV) Signal Analysis: Clinical Applications. CRC Press, 2013 Chudáček, Václav: Automatic Analysis of Intrapartum Fetal Heart Rate. PhD Thesis. CVUT Prague, 2011

Realization form: SW project + report

Date: 03.04.2013

Topic: Advanced signal processing for health care (EEG)

Department: Department of Cybernetics

Supervisor: Ing. Václav Gerla Ph.D., Doc. Ing. Lenka Lhotská CSc.

Announce as: Diploma thesis, Individual project

Examiner: doc. Ing. Vladimír Krajča, CSc.

Description: The main aim of the project is design and implementation of advanced methods of biomedical signal preprocessing and processing. The work will be performed using EEG recordings provided by cooperating university hospitals. New approaches will be studied, as for example adaptive segmentation, application of speech processing algorithms, etc. The task will be to study and compare several methods, successively implement restricted set of methods and test their functionality and quality of processing on real signals. It is expected that finally there will be different methods used for adult EEG and different methods for newborn EEG because the characteristics of these signals are different. Used hardware and software: PC/laptop (options Linux/Windows OS), MatLab, possibly Java programming language (if necessary)

Phases of the project

Study of applications of signal processing methods in biomedical signal processing

Study of EEG recordings, i.e. differences between newborn, child and adult EEG, especially in sleep recordings

Study and implementation of selected methods for signal preprocessing and processing:

- Defining the task (detection of noise and artefacts, feature extraction and classification)
- Design of individual methods
- Implementation of selected methods
- Experiments and their evaluation

Final report

Bibliography: Adeli, Hojjat: Automated EEG-Based Diagnosis of Neurological Disorders: Inventing the Future of Neurology. CRC Press. 2010 Gerla, V.: Automated Analysis of Long-Term EEG Signals. PhD Thesis. CVUT Prague, 2012 Sanei, S.; Chambers, J.A.: EEG Signal Processing. Wiley, 2007

Realization form: SW project + report

Date: 03.04.2013

Topic: Advanced signal processing for health care (PPG)

Department: Department of Cybernetics

Supervisor: Doc. Ing. Lenka Lhotská CSc., Ing. Jakub Kužílek

Announce as: Diploma thesis, Individual project

Description: The main aim of the project is design and implementation of advanced methods of biomedical signal preprocessing and processing. The work will be performed using PPG (photoplethysmography) recordings provided by cooperating university hospitals. New approaches will be studied, as for example application of speech processing algorithms. The task will be to study and compare several methods, successively implement restricted set of methods and test their functionality and quality of processing on real signals.

Used hardware and software: PC/laptop (options Linux/Windows OS), MatLab, possibly Java programming language (if necessary)

Phases of the project

Study of applications of signal processing methods in biomedical signal processing

Study of PPG recordings, i.e. differences between child and adult PPG, especially recorded on different parts of the body (finger, ear).

Study and implementation of selected methods for signal preprocessing and processing:

- Defining the task (detection of noise and artefacts, feature extraction and classification)
- Design of individual methods
- Implementation of selected methods
- Experiments and their evaluation

Final report

Bibliography: Mumford, David; Desolneux, Agnes: Pattern Theory: The Stochastic Analysis of Real-World Signals. A.K.Peters, 2010 Nait-Ali, Amine: Advanced Biosignal Processing. Springer. 2009 Northrop, Robert B.: Signals and Systems Analysis in Biomedical Engineering. CRC Press. 2010

Realization form: SW project + report

Date: 03.04.2013

Topic: Medical decision support system

Department: Department of Cybernetics

Supervisor: Ing. Michal Huptych , Doc. Ing. Lenka Lhotská CSc.

Announce as: Diploma thesis, Individual project

Description: The main aim of the project is design and implementation of a data model and design of an ontology in a specified medical domain, e.g. cardiology or obstetrics. The data model will be based on the data acquired from a cooperating university hospital. First design of the corresponding ontology will be based on literature study (medical guidelines, evidence-based medicine). The modifications will be developed in cooperation with medical doctors. Used hardware and software: smart phone with Android operating system, PC/laptop (options Linux/Windows OS), Java programming language, Oracle and ontology-editing tools. Interoperability and standardization issues must be considered. Knowledge of HL7 is welcome.

Phases of the project

Study of applications of medical decision support systems

Study of standardized structured medical vocabularies (e.g. SNOMED) and international coding systems

Design of an ontology in a specified medical domain:

- Defining classes in the ontology

- Arranging the classes in a taxonomic hierarchy

Implementation in an ontology-editing environment (e.g. Protégé, Ontolingua)

Final report

Bibliography: Křemen, Petr: Building Ontology-Based Information Systems. PhD Thesis. CVUT Prague, 2012 Pease, Adam: Ontology: A Practical Guide. SoftPress. 2011 Suarez-Figueroa, Carmen Mari: Ontology Engineering in a Networked World. Springer, 2012

Realization form: SW project + report

Date: 03.04.2013

Topic: Mobile technologies for health care

Department: Department of Cybernetics

Supervisor: Doc. Ing. Lenka Lhotská CSc., Ing. Miroslav Burša

Announce as: Diploma thesis, Individual project

Description: The main aim of the project is design and implementation of communication and processing functions in the chain measuring device – smart phone – PC/laptop. The application will be used by non-technical personnel (medical doctors, nurses, patients). Thus the user interface must be designed according to their requirements. The measuring device is collecting biomedical signals (in the simplest version heart rate, in more complex ECG or PPG), the data communication is wireless using Bluetooth technology. Smart phone should have several functions: display of measured signal, simple calculation of indicative parameters with immediate information feedback (normal state, slight deviation, alarm), data communication to a PC for storage and detailed calculation. The data communication must respect all requirements laid on data privacy and security. Used hardware and software: smart phone with Android operating system, PC/laptop (options Linux/Windows OS), Java programming language

Phases of the project

Study of applications of mobile technologies in medicine

Study of communication between mobile device and PC,

mobile device and signal acquisition device

Study and development of a small system for monitoring task:

- Defining the monitoring task (acquisition of selected biological signal, feature extraction and classification)

- Design of individual methods

- Implementation of selected methods

- Experiments

Final report

Bibliography: Al-Hakim, L.: Web mobile-based Applications for Healthcare Management. Idea Group Publishing. 2007
Olla, Phillip: Mobile Health Solutions for Biomedical Applications. Hershey, 2009
Xiao, Y; Chen, H.: Mobile Telemedicine - A Computing and Networking Perspective. CRC Press, 2008

Realization form: SW project + report

Date: 03.04.2013

Topic: Turing's Imitation Game - Transcript Analysis

Department: Department of Cybernetics

Supervisor: Prof. Kevin Warwick

Announce as: Diploma thesis, Bachelor thesis, Individual project, Voluntary technical project, Semestral project

Description: Turing's Imitation Game (also known as the Turing Test) involves brief conversations between an interrogator and hidden entities which are either human or machine. At the end of each conversation the interrogator must decide who/what they have been communicating with - was it a human or a machine?.

Significant transcript data is presently available from a number of Turing test events held in the last 2/3 years, the most recent being at Bletchley Park, England in 2012. This project involves an analysis of new conversations between human interrogators and either machines or humans to assess why interrogators came to correct conclusions and why they made errors, for example by identifying machines as humans.

