Faculty of Informatics and Information Technologies
Slovak University of Technology in Bratislava (FIIT STU)

DESIGN, VERIFICATION,
TESTABILITY AND RELIABILITY
OF DIGITAL SYSTEMS

Institute of Computer Systems and Networks FIIT STU

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Activities and Benefits in Digital Systems Design

The presentation is targeted to whom with **interest to cooperate** with the Faculty of Informatics and Information Technologies of the Slovak University of Technology in Bratislava – FIIT STU through:

- joint research, development and applied national and international projects,
- real **digital circuits and systems design** based on bi-lateral cooperation,
- establishment of a joint **design laboratory or centre** with a design company,
- consultation in the field **design and test of digital systems, embedded** systems,
- organisation of workshops or conferences related to the mentioned fields,
- **special lectures** done by experts from design companies in the selected courses,
- leading diploma thesis,
- finding and supporting **graduated excellent and skilled students**.

**FIIT STU is prepared to start collaboration with you.**
About FIIT STU — http://www.fiit.stuba.sk

FIIT STU – Faculty of Informatics and Information Technologies – the youngest faculty of the Slovak University of Technology.

Location: Ilkovičova 3, 842 16 Bratislava (Mlynská dolina), Slovakia.

FIIT STU is moving into the new building at the begining 2013.
Institute of Computer Systems and Networks FIIT STU in Bratislava, Slovakia

**Opening the New FIIT STU Building**

New areas for information technologies education, research, development and new laboratories in Bratislava.

Opening ceremony in June 2012 – dean of FIIT STU, representatives of Ministry of Education and companies.
Where is FIIT STU located?

FIIT STU – Mlynská dolina is app. 5 km from the historical, cultural and shopping centres in Bratislava.
How to get to FIIT STU in Bratislava?

- Slovakia is situated in the middle of Europe.
- Bratislava is located near Vienna (50 km) and Budapest (180 km).
- Arriving possibilities by:
  - plane: to Bratislava airport
  - by train: to Bratislava railway station
  - by boat: from Vienna directly to the Bratislava
FIIT STU: Education – Research – Development

- Bc. student program - 3 years and 4 years.
- MSc. student program - 5 years in total.
- PhD. student program – internal (3 years) and external (5 years).

Cooperation with:
- On Semiconductor Brno.
- CISCO Academy
- FUNTORO Lab
- NGN Lab

Individual student’s hardware development oriented projects.

Bilateral and multilateral projects.
- Student’s thesis – talented students.
- Student’s mobilities within Europe’s R&D.
- Participation and organization of research conferences.

Supporting theoretical knowledge, practical skills and team work.

...the best comes out from us...
Human Resources

- **Staff:**
  - 16 full time professors and associate professors,
  - 42 teachers,
  - 6 research fellows,
  - 18 external part time industry lecturers.

- **Students:**
  - Approx. 940 full time.

Student – staff ratio: 20 : 1
99.4 % of graduates are successfully deployed in Slovak industry as well as abroad

FIIT STU graduates unemployment: 0.6%
Accredited study programs by IET community, which is established in London
Institutes of FIIT STU

Institute of Applied Informatics

Institute of Informatics and Software Engineering

Institute of Computer Systems and Networks FIIT STU in Bratislava, Slovakia

Institutes of FIIT STU

Institute of Applied Informatics

Institute of Informatics and Software Engineering

Institute of Computer Systems and Networks

Design, modeling, simulation, verification and synthesis of digital systems – using professional CAD tools, VHDL, Verilog, HandelC, SystemC.

Testability and reliability of digital systems – methods, architectures including DfT and BIST, test standards and JTAG and IEEE 1500 and six sigma.

Embedded systems and SoCs using microcontrollers and microprocessors (8051, x86, ARM, soft cores Altera, etc.) – development of methods, algorithms, and advanced embedded systems applications (RTOS).

Network and communication systems (NGN).
Institute of Computer Systems and Networks
Staff - design and test courses

- Full staff:
  - 1 professor
  - 5 associate professors
  - 6 PhD staff
  - 1 researcher
  - 21 PhD students – in design, testing, verification of digital systems, embedded systems and their application, as well as advanced networks (NGN).

Lectures and individual or team student’s work.
Events

- Organisation of research events:
  - Computer systems architectures and diagnostics – workshop for PhD students.
  - Student’s conferences at FIIT STU.

Our successful PhD. and MSc. students and their presentations.
Design Laboratories

<table>
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<tr>
<th>FPGA Design</th>
<th>Embedded Systems</th>
<th>Digital systems description</th>
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<td>This laboratory is for teaching programmable logic devices. The students are involved in design, implementation and verification of applications for programmable logic and gate arrays.</td>
<td>This laboratory is oriented to design of embedded systems, microprocessors and interfacing. The students are involved in design, implementation and verification of microprocessors based applications.</td>
<td>This laboratory is predefined for teaching digital systems design, testing, diagnostics, reliability and reconfigurable digital systems. The students are to prove their practical and theoretical skills on digital systems development.</td>
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### Education – courses for digital design

**Bc. Study Programme**
- Logic circuits
- Computer Architectures
- Microcomputers
- Digital Systems Description
- Diagnostics of Digital Systems
- Programmable Logic
- Peripheral Devices
- Modeling and Simulation

