Where: Czech Republic - Prague / Praha

City of Prague
Czech Beer
Crystal Glass
Classical Music
Word “robot” (K. Čapek, 1920)
J. Kepler, Tycho de Brahe (16-17 cent.)
Albert Einstein (1911)
When

1707 Czech Technical University in Prague
1906 Institute of Electrical Engineering
1952 Department of Control Engineering (DCE)
Czech Technical University in Prague

Staff: 3000 (academics 1300: professors 140)
Students: 23 000
Since 1707

6 Faculties +

Faculty of Civil Engineering
Faculty of Mechanical Engineering
Faculty of Electrical Engineering
Faculty of Nuclear Sciences and Physical Engineering
Faculty of Architecture
Faculty of Transportation Sciences

+ services, research institutes, ...
Faculty of Electrical Engineering

Staff: 742 (academics 400, professors 40), Students: 5000
Program: Electrical Engineering and Informatics
Since 1920

Bachelors:
Electric Power Engineering; Electronics and Communication Technology; Cybernetics and Measurement; Computer Science and Engineering

Masters:
Electric Drives and Transport; Electric Power Eng; Technological Systems; Economics and Mgmt of Electrical Eng. and Energy; Electronics; Radioelectronics; Telecom. Technology; Measurement Technology; Engineering Cybernetics; Computer Science and Engineering; Biomedical Engineering; Technical Cybernetics; Aircraft Information and Control Syst.

Doctors:
Applied Math.; Plasma Physics; Electrotechnology and Materials; Electric Machines, Apparatus and Drives; Theory of Electrical Engineering; Radioelectronics; Telecom. Engineering; Acoustics; Electronics; Control Engineering and Robotics; Measurement Technology; Computer Science and Informatics; Artificial Intelligence and Bionics; Electric Power Eng.; Company Economics and Management
Automatic control of engineering, physical, biological, medical, transport, economical and other systems in the broadest sense from theory, modeling, and design, through algorithms, software and hardware, networks and communication, automata, embedded systems and robotics, to practical applications, industrial realizations and their impact to society.

Mission

- Education of Bachelors, Masters and Doctors in Cont. Eng.
- Top level theoretical and applied research
- Technology and science promotion in industry and society

Data

- Staff: 59 (4 professors, 10 docents, 10 assistants, 25 researchers)
- PhD students: 32
- Budget: 1.3 M Euro
  (1/3 governmental subvention for teaching + 2/3 projects)
Engineering Track 5: Space Automation and Control (30 ECTS)

3rd semester modules:
- Space Systems, Modeling and Identification (7.5 ECTS)
- Optimal and Robust Control Design (7.5 ECTS)
- Estimation, Filtering and Fault Detection (7.5 ECTS)
- Project (7.5 ECTS)

4th semester: Master Thesis
- 30 ECTS

Double degree:
- MSc in Electrical Engineering and Informatics (Ing)
- ~10 Students
Space Systems, Modeling and Identification

Prof. V. Kučera:
introduce to systems theory and properties, models building and identification methods

various types of systems: CT and DT, LTI, LTV, nonlinear, MIMO
properties of space systems: stability, controllability, observ., realiz.
input-output and state-space models, model reduction and data sampling
deterministic and stochastic identification, FF and FB control structures
modern software tools for systems analysis, mod/sim. - Matlab and tbxs

Optimal and Robust Control Design

Prof. M. Šebek
introduce and train classical and modern optimal and robust control
design methods, algorithms and tool

LQ and LQG optimal controllers, time-optimal and finite impulse response
uncertain systems: parametric, interval, unstructured, …
robust stability and performance, optimization tech. for robust cont. design
(e.g. semi definite programming, LMI, …)
H-2 and H-infinity optimal robust controllers
Estimation, Filtering and Fault Detection

Prof. V. Havlena

provide an introduction to problems of estimation, filtering and fault detection in space born systems

estimation, filtering and fault detection in space born systems
estimates of various types: mean squares, maximum likelihood and Bayesian
Wiener and Kalman filtering
deterministic and stochastic fault detection, fault isolation techniques

Software for Space Control, Embedded Systems

Prof. Z. Hanzálek

critical, autonomous, robust space applications,
reliable processors and real-time operating systems

computer aided real-time measurement and control
real-time computer systems for space control
basic structures of RTOS: scheduler, inter-task communication primitives
structure of RTOS VxWorks from WindRiver systems, environ.Tornado II
basic knowledge of RTOS VxWorks
Current R&D aerospace projects at DCE

- Fly-by-wire system for a subsonic combat aircraft
- Stabilized platform for UAV aircraft
- Active control for new generation flexible passenger aircraft
- UAV helicopter
- X-ray pixel sensors for orbital observations
Government supported project, 2007-2011
Cooperation with Aero Vodochody, Czech producer and developer of training and light combat jet aircraft
Intended for the new generation aircraft to replace current hydro-mechanical linkages, augment its maneuverability and increase flight comfort and performance
DCE responsible for HIL simulator (hardware-in-the-loop) and development of control algorithms and schemes for particular configurations of the flight control system

Project leader: Zdenek Hanzalek, hanzalek@fel.cvut.cz
References: www.aero.cz
UAV stabilized platform

- Cooperation with VTUL PVO Prague (Air Force Research Institute), developer and supplier of UAVs for the Czech Army
- Optical and infrared cameras and a laser rangefinder as payload
- Control goals: wind & turbulence attenuation and target tracking
- DCE responsible for on-board control system: HW & SW development, control system design

Project leader: Zdenek Hurak, z.hurak@c-a-k.cz
References: www.vtul.cz
Active control for a flexible aircraft

- **EU funded** project proposal, 2008-2012, FP6
- **Consortium** includes EADS, Airbus, DLR, ONERA, Alenia and others
- **Development of control systems** for upcoming high-capacity passenger aircraft, to increase passenger comfort and reduce weight and fuel consumption
- **DCE** involved in optimal and robust control algorithms and command shaping

- **Project leader**: Martin Hromcik, m.hromcik@c-a-k.cz
DCE project on development of small UAV, based on a 7kg RC kit helicopter

HW: aircraft construction and maintenance, control electronics,
SW: control routines, measurement pre-processing, servo control, mission programming, …

Project leader: Zdenek Hanzalek, hanzalek@fel.cvut.cz
Reference: http://rtime.felk.cvut.cz/helicopter
X-ray pixel sensors for orbital observations

- Utilization of special pixel X-ray sensors for space on-orbit observations
- Small-size: suitable for microsatellites
- Cooperation with the Czech Astronomical Institute (X-ray optics developer) and Inst. of Experimental and Applied Physics (sensor provider)

Project leader: Martin Hromcik, m.hromcik@c-a-k.cz
Application Research

- Linear combustion engine / generator

- Automated Fish Production
Application Research

- active car suspension
- solar power plant control
- astronomic VLT telescopes positioning
- aircraft computer
- real-time operating systems
- embedded systems
- Prague tunnel modeling
- remotely programmable mobile robot
- bio control (human muscles)
- nano control
- ...

[Images of various applications related to the listed research areas]
Industrial Implementations

- Optimization of a combustion process in Otrokovice heating plant

- Steam plant optimization in SASOL (South Africa Synthetic Oil)

- Communication protocol for trains
  - implemented in
    - Prague metro
    - Pendolino
Contact info

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