Instruction: Contact: Kevin Warwick www.kevinwarwick.com
Recommended courses: Artificial Intelligence

Bibliography: K.Warwick, H,Shah and J.Moor, "Some Implications of a Sample of Practical Turing Tests", Minds and Machines, DOI10.1007/s11023-013-9301-y, 2013
H.Shah and K.Warwick, "Testing Turing's Five Minutes, Parallel-Paired Imitation Game", Kybernetes, Vol.39, Issue.3, Special Issue on Alan Turing, pp.449-465, 2010
H.Shah and K.Warwick, "Hidden Interlocutor Misidentification in Practical Turing Tests", Minds and Machines, Vol.20, Issue.3, p.441-454, 2010
All papers available from: k.warwick@reading.ac.uk

Realization form: Report/Paper Writing

Date: 03.04.2013

Topic: Visual odometry (SLAM) from omnidirectional camera

Department: Department of Cybernetics

Supervisor: Doc. Ing. Tomáš Svoboda Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project, Voluntary technical project, Semestral project

Description: Center for Machine Perception, Department of Cybernetics, contributes to the EU project NIFTi by developing visual algorithms for object/victim detection and robot localization. Among many other sensors, The robot carries an omnidirectional camera on board.

One of the important tasks is the robot localization in an unknown terrain. The goal of this work is to develop and implement a real-time robot method for visual based localization of the robot. The method will complement and robustify the laser based mapping and robot odometry filtering

Instruction: Contact: Tomáš Svoboda
<http://cmp.felk.cvut.cz/~svoboda>
Recommended courses: Computer Vision Methods, Three-Dimensional Computer Vision

Bibliography: F. Fraundorfer and D. Scaramuzza. Visual odometry : Part ii: Matching, robustness, optimization, and applications. Robotics Automation Magazine, IEEE, 19(2):78-90, June 2012.
Y. Ma, S. Soatto, J. Kosecka, and S.S. Sastry. An Invitation to 3-D Vision: From Images to Geometric Models, volume 26 of Interdisciplinary Applied Mathematics Series. Springer, New York, 2010

Realization form: code C/C++; Python

Date: 29.03.2013

Topic: Bipolar patients analysis

Department: Department of Cybernetics

Supervisor: Ing. Daniel Novák Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Examiner: MUDr. Filip Spaniel

Description: Bipolar disorder, also known as manic-depressive illness, is a brain disorder that causes unusual shifts in a person's mood, energy, and ability to function. Different from the normal ups and downs that everyone goes through, the symptoms of bipolar disorder are severe. They can result in damaged relationships, poor job or school performance, and even suicide. About 5.7 million American adults or about 2.6 percent of the population age 18 and older in any given year, have bipolar disorder. Bipolar disorder typically develops in late adolescence or early adulthood.

The aim of the project is analysis of bipolar patient's movement activity. The movement activity is being measured by one-dimensional acceleration sensor (- [Actiwatch](#)). Furthermore, each week a simple SMS questionnaire is send. The analysis consists of digital signal processing of measured movements and integration of the acquired results with SMS information.

The example of feature extraction is here:

Instruction: 1) Study state of art of bipolar disease
2) Design method for bipolar relapse prediction
3) Integrate the suggested method to ITAREPSsystem.

Bibliography: [1] Jones SH, Hare DJ, Evershed K., Actigraphic assessment of circadian activity and sleep patterns in bipolar disorder, *Bipolar Disord.* 2005 Apr;7(2):176-86. Scarna A, Seml [2] Michael Bauer, Paul Grof, Temporal relation between sleep and mood in patients with bipolar disorder, *Bipolar Disorders* 2006: 8: 160-167

Realization form: matlab

Date: 14.02.2013

Topic: Smart Grid: Intelligent Scheduling of Hybrid and Electric Vehicles Storage Capacity

Department: Department of Cybernetics

Supervisor: Ing. Martin Macaš Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Description: Apply a random search heuristic (genetic algorithm, particle swarm, or any other) to problem of intelligent scheduling of hybrid and electric vehicle storage capacity in a parking lot for profit maximization in grid power transactions.

Instruction: 1. implement the application
2. perform experimental evaluation

Bibliography: Hutson et al., Intelligent Scheduling of Hybrid and Electric Vehicle Storage Capacity in a Parking Lot for Profit Maximization in Grid Power Transactions, 2008.

Realization form: Matlab, Java, ...

Date: 30.10.2012

Topic: Automated processing of eye-movement signals

Department: Department of Cybernetics

Supervisor: Ing. Martin Macaš Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Examiner: Vratislav Fabian

Description: Eye-movement (oculographic) signals is an important biological signal that can be used in many applications. Their automated processing can be very useful in many existing healthcare, business and other systems.

Instruction: Propose, implement and evaluate a system for automated processing of oculographic signals.

Realization form: Matlab, JAVA

Date: 27.10.2012

Topic: Smart Grid datasets: Survey

Department: Department of Cybernetics

Supervisor: Ing. Martin Macaš Ph.D.

Announce Individual project

as:

Examiner: Pavel vrba

Description: A smart grid is an electrical grid that uses information and communications technology to gather and act on information, such as information about the behaviors of suppliers and consumers, in an automated fashion to improve the efficiency, reliability, economics, and sustainability of the production and distribution of electricity.

Date: 27.10.2012

Topic: Functional MRI of hypercapnia data

Department: Department of Cybernetics

Supervisor: Doc. Ing. Jan Kybic Dr.

Announce as: Diploma thesis, Individual project, Voluntary technical project,

Description: Hypercapnia is a condition of increased presence of carbon dioxide in the blood. Normal reaction of brain to this condition is vessel dilation that will increase the blood flow in the brain in order to compensate for the decreased presence of oxygen in blood. This processes can be monitored over time using a special MRI sequence called BOLD. The BOLD sequence is sensitive to the level of oxygen in blood and increased oxygen concentration shows as increased signal in the images. Hypercapnia BOLD imaging can used to study the vasoreactivity of vessels to the fluctuating level of carbon dioxide in blood. It can be used to identify brain regions with non-standard reaction and as such to identify problematic vessels that may contain stenosis or some other vascular pathology. The hypercapnia is usually induced by letting the subjects breath air with increased carbon dioxide concentrations during MRI examination. In our data, we have used several periods of controlled breathholds which is more convenient for use in clinical practice. This, however, brings additional issues in data evaluation as the patients are not always capable to dutifully follow the protocol. The aim of this thesis is to evaluate clinical data from 50+ patients obtained during one or more sessions. The brain of each patient is supposed to contain normal regions and it may contain also pathological regions. The time course of BOLD signal in each patient needs to be examined first to identify what is the normal reaction for each patient (as being close to the expected response). Subsequently, the whole brain of each patient needs to be studied to identify if there are regions with no reaction and with pathological reaction. The result of the automatic analysis of the hypercapnia fMRI data will be compared with clinical findings and the sensitivity and specificity of the automatic method and the BOLD examination will be assessed. Data and clinical findings will be supplied by University hospital in Dresden. The results will be evaluated in close collaboration with medical doctors from the hospital. The applicant is expected to visit Dresden regularly.

The applicant is expected to be fluent in English and have good programming skills in Matlab. Willingness to learn basic principles of fMRI and BOLD imaging as well as to learn the basic medical background of the problem is expected.

[In collaboration with Mgr. Jan Petr, Ph.D.]

Instruction: 1. Learn the principles of functional MR imaging and data processing.

2. Design and implement a method for evaluation of hypercapnia sequences, to distinguish between normal and pathological regions.