**Msc. Study Programme**
- Architectures of Computer Systems
- Digital Systems Design
- Digital Systems Testing
- Embedded Systems
- Application of Embedded Systems
- Reconfigurable Digital Systems
- System on Chip Design
- Reliability of Digital Systems
- Computing Systems Research

Institute of Computer Systems and Networks FIIT STU in Bratislava, Slovakia
Applicability of our graduates

Graduated students from FIIT STU (Computers Systems and Networks study programme) are prepared for the following job positions:

- Design Manager
- Lead Designers (FPGA, ASIC, SoC)
- System Designer (SoC, Embedded systems)
- Test Engineer – digital systems
- Product Manager
- etc.
Best Awarded Master Thesis 2010 - 2012

- Synthesis of VHDL from SIMULINK model.
- Asymmetric Hardware Cipher.
- Hardware Encryption With Public-Key Encryption.
- Experimental Embedded System for Remote Monitoring and Regulation Management.
- Reliable Design of Self-Testing and Repairing Memories.
- Visualization of SystemC Model Simulation.
- Detection and Animation of Dynamic Hazards in Combinational Logic Circuits.
- Automatic Test Pattern Generation for Sequential Circuits using ATALANTA.
- Experimental Embedded System for Remote Monitoring and Regulation Management.
- VHDL Digital Systems Model Visualization.
- Modeling and Diagnostics by Petri Nets.
- Modular operating system for embedded systems.
- Passive USB packet acquisition.
Title: Synthesis of VHDL from SIMULINK model.

Objectives: Development of a new tool for speeding up the design of embedded systems with focus on high performance and reliability based on the FPGA technology.

Outcomes: A new developed tool enables synthesis of the VHDL from model created in the Mathworks Simulink. There are also contemplated different tools for the FPGA synthesis from high-level languages.
Title: Securing System with Multiple FPGA Based Hardware Watchdogs

Objectives: Development of embedded hardware architecture to provide advanced security for real-time systems.

Outcomes: A securing device with multiple individually configurable hardware watchdog timers providing extra security for each process and the whole secured system.

A new hardware architecture of multiple hardware watchdog device; implemented in FPGA.
Research – current projects related to design

- **VEGA 1008/12** Design optimization of low-power digital and mixed integrated circuits (2012 - 2015)
  
  **Objectives:** to develop methods for optimal design at the system level together with testing and verification support.

- **VEGA 1/1105/11** Robust MPC for hybrid systems (2011 – 2013)
  
  **Objectives:** to research and development, algorithmization and implementation of robust predictive control methods for non-linear hybrid processes realized on embedded computer systems.

- **Development of Center of Excellence for Smart Technologies, Systems, and Services II (ITMS 26240120029)**
  
  **Objectives:** to design, create, and put into operation the technological infrastructure that enables to operate the Centre of excellence of research and development for enterprise information source processing and presentation with the application of advanced distributed architectures for parallel processing and high performance computing for complex applications.
Selected publications (1)


Selected publications (2)


- **KRIŠTOFÍK, Š., GRAMATOVÁ, E.:** Repair Analysis For Embedded Memories Using Block-Based Redundancy Architecture, Proceedings of ICCSE 2012, Londýn, 6. 7. 2012.
Current PhD Thesis

- Design methods for asynchronous digital circuits (1 PhD student, 2011 – 2014)
- Binary decision diagrams in optimization of multiplexer tree designs
  (1 PhD student, 2010 – 2013)
- Verification methods based on in-house specification language for digital design
- Methods and architectures for built-in self test RAM memories
  (1 PhD student, 2011 – 2014).
- Functional testing of microprocessors (1 PhD student, 2010 – 2013).
- Algorithms and methods for delay faults testing of digital circuits
  (1 PhD student, 2012 – 2015).
- Development methods and architectures of embedded systems for automotive
- Modular operating systems for embedded platforms (1 PhD student, 2012 – 2015).
Current PhD Thesis

- Design methods for asynchronous digital circuits (1 PhD student, 2011 – 2014)
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- Functional testing of microprocessors (1 PhD student, 2010 – 2013).
- Modular operating systems for embedded platforms (1 PhD student, 2012 – 2015).
**Title:** Implementation of Embedded Expert Systems via Programmable Hardware

**Objectives:** Analyse the capability of employing a programmable hardware to design expert systems. Develop a method for building embedded expert systems.

**Outcomes:** Proposal of two methods of FPGA based hardware acceleration of inference mechanism for expert reasoning; definition of a method for embedded expert systems implementation. Design of a complex development toolchain for implementing embedded expert systems via programmable hardware.
**Title:** Test Generation for Asynchronous Sequential Circuits

**Objectives:** to develop and implement a new test pattern generator for asynchronous sequential circuits.

**Outcomes:** The new effective TPG for asynchronous sequential circuits - TACKLESS has been realised for generating deterministic test sequences. The system identifies hazards before the test generation. A new fault simulator has been developed for speeding up TPG process. The results were tested over some benchmarks and compared with the existing ATPG tools.
Our Mission and Vision

- To become the leading national institution in informatics and information technologies research and development including **digital and embedded systems architectures and design** and their effective application.

- To become an internationally recognized research and development oriented institution with hands on **collaboration with leading companies**.

- To establish **modern laboratories and development centers** in a close cooperation with leaders in order to further increase the industry and business experience of our graduates.

- To enable our graduates to work on practical product design and development effort in Slovakia most notably in the area of the **design of microprocessor architectures, systems and their applications**.