3. Experimentally evaluate the developed method on provided clinical data.

Bibliography: -Bernstein, King, Zhou: Handbook of MRI pulse sequences. - McRobbie, Moore, Graves, Prince: MRI From picture to proton. -U. S. Yezhuvath, K. Lewis-Amezcuca, R. Varghese, G. Xiao, and H. Lu, "On the assessment of cerebrovascular reactivity using hypercapnia BOLD MRI.," NMR in biomedicine, vol. 22, no. 7, pp. 779–86, Aug. 2009.

Realization fo kod v Matlabu, vysledky experimentu
rm:

Date: 24.09.2012

Topic: Optimal MRI acquisition times for brain tissue segmentation from signal relaxation curve

Department: Department of Cybernetics

Supervisor: Doc. Ing. Jan Kybic Dr.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Description: In MRI, The T1 relaxation time of brain tissue can be measured separately in each voxel from the signal recovery after saturation measured at multiple times. This information can be used to provide brain segmentation with good accuracy without using any prior knowledge about brain topology.

What has not been studied yet is the optimal settings of the acquisition times. The influence of more dense sampling and/or presence of noise in the data on the accuracy and systematic error of the segmentation needs to be evaluated. The obtained segmentation will be used for correcting partial volume effect in perfusion MRI measurement. The real data will be provided by the Helmholtz-Zentrum Dresden Rossendorf.

[In collaboration with Mgr. Jan Petr, Ph.D.]

Instruction: Learn the basic principles of MR imaging and study the algorithm for brain segmentation from T1 signal recovery.

Design a simulated experiment and analyze influence of noise and sampling pattern on accuracy and systematic errors in the segmentation.

Test the ideal sampling pattern on real data.

Optional. Demonstrate improvement of the ideal sampling in application on perfusion MRI.

Bibliography: Bernstein, King, Zhou: Handbook of MRI pulse sequences. McRobbie, Moore, Graves, Prince: MRI From picture to proton. W. Shin, X. Geng, H. Gu, W. Zhan, Q. Zou, and Y. Yang, "Automated brain tissue segmentation based on fractional signal mapping from inversion recovery Look-Locker acquisition.," NeuroImage, vol. 52, no. 4, pp. 1347-54, Oct. 2010.

Realization form: Code in Matlab. Results of the experiment.

Date: 24.09.2012

Topic: Open Street Maps for Mobile Robot Navigation

Department: Department of Cybernetics

Supervisor: Dr.rer.nat. Martin Saska

Announce as: Bachelor thesis, Individual project, Semestral project

Description: Open Street Map is a public, open, XML-based format specification for description of outdoor environment. The format allows easy extension for the purposes of map-based mobile robot navigation. The purpose of this work is to design the OSM format extension. Moreover, the student should implement a mobile robot navigation algorithm, which would use the OSM extension.

Instruction: Get to know the OSM specification and basics of map-based mobile robot navigation algorithms. Design an extension of the OSM for the purpose of mobile robotics. Implement and test a navigation algorithm, which would use the OSM.

Bibliography: OSM specifications.

Realization form: SW projekt

Date: 19.06.2012

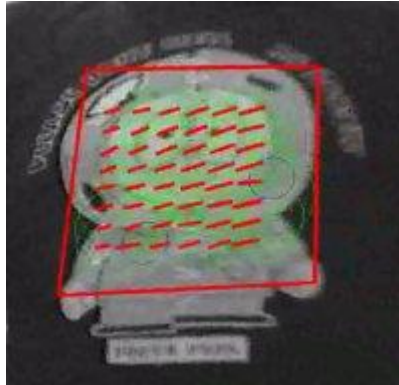
Topic: Learnable predictors for detection and tracking in images and videos

Department: Department of Cybernetics

Supervisor: Doc. Ing. Tomáš Svoboda Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project, Voluntary technical project,

Description:



We will follow the idea of learnable predictors/detectors. Simply speaking the principle is to collect a few training images and learn a direct mapping between observations and parameters, e.g. motion. The learning process explicitly optimizes the predictor complexity

w.r.t. predefined accuracy and operating range (basin of attraction)

The approach proved to be extremely efficient and robust for objects

whose appearance were available for off-line learning in advance. We

focus on paradigm person generic detector by appearance encoded

regression. The learning procedure will separate appearance variations

in unsupervised manner. The approach will allow for learning on few

class examples (people) and detection/tracking on the complete class

Bibliography: [1] K. Zimmermann, J. Matas, and T. Svoboda. Tracking by an Optimal Sequence of Linear Predictors. IEEE Transactions on Pattern Analysis and Machine Intelligence. 2008

[2] K. Zimmermann, T. Svoboda, J. Matas. Simultaneous learning of motion and appearance, ECCV 2008 Workshop on Machine Learning for Vision-based Motion Analysis

Date: 12.12.2009

Topic: Healthy computer controller (keyboard replacement)

Department: Department of Cybernetics

Supervisor: Ing. Miroslav Uller , RNDr. Petr Pudlák Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Description: Everybody knows that current computer controllers such as keyboards and mice are quite unhealthy. Users suffer from a lack of movement, develop unnatural movement/postural patterns and ultimately repetitive strain injury. I believe that one of solutions could be developing a controller that would generate input for a computer using complex movements of arms (hands, fingers) and legs. If such a controller would be well designed, it would promote good movement patterns, help to gain physical condition and prevent many lifestyle diseases. Just imagine a programmer leaving a computer after a long day, his/her whole body stretched and exercised, instead of pains and aches just light and pleasant physical fatigue.

This project would obviously require cooperation of experts in several fields, namely:

- * in physiotherapy (to devise proper movement sequences/patterns),
- * in the design input controllers (to map the movement sequences/patterns to computer inputs so that data can be entered efficiently),
- * in engineering so that the controller would be robust, easy to manufacture and could replace keyboard/mouse in operating systems.

Contact: uller@labe.felk.cvut.cz, petr@pudlak.name

Realization form: HW

Date: 10.04.2009

Topic: Peer-to-peer backup system based on BitTorrent

Department: Department of Cybernetics

Supervisor: Ing. Miroslav Uller , RNDr. Petr Pudlák Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project

Description: Peer-to-peer (P2P) data sharing systems are widely used now. However, I'm still missing a multi-platform backup solution based on this technology. Imagine the following scenario: Each user backups his/her data, encrypts it, perhaps signs it with a digital signature, and publishes it into a P2P network. At the same time (s)he offers some disk space to other participants to store their data. Then, the users automatically exchange data so that their data are distributed in the network and can be downloaded later by the respective owner in a case of a loss.

Most of the technology required for the project is already available. In particular:

- * Cryptography libraries for encrypting user data.
- * P2P library for distributing the data. The best choice for P2P communication seems to be BitTorrent protocol, as it is widely used, is proved to be robust and effective, and there are several libraries to choose from.
- * For better efficiency, the program could also include some compression algorithm(s) with high compression ratio, for example Lempel-Ziv-Markov chain algorithm.
- * In some cases the user's software doesn't or can't support incremental backup. Clonezilla, a program for saving whole disks/partitions, is a good example. In such a case the program could assist the user with its own solution, which could be based on rdiff.

The aim of the project would be to create

- * a full featured user friendly client, and
- * a server on a top of a BitTorrent tracker that aids the clients in distributing the data, determines the credit of the clients (i.e. the ratio between space designated for others and the amount of own data to be distributed), etc.

Contact: uller@labe.felk.cvut.cz, petr@pudlak.name

Realization form: SW projekt

Date: 10.04.2009

Topic: Extended sniffer agent for observing non-trivial communication protocols

Department: Department of Cybernetics

Supervisor: Ing. Jiří Vokřínek Ph.D., Ing. Jiří Bíba

Announce Individual project

as:

Description: Inter-agent communication presents a corner stone of multi-agent solutions. A visualization of the communication is crucial as for a code debugging as for a presentation of the solution. The goal of this project is to extend the current sniffer agent for multi-agent platform JADE (Java Agent DEvelopment framework) or A-globe by a functionality needed for a visualization of inter-agent communication in supply-chain/e-commerce domain (e.g. observation of a contract in a non-trivial interaction protocol). A prerequisite of subscribing for this project is an average skill in Java programming at least (alternatively in C++ or C#).

Date: 05.02.2008

Topic: Logical analyzer for a visualization of multi-agent simulations

Department: Department of Cybernetics

Supervisor: Ing. Jiří Bíba , Ing. Jiří Vokřínek Ph.D.

Announce Individual project

as:

Description: Multi-agent simulation running in a non-linear time allows a full exploitation of the processor computational power. A just-in-time visualization of the simulation in a real time lacks reason due to the non-linearity of time, however, once the simulation is recorded, it can be re-played linearly in time. The goal of this project is to implement an extension of the the current logger agent in order to equip it with a capacity of visualizing social relations between agents, their cooperation and its configuration, commitments of the agents and their fulfilment during the cooperation, etc. The basic platform for implementation will be JADE (Java Agent DEvelopment) platform or A-globe platform. A prerequisite of subscribing for this project is an average skill in Java programming at least (alternatively in C++ or C#).

Date: 05.02.2008

Topic: Renegotiable Competitive Contract Net Protocol for flexible cooperation in competitive environments

Department: Department of Cybernetics

Supervisor: Ing. Jiří Bíba , Ing. Jiří Vokřínek Ph.D.

Announce Individual project

as:

Description: A cooperation in competitive environments requires underlying negotiation protocols covering the cooperation lifecycle as whole. Moreover, a flexible cooperation requires means of adaptation (extension or reduction) of the existing commitments. Extend the current implementation of the Competitive Contract Net Protocol by renegotiation phases according to provided specification and test the implementation on a simple scenario. The basic platform for implementation will be JADE (Java Agent DEvelopment) platform. A prerequisite of subscribing for this project is an average skill in Java programming at least (alternatively in C++ or C#).

Date: 05.02.2008

Topic: Visualisation of graphs in 3D

Department: Department of Cybernetics

Supervisor: Ing.et Ing. Petr Buryan

Announce as: Bachelor thesis, Individual project, Voluntary technical project,

Description: Graph mining became during past decades an area attractive for data-mining researchers as it enables to challenge its typical problems starting from many points of view. One of interesting tasks is presenting results in a user-friendly form.
Goal of this project is to search for or develop and implement fast algorithm in Java (e.g. based on Java3D library) for visualisation of relational structures in 3D.

Realization form: Java code and doc

Date: 18.01.2008

Topic: Adaptive Optimization

Department: Department of Cybernetics

Supervisor: Doc. Ing. Filip Železný Ph.D.

Announce as: Diploma thesis, Bachelor thesis, Individual project, Voluntary technical project,

Examiner: Jiří Kléma

Description: Develop a prototype application of an algorithm that learns how to solve a certain kind of a combinatorial problem from examples of small instances and solutions of that problem, and then applies this learned knowledge for solving larger instances of the problem.

(Scary as it may seem, this assignment's complexity may be reduced quite arbitrarily).

Instruction: The extent of the deliverable will depend on the particular project category (diploma thesis / Bc. / semestral project / ...). Agreement will be settled with the supervisor.

Bibliography: Will be provided by the supervisor.

Realization form: Code in a language of student's choice + report

Date: 09.11.2007

Management concept of Smart Grids networks

Smart Grids are energy networks, which use information and communication technologies for real-time management of electricity production and consumption. Telecommunications is a branch where the network management is mastered very well. The aim of the work is a complex analysis of existing procedures for managing telecommunications networks usage for Smart Grids management.

The work will be elaborated in accordance with the activities of the TM Forum organization.

Supervisor: Zdenek Brabec (zdenek.brabec@fel.cvut.cz)

Department of Telecommunication

Bio-inspired Information Concealing

This project will investigate practical applicability of repeats-based information concealing on real-life data. Participants will apply this technique to various data samples (text, email, network traffic, audio, video) and analyze its performance.

Matlab, Linux/Unix scripting and general computer programming skills will be utilized.

Required skills: working English speaking and writing, basic combinatorial mathematics and statistics

Recommended skills: General programming, Matlab, Linux/Unix scripting

Supervisor: Lukas Kencl (lukas.kencl@rdc.cz)

Department of Telecommunication

SIP Server Traffic Anonymizer

This project will build tools to pre-process and anonymize large SIP network traffic traces. Working with a large dataset obtained from a commercial partner, the results will be published as an open-source prototype.

Linux/Unix scripting, SIP protocol knowledge and general computer programming skills will be utilized.

Required skills: working English speaking and writing, basic network protocols knowledge, SIP knowledge and experience, Linux/Unix scripting

Supervisor: Lukas Kencl (lukas.kencl@rdc.cz)

Department of Telecommunication

User identification with utilization of depth sensor data (e.g. Microsoft Kinect, Asus Xtion PRO, etc.)

- research various methods of user identification with utilization of depth sensor data (face recognition, recognition based on body proportions, etc.)
- based on the research, choose at least one method and make a referential implementation

Supervisor: Roman Hak (roman.hak@fel.cvut.cz)

Department of Telecommunication

Interactive multi-touch gesture recognition

- research existing methods and libraries / toolkits for interactive multi-touch gesture recognition
- based on the research, choose the most appropriate library (or implement own solution if no one is suitable) and implement a gesture recognizer
- the recognizer should be capable of defining custom set of gestures

Supervisor: Roman Hak (roman.hak@fel.cvut.cz)

Department of Telecommunication

Interactive 3D gesture recognition utilizing a depth sensor (e.g. Microsoft Kinect, Asus Xtion PRO, etc.)

- research methods and libraries / toolkits / framework for interactive 3D gesture recognition
- based on the research, choose the most appropriate library (or implement own solution if no one is suitable) and implement a gesture recognizer
- the recognizer should be capable of defining custom set of gestures

Supervisor: Lukas Kencl (roman.hak@fel.cvut.cz)

Department of Telecommunication

Use of Ripley's K function in femtocell environments

The aim of project is to investigate how we can describe/ characterize distribution of femtocells in a macrocell, i.e. whether femtocell locations are homogenous, cluster, disperse, etc. To characterize the distribution, Ripley's K function will be used.

Steps: to familiarize with femtocell problematic – to develop a model in Matlab (one macrocell containing various number of femtocells that are differently distributed in the macrocell) – to characterize the femtocell distribution with the help of Ripley's K function.

Recommended skills: General programming, Matlab

Supervisor: Robert Bestak (robert.bestak@fel.cvut.cz)

Department of Telecommunication

Models for femtocell networks

The aim of project is to compare different existing models for femtocell placement (random placement /dense-urban model/ etc.) and develop new ones suitable for the femtocell environment.

Steps: to familiarize with femtocell problematic – to implement exiting models in Matlab and to analyze their features – to design new model(s) suitable for the femtocell environment

Recommended skills: General programming, Matlab

Supervisor: Robert Bestak (robert.bestak@fel.cvut.cz)

Department of Telecommunication

Virtualization of VoIP servers

The task is to evaluate suitability of virtualization for high available VoIP servers distributed in wide area network. Requirements on network characteristics such as jitter, round trip time and bandwidth should be analyzed.

Recommended skills: General programming, HW virtualization

Supervisor: Robert Bestak (robert.bestak@fel.cvut.cz)

Department of Telecommunication

Nonlinear Schrödinger equations

Analyze the solution propagation in dispersion decreasing optical fibers. In this context, make a Matlab script as a solver of the nonlinear Schrödinger equations by the split-step Fourier method. As the outcome of the project, plot a “mesh” graph (mesh je v Matlabu 3D graf) of the normalized solution energy versus the solution duration versus the normalized fiber length.

Supervisor: Michal Lucki (lucki@fel.cvut.cz)

Department of Telecommunication

Android logistic assistant for storage areas

Program the Android client and server application for logistic assistant. Verify the communication and system features in laboratory conditions. Consider secure communication (SSL/TLS).

Logistic terminal uses GPS, NFC and Wi-Fi technologies for controlling of logistic operation in storage areas. The user of the Android application is routed by remote server to specific GPS coordinates, where he is obliged to confirm the finding of the specific logistic unit. The unit is equipped by NFC tag. After confirmation, the server application routes the user to the place of goods delivery.

Supervisor: Lukas Vojtech (lukas.vojtech@fel.cvut.cz)

Department of Telecommunication

System for unique identification of goods using NFC tags

Develop an Android application to identify goods that is equipped by NFC tags. The specific goods is equipped with NFC tags, which allow verification of the goods origin, i.e. production information, distribution chain, expiration, etc., with the aid of remote database. Secure communication with the server should be taken into account. There will be a cooperation with another student.

Supervisor: Lukas Vojtech (lukas.vojtech@fel.cvut.cz)

Department of Telecommunication

Software Radio on Digital Signal Processor

The aim of this activity is the support of laboratory education in the digital signal processing.

This activity comprises programming of known algorithms for a direct conversion radio receiver on the digital signal processor (DSP) including filtering and demodulation. The programming is supposed in C. The hardware platform is the starter and development kit based on the floating point digital signal processor TMS320C6748.

This activity comprises 20% hardware and 80% software.

Supervisor: Pavel Zahradník (zahradni@fel.cvut.cz)

Department of Telecommunication

Karhunen Loeve and Discrete Cosine Transforms on Digital Signal Processor

The aim of this activity is the support of laboratory teaching in the digital signal processing.

This activity comprises programming of both transform on the digital signal processor (DSP). The programming is supposed in C. The hardware platform is the starter and development kit based on the floating point digital signal processor TMS320C6748. This is a 100% software activity.

Supervisor: Pavel Zahradník (zahradni@fel.cvut.cz)

Department of Telecommunication

Support for Laboratory Education in Digital Signal Processing in Matlab

The aim of this activity is the support of laboratory education in the digital signal processing.

This activity comprises the preparation of selected laboratory tasks in the Matlab environment.

It is focused on processing of audio signals in real time using recent Matlab options.

The signal processing includes signal filtering and signal analysis.

This is a 100% software activity.

Supervisor: Pavel Zahradník (zahradni@fel.cvut.cz)

Department of Telecommunication

Laser Beam Deflector

The aim of this activity is the design and development of a two-dimensional pointing mirror for the steering of a laser beam. The control of the mirror is supposed using a fast microcontroller. Its programming is supposed in C. Intermediate hardware and software skills are required.

This activity comprises 50% hardware and 50% software.

Supervisor: Pavel Zahradník (zahradni@fel.cvut.cz)

Department of Telecommunication

Estimation of signal to noise ratio of mobile users

Investigate options how to estimate an evolution of the signal to noise ratio observed by mobile users. The objective is to evaluate and compare various ways of signal estimation from the estimation error perspective with respect to the wide range user's mobility patterns.

Supervisor: Zdenek Becvar (zdenek.becvar@fel.cvut.cz)

Department of Telecommunication

Path selection for data delivery in femto-cloud

Analyze potential parameters that should be considered for selection of most suitable path for delivery of data from user equipment to femtocells composing so-called femto-cloud. Then, the parameters should be put to a relation with requirements of individual users and quality of communication channels in order to select an access station for users.

Supervisor: Zdenek Becvar (zdenek.becvar@fel.cvut.cz)

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. and MS. Students)

Exchange Project: Analysis and processing of intracranial EEG

Supervisors: Ing. Petr Ježdík, PhD. (jezdip1@fel.cvut.cz), Ing. Radek Janča (jancarad@fel.cvut.cz), Doc. Ing. Roman Čmejla, CSc. (cmejla@fel.cvut.cz)

Department: Department of Circuit Theory (DCT), Faculty of Electrical Engineering, Czech Technical University CTU in Prague (<http://sami.fel.cvut.cz/isarg/>)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is aimed on methods for analyses of intracranial (invasive) EEG in interictal, ictal and postictal epileptic state in time and frequencies domain. Analyses are focused on seizure onset zone detection, specific waveform identification and epileptiform-network links finding. Precise localization and removing of epileptic zones is essential for successful outcome of surgical treatment. There are extensive EEG signal databases and MATLAB codes in ISARG group cooperating with University Hospital Motol in Prague.

Requirements:

Basics in the area of Digital Signal Processing, knowledge of MATLAB

Recommended subjects to be studied at the DCT:

- Biological Signal Processing (PhD subject)
- Digital signal processing (PhD subject)
- Phonetic signals and their coding (PhD subject)
- Basic Signal Processing (available for fall semester)
- Signal theory (fall semester)
- Biological signals (spring semester)
- Digital Signal processing (spring semester)

References:

- [1] R. Janca, P. Jezdik, R. Cmejla, P. Krsek, J.G.R. Jefferys, P. Marusic, P. Jiruska (2013). "Automatic Detection and Spatial Clustering of Interictal Discharges in Invasive Recordings," in IEEE International Symposium on Medical Measurements and Applications, Ottawa, Kanada (in Press).
- [2] T. Havel, R. Janca, P. Jezdik, Cmejla R., P. Krsek, P. Jiruska, P. Marusic (2013). "Automatic Detection of High-frequency Oscillations In Invasive Recordings," in IEEE International Symposium on Medical Measurements and Applications, Ottawa, Kanada (in Press).
- [3] Balach, J. - Havel, T. - Ježdík, P. - Janča, R.: Detection of Epieptic Seizure from Scalp EEG as a Support for SPECT Scan. In Proceedings of Electronic Devices and Systems EDS 2012. Brno: VUT v Brně, FEKT, 2012, vol. 1, p. 116-119. ISBN 978-80-214-4539-0.
- [4] P. Jiruška, G. T. Finnerty, A. D. Powell, N. Lofti, R. Čmejla, and J. G. Jefferys. (2010). "Epileptic high-frequency network activity in a model of non-lesional temporal lobe epilepsy," *Brain*, 133(5): 1380-1390.
- [5] R. Janča, P. Ježdík, R. Čmejla, R. Glajcar, P. Kršek, and A. Jahodová (2011). "Seizure onset zone detection and localization in intracranial electroencephalography using directed transfer function," in IEEE International Symposium on Medical Measurements and Applications, Bari, Italy, 93-97.

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. and MS. Students)

Exchange Project: Analysis and processing of Multichannel Surface EMG

Supervisors: Ing. Jan Sedlák (sedlaj15@fel.cvut.cz), Ing. Daniel Špulák (daniel.spulak@gmail.com), Doc. Ing. Roman Čmejla, CSc. (cmejla@fel.cvut.cz)

Department: Department of Circuit Theory (DCT), Faculty of Electrical Engineering, Czech Technical University CTU in Prague (<http://sami.fel.cvut.cz>)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is aimed on processing of multichannel surface electromyographic signals, muscle activity detection and muscle coordination maps. We cooperate with colleagues from the Faculty of Physical Education and Sport, which record surface EMG signals for various sports activities. There are extensive EMG signal databases and MATLAB codes in SAMI group.

Requirements:

Basics in the area of Digital Signal Processing, knowledge of MATLAB

Recommended subjects to be studied at the DCT:

Biological Signal Processing (PhD subject)
Digital signal processing (PhD subject)
Phonetic signals and their coding (PhD subject)
Basic Signal Processing (available for fall semester)
Signal theory (fall semester)
Biological signals (spring semester)
Digital Signal processing (spring semester)

References:

- [1] Špulák, D. - Čmejla, R. - Mikulíková, P. - Bezoušková Paulů, J. - Kračmar, B.: Muscle Activity Detection Using EMG Envelope Thresholding - Comparison of Various Approaches. In 20th Annual Conference Proceeding's Technical Computing Bratislava 2012 [CD-ROM]. Prague: HUMUSOFT, 2012, p. 1-5. ISBN 978-80-970519-4-5.
- [2] Špulák, D. - Sedlák, J. - Čmejla, R.: Processing of Multichannel Surface Electromyographic Signals. In Czech-German Workshop on Speech Pathology and Biological Signals - Proceedings [CD-ROM]. Prague: CTU, Faculty of Electrical Engineering, Department of Circuit Theory, 2012, p. 42-44. ISBN 978-80-01-05164-1.

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. and MS. Students)

Exchange Project: Analysis and Assessments in Speech Pathology

Supervisors: Ing. Jan Ruzs, PhD. (rusz.mz@gmail.com), Doc. Ing. Roman Čmejla, CSc. (cmejla@fel.cvut.cz)

Department: Department of Circuit Theory (DCT), Faculty of Electrical Engineering, Czech Technical University CTU in Prague (<http://sami.fel.cvut.cz>)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is aimed to finding methods that would be based on the analysis of speech pathological audio recordings and would be able to objectively and automatically determine the degree of speech disorders. These methods could be useful for medical experts in determining of speech pathology severity. There are extensive speech pathology databases and MATLAB codes in SAMI group.

Requirements:

Basics in the area of Digital Signal Processing, knowledge of MATLAB

Recommended subjects to be studied at the DCT:

Biological Signal Processing (PhD subject)

Digital signal processing (PhD subject)

Phonetic signals and their coding (PhD subject)

Basic Signal Processing (available for fall semester)

Signal theory (fall semester)

Biological signals (spring semester)

Digital Signal processing (spring semester)

References:

[1] R. Čmejla, J. Ruzs, P. Bergl, and J. Vokřál. (2013). Bayesian changepoint detection for the automatic assessment of fluency and articulatory disorders. *Speech Communication*, 55(1): 178-189.

[2] J. Ruzs, R. Čmejla, H. Ružičková, and E. Růžička. (2011). "Quantitative acoustic measurements for characterization of speech and voice disorders in early untreated Parkinson's disease," *Journal of the Acoustical Society of America*, 129(1): 350-367.

[3] T. Lustyk, P. Bergl, R. Čmejla, and J. Vokřál. (2011). "Change evaluation of Bayesian detector for dysfluent speech assessment," in *International Conference on Applied Electronics 2011, Pilsen, Czech Republic*, 231-234.

[4] Novotný, M. - Ruzs, J. - Čmejla, R.: AUTOMATIC SEGMENTATION OF PHONEMES DURING THE FAST REPETITION OF (/PA/-/TA/-/KA/) SYLLABLES IN A SPEECH AFFECTED BY HYPOKINETIC DYSARTHRIA. *Lékař a technika*. 2012, roč. 42, č. 2, s. 81-84. ISSN 0301-5491.

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student, (advanced MS. Student)

Exchange Project: Small Vocabulary Speech Recognition in English

Supervisors: Doc. Ing. Petr Pollak, CSc., (pollak@fel.cvut.cz)

Department: Department of Circuit Theory, Faculty of Electrical Engineering, Czech Technical University CTU in Prague

Duration of study at CTU: 1-2 semesters

Abstract:

Within this project student should realize chosen small vocabulary speech recognizer. Possible applications are digit recognizer (for voiced controlled dialing), command recognizer (voiced control of a consumer device), name recognizer (voiced controlled information system). Recognizer should be realized using publicly available HTK Toolkit. The operation will be simulated using speech data from available speech databases. Depending on availability of training and testing speech data, a realization of a recognizer in some other language is also possible under personal agreement.

Requirements:

Student should be familiar with the basis of digital signal processing, some experiences in speech processing are invited but it is not necessary condition. Recommended subjects for study at CTU FEE are AE2M99CZS Digital Signal Processing (taught in winter semester) and AE2M31ZRE Speech processing (taught in summer semester). The passing of these subjects is not mandatory, it is a recommended option. Basic experiences in programming and with operation system Linux are invited.

References (the project is closely related to work presented in the following papers):

[1] Rabiner, L., Schafer, R. W.: Introduction to Digital Speech Processing Foundations and Trends in Signal Processing). Now Publishers Inc, 2007.

[2] Huang, X., Acero, A., Hon, H.-W.: Spoken Language Processing. Prentice Hall, 2001.

[3] Deller Jr., J. R., Hansen, J. H. L., Proakis, J. G.: Discrete-time Processing of Speech Signals. Wiley, 2000.

[4] Rabiner, L., Juang, B.-H.: Fundamentals of Speech Recognition. Prentice Hall, 1993.

[5] S. Young and et al., The HTK Book, Version 3.4.1. Cambridge, 2009.

[6] Oppenheim, A. V., Schafer, F. W.: Discrete-Time Signal Processing. Prentice-Hall. 2nd edition. 1999

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student, (advanced MS. Student)

Exchange Project: Electronic Circuit Analysis in Maple program

Supervisors: ass. Prof. Jirí Hospodka (hospodka@fel.cvut.cz)

Department: Department of Circuit Theory, Faculty of Electrical Engineering, Czech Technical University CTU in Prague

Duration of study at CTU: 1-2 semesters

Abstract:

The project is focused on testing of simulation software for electronic circuit analysis. The simulation software consists of a special package named PraCAN for program Maple. The goal of the project is to develop test scripts for the entire package and also examples on which the rightness and accuracy of the calculations will be tested. As a comparison simulator we use WinSpice program, but another type of simulator (PSpice, MicroCap, ...) can be used.

Requirements: Knowledge of basic methods for electric and electronic circuit analysis, knowledge of a Spice simulator and basic programming skills. Knowledge of the Maple program and its programming language is an advantage.

Recommended subjects to be studied at the DEF:

Analog Circuits (available for fall semester)

Laboratory of Electronic Systems (spring semester)

Integrated System Structures (fall semester)

Implementation of Analog Systems (fall semester)

References (the project is closely related to work presented in the following papers):

[1] J. Vlach and K. Singhal, *Computer Methods for Circuit Analysis and Design*, Van Nostrand Reinhold Company Inc., New York 1994, 2nd Edition, ISBN 0-13-879818-4..

[2] J. Bicak and J. Hospodka, *PraCAN – Maple Package for Symbolic Circuit Analysis*, Digital Technologies 2008, EDIS ~ Zilina University Publisher, Zilina, 2008, ISBN 978-80-8070-953-2.

[3] Hospodka, J. - Bicak, J.: *Symbolic analysis of nonlinear electronic circuits by PraCAN package in Maple program*. Proceedings of the International Workshop on Symbolic and Numerical Methods, Modeling and Applications to Circuit Design 2010 [CD-ROM]. Tunis: IEEE - Tunisia, 2010, ISBN 978-1-4244-6815-7.

[4] A. Vladimirescu, *The Spice Book*, John Wiley & Sons, Inc., New York 1994, ISBN 0-471-60926-9.

[5] M. Smith, *WinSpice User's Manual*, <http://www.winspice.com>, 2007.

[6] Gray, P. R., Hurst, P.J., Lewis, S.H.: *Analysis and Design of Analog Integrated Circuits*. John Wiley & Sons, U.S., 2001.

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student, (advanced MS. Student)

Exchange Project: Design of Digital Filter in Maple program

Supervisors: ass. Prof. Jirí Hospodka (hospodka@fel.cvut.cz)

Department: Department of Circuit Theory, Faculty of Electrical Engineering, Czech Technical University CTU in Prague

Duration of study at CTU: 1-2 semesters

Abstract:

The project is focused on creation new functions for standard digital filters design. The software for implementation is mathematical program Maple. Syntfil package exists for analog electric filter design in Maple, see <http://syntfil.feld.cvut.cz/index.html.en>. The goal of the project is to develop new function of Syntfil package for standard digital filters design. Syntfil package enables the design of transfer functions of continuous-time analog filters, including the synthesis of analog electrical circuit of the filter. The project would include design converting procedures from analog filters to digital filters (from s variable to a variable z), i.e. design IIR filters. Function for FIR filter design could be an advantage.

Requirements: Basic knowledge of digital and analog filter design. Knowledge of the Maple program and its programming language is an advantage.

Recommended subjects to be studied at the DEF:

Analog Circuits (available for fall semester)

Digital Signal processing (fall semester)

Electronic Circuits and Filters (fall semester)

References (the project is closely related to work presented in the following papers):

[1] D. Schlichthärle: *Digital Filters: Basics and Design*, Springer, 2nd edition, 2011, ISBN-13: 978-3642143243.

[2] R. W. Hamming: *Digital Filters*, Dover Publications, 3rd edition, 1997, ISBN-13: 978-0486650883.

[2] Shumann, R., Ghausi, M. S., Laker, K. R.: *Design of Analog filters*. Prentice-Hall, New Jersey 1990, ISBN 0-13-200288-4.

[3] J. Hospodka and J. Bičák: *Syntfil - Synthesis of Electric Filters in Maple*, MSW 2004 [CD-ROM]. Waterloo, ON: Maplesoft, a division of Waterloo Maple Inc., 2004.

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student (or advanced MSc. student)

Exchange Project:

Determination of hemodynamic parameters and primary screening of atherosclerosis

Supervisors: Ing. Jan Havlík, Ph.D. (xhavlikj@fel.cvut.cz)

Department:

Department of Circuit Theory, Faculty of Electrical Engineering,
Czech Technical University in Prague

Duration of study at CTU: 1 - 2 semesters

Abstract:

The project deals with the design and implementation of signal processing methods for measuring of blood pressure and hemodynamic parameters. Consequently, the target of the project is a design of methods for primary screening of atherosclerosis based on hemodynamic parameters and a shape of the pulse wave. An experimental workplace has been designed and developed for solving the project. New signal database has been collecting using this workplace.

Requirements: Strong basics in the area of signal processing and/or circuit theory and hardware design, knowledge of MATLAB

Recommended subjects to be studied at the DEF:

Theory of Systems (PhD student)

Biological Signals (PhD or MSc student)

Medical Equipment (MSc student)

References (the project is closely related to work presented in the following papers):

- [1] P. Natarajan, A. H. Shennan, J. Penny, H. A. W a M. a. A. J. De Swiet, „Comparison of auscultatory and oscillometric automated blood pressure monitors in the setting of preeclampsia,“ *American Journal of Obstetrics & Gynecology*, vol. 181, n. 5, pp. 1203-1210, 1999.
- [2] K. P. Myung a W. M. a. C. Y. Shirley, „Comparison of Auscultatory and Oscillometric Blood Pressures,“ *Arch Pediatr Adolesc Med.*, vol. 155, pp. 50-53, 2001.
- [3] J. A. Posey, L. A. Geddes a H. a. M. A. G. Williams, „The meaning of the point of maximum oscillations in cuff pressure in the indirect measurement of blood pressure. Part 1.,“ *Cardiovasc. Res. Cent. Bull.*, n. 8, pp. 15-25, 1969.
- [4] L. A. Geddes, M. Voelz a C. a. R. D. Combs, „Characterization of oscillometric method for measuring indirect blood pressure,“ *Ann. Biomed. Eng.*, vol. 10, pp. 271-280, 1983.
- [5] G. Drzewiecki a R. a. A. H. Hood, „Theory of the Oscillometric Maximum and Systolic and Diastolic Detection Ratios,“ *Ann. Biomed. Eng.*, vol. 22, pp. 88-96, 1994
- [6] H. Sorvoja, „Noninvasive Blood Pressure Pulse Detection and Blood Pressure Determination,“ *Acta Univ. Oul.*, p. C 259, 2006.
- [7] G. Drzewiecki and J. D. Bronzino, „Noninvasive assessment of arterial blood pressure and mechanics,“ v *The Biomedical Engineering Handbook*, New York, USA, Boca Raton, 1995, pp. 1196-1211.

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student (or advanced MSc. student)

Exchange Project:

Vital Signs Monitoring – hardware design and implementation of methods

Supervisors: Ing. Jan Havlík, Ph.D. (xhavlikj@fel.cvut.cz)

Department:

**Department of Circuit Theory, Faculty of Electrical Engineering,
Czech Technical University in Prague**

Duration of study at CTU: 1 - 2 semesters

Abstract:

The project aims with the design and realization of the system for telemonitoring of selected vital signs like the heart rate, blood oxygenation, breathing frequency etc. The signs are sensed using own hardware; the acquired signals are preprocessed and transferred wirelessly. The project includes both hardware design and realization, and software/firmware design and implementation.

Requirements: strong basics in the area of hardware design and/or signal processing, knowledge of MATLAB

Recommended subjects to be studied at the DEF:

Theory of Systems (PhD student)

Biological Signals (PhD or MSc student)

Medical Equipment (MSc student)

References (the project is closely related to work presented in the following papers):

- [1] Martin-Lesende, E. Orruno, C. Cairo, A. Bilbao, J. Asua, M. Romo, I. Vergara, J. Bayn, R. Abad, E. Reviriego, and J. Larranaga: “Assessment of a primary care-based telemonitoring intervention for home care patients with heart failure and chronic lung disease. The TELBIL study”; BMC Health Services Research, vol. 11, no. 56 (2011).
- [2] M. Lee and T. Gattton: “Wireless health data exchange for home healthcare monitoring systems”; Sensors, vol. 10, no. 4 (2010), 3243 – 3260.
- [3] L. Lhotska, O. Stepankova, M. Pechoucek, B. Simak, and J. Chod: “ICT and eHealth projects”; Proc. Telecom World (ITUWT), 2011 Technical Symposium at ITU, Piscataway: IEEE (2011), 57 – 62.

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: Ph.D. student, (advanced MS. Student)

Exchange Project: Modal Analysis of Electrically Small Radiators

Supervisors: [ass. Prof. Pavel Hazda, \(hazdrap@fel.cvut.cz\)](mailto:hazdrap@fel.cvut.cz),
[Prof. Milos Mazánek \(mazanekm@fel.cvut.cz\)](mailto:mazanekm@fel.cvut.cz)

Department: Department of Electromagnetic Field (DEF), Faculty of Electrical Engineering, Czech Technical University CTU in Prague (www.elmag.org)

Duration of study at CTU: 1-2 semesters

Abstract:

The project is aimed on characteristic mode analysis of small antennas/radiators. These very illustrative elementary solutions are obtained by decomposition of the Method of Moments impedance matrix. DEF has number of in-house MATLAB codes including mesh generator, MoM code, characteristic mode analyzer etc. The challenging study will involve deep analysis of topological properties of small antennas related to radiation efficiency, radiation Q-factor, bandwidth and gain.

Requirements: Strong basics in the area of electromagnetics and antenna theory, knowledge of MATLAB and some EM simulation software (CST/HFSS/FEKO...)

Recommended subjects to be studied at the DEF:

Antennas and EMC in Radiowave Communication (available for spring semester)

Computer Aided Modeling of Fields (spring semester)

Terrestrial and Satellite Radio links (fall semester)

Antenna Design and Technology (fall semester)

Perspectives in Millimetre and Submillimetre Technology (spring semester)

Selected Chapters of Antenna Technologies and Propag. of Electromag. waves (PhD subject)

Electrodynamics (Ph.D. studies)

References (the project is closely related to work presented in the following papers):

[1] G. A. E. Vandenbosch, "Reactive energies, impedance, and Q factor of radiating structures," IEEE Trans. Antennas Propag., vol. 58, no. 4, pp. 1112–1127, Apr. 2010.

[2] A. D. Yaghjian and S. R. Best, "Impedance, bandwidth and Q of antennas," IEEE Trans. Antennas Propag., vol. 53, no. 4, pp. 1298–1324, April 2005

[3] R. F. Harrington and J. R. Mautz, "Theory of characteristic modes for conducting bodies," IEEE Trans. Antennas Propag., vol. 19, no. 5, pp.622–628, Sept. 1971.

[4] M. Capek, P. Hazdra, and J. Eichler, "A method for the evaluation of radiation Q based on modal approach," IEEE Trans. Antennas Propag., vol. 60, no. 10, pp. 4556–4567, Oct. 2012.

[5] Sievenpiper, D. F., et al., "Experimental validation of performance limits and design guidelines for small antennas," IEEE Trans. Antennas Propag., vol. 60, no. 1, pp. 8–19, Jan. 2012,

[6] Eichler, J., Hazdra, P., Čapek, M., Mazánek, M.: Modal Resonant Frequencies and Radiation Quality Factors of Microstrip Antennas. IJAP, Vol. 2012, 9 pages.

PhD theses of CTU in Prague, University of Valencia, University of Oulu (available at CTU)

One semester project for visiting student

Topic: Energy and economic effectiveness of biomethane production and utilization – fuel cycle approach

Suitable: MSc student or advanced BSc. student

Duration: One semester

Supervisor: Jaroslav Knápek (knapek@fel.cvut.cz)

Department: Department of Economy, Management and Humanities

Abstract and goal definiton:

Biomethane production is based on anaerobic digestion of biomass or other biodegradable matter (e.g. waste from agriculture) and upgrade of originating biogas to the quality of biomethane (natural gas). Originating biogas can be directly used for power and heat production in cogeneration unit or can be upgraded into biomethane. Biomethane can serve as the substitute of natural gas or other fossil fuels in heat production or can serve as the gaseous fuel for transportation. Biomethane production and utilization can be defined as the series of energy processes starting with biomass planting on agriculture land, through biomass logistics, biomass processing into biogas and biomethane and biomethane delivery to the final customers. The goal of the work is to analyze biomethane fuel cycle (based on intentionally planted biomass on agriculture land – typically fresh maize), to identify individual elements of fuel cycle including their typical technical and economic parameters (for widely used technologies) and to evaluate energy efficiency of given fuel cycle and to evaluate economic competitiveness of produced biomethane against fossil fuels (natural gas, coal) and biogas utilization for power and heat production.

Task includes following steps:

1. Discussion of technologies used for biomethane production, collection of data (typical technical and economic parameters)
2. Overview of biomethane production and utilization in EU member states, discussion of possibilities of biomethane utilization and future perspectives of biomethane
3. Analysis of biomethane production fuel cycle, identification of fuel cycle elements, data collection (range of typical energy losses in individual fuel cycle elements, economic parameters)
4. Evaluation of net energy efficiency of biomethane fuel cycle and its comparison with biogas fuel cycle
5. Evaluation of economic effectiveness of biomethane production and its competitiveness against fossil fuels
6. Preparation of economic model of biomethane fuel cycle

Requested knowledge: Basics in financial management, basics in renewable energy sources, basics in power and heat production

Recommended subjects for the study at FEE: Corporate Finance (AE0B16FIP), Ecology and Economy (AE1M16EKL)

Faculty of EE, CTU in Prague – project for visiting student

Suitable for: advanced MS. Student

Exchange Project: Power System Stability Analysis in Island Operation Mode

Supervisors: prof. Ing. Josef Tlustý, CSc. (tlusty@fel.cvut.cz), Ing. Zdenek Muller, Ph.D. (zdenek.muller@fel.cvut.cz)

Department: Department of Electrical Power Engineering, Faculty of Electrical Engineering, Czech Technical University CTU in Prague (k315.feld.cvut.cz)

Duration of study at CTU: 1-2 semesters

Abstract:

The project aims at the impact of distributed generation (e.g. renewable sources) on operational and control aspects of distribution and transmission systems. The project is focused on the determination of the voltage profile, power losses, power quality and voltage stability. Models of distribution and transmission systems with considerable DG penetration will be used. The influences of DG on voltage stability limits of a power system will be studied. The project case study will be concentrated on island operation modes under different operation conditions.

Requirements: Very good knowledge of power system modeling and power plant operation modes, knowledge of MATLAB and/or other simulation software (Wolfram Mathematica, MathModelica).

Recommended subjects to be studied at the Department of Electrical Power Engineering:

- Electrical Sources and Systems (available for fall semester)
- Control of Power Systems (spring semester)
- High Voltage Engineering (spring semester)
- Power Engineering 2 (spring semester)
- Power Plants (fall semester)
- Transmission and Distribution of Electricity (spring semester)

References (the project is closely related to work presented in the following papers):

[1] Spetlik, J.: Distributed Energy Sources Modeling and Implementation. CTU in Prague, FEE, Prague 2007. (Ph.D. thesis).

[2] Knazkins, V.: Stability of Power Systems with Large Amount of Distributed Generation, KTH Vetenskap Och Konst, Stockholm 2004 (doctoral thesis)

[3] Azmy, A.M., Erlich, I.: Impact of Distributed Generation on Stability of Electrical Power Systems, IEEE Paper, 2002, ISBN 0-7803-9165-X

[4] The Impact of Renewable Energy Sources and Distributed Generation on Substation Protection and Automation, CIGRE Brochure, CIGRE, Paris 2010.

[5] Tlustý, J. - Müller, Z. - Valouch, V.: Stability Control of Renewable Energy Sources in Distribution Systems. In 2010 IEEE Convention of Electrical and Electronics Engineers in Israel [CD-ROM]. Piscataway: IEEE, 2010, p. 1-5. ISBN 978-1-4244-8680-9.

[6] Mğaya, E., Švec, J., Tlustý, J., Sýkora, T.: The impact of connecting wind power plant to the distribution network In Proceedings of The 7th International Conference on Power System Operation and Planning, Cape Town:6-10, 2007.