

Doctoral Studies

in the area of

Dependable Hardware - Software Systems

in cooperation with

Poznan University of Technology, Poland

Silesian University of Technology, Poland

Technical University of Liberec, Czech Republic

Tallinn University of Technology, Estonia

Why Should Anybody Become a Specialist for Dependable Electronic Systems?

Computers and software in embedded electronics control the functions of cars, trains, aeroplanes, production plants and medical systems. Most of these applications are time- and safety critical. Large physical systems controlled by “embedded” electronics are nowadays labelled as “cyber physical systems” (CPS). Examples are power grids, air traffic control and rail traffic control.

Europe has been strong in automotive technology and mechanical engineering, and this strength is the key source of income for countries like Germany, Poland, the Czech Republic, France, and even Austria and Switzerland. European technology companies cannot be extremely cheap for various reasons, and that means they have to be very good in terms of quality to stay competitive.

The strength of companies is based on the qualification and the know-how of their work force, notably their engineers. In some sense, computer scientists are a special sort of engineers, who do most of the software job and manage system complexity. European high-tech industry is doing well, is creating new jobs by the thousands, and has held a very good position in the worldwide competition, even against international competitors.

But now the lack of qualified manpower is becoming the real bottleneck for growth and the main reason of concern for European economic development. Even a country, which is as rich in agriculture and natural resources as the United

States, apparently cannot have a prosperous economy, if the workforce is dominated by an abundance of finance managers, economists, business administrators and lawyers with engineers becoming an endangered species.



Embedded Controller for Automotive Applications
(picture courtesy of Robert Bosch GmbH)

As Europe has neither Wall Street nor Hollywood, but companies like BMW, Daimler-Benz, Audi, Skoda, Volkswagen, Bosch, and Continental, which have all become more or less international, there is a real need for joint action by companies and universities to secure the qualification of the future work force. Most electronic systems of everyday use such as mobile phones, smart phones, notebook computers, radios, and TV sets are now manufactured in Asia. However, this loss is more than compensated by the need for electronic sub-systems in embedded applications such as cars, trucks, trains, airplanes, tooling machines, industrial plants, and even smart homes. The main difference between everyday electronics and embedded systems, however, is the required level of dependability and longevity. Cars have to

provide reliable service for about 10-15 years, trains and airplanes are typically used for 30 years or more. Companies in Europe depend on the quality of their products, which need guaranteed dependability. This demand has become so strong that something has to be done in education. Traditionally, engineers and computer scientists have been educated to design systems that work after production.



Application Specific Microprocessor

(designed by students of Brandenburg University of Technology Cottbus and manufactured by Leibniz-Institute IHP of Frankfurt/Oder, Germany)

Now they must learn to design systems that show a dependable long-time operation even in the presence of faults. This is a much more challenging job that has to be supported by efforts in education. There must be young people who are willing to meet this challenge and who will go for this type of education. The employment prospects are bright, even with companies that have a long history of outstanding benefits for their workforce.

Education of First-Rate Experts

Learning to design either hardware or software for electronics systems with embedded computers is very complex already. Typically it takes more than a 3-years bachelor program, even a master is hardly enough. Doctoral education in Europe traditionally has had a focus on in-depth research in a very narrow area with relatively little education towards an extended overlook, for example in all the basic technologies that make hardware/software systems highly reliable or dependable. Furthermore, teaching a post-graduate student the necessary topics that give her or him a "state-of-the-art" overlook is beyond the means of a single university. The range of topics is too large. Therefore the task is tackled by a consortium of European universities.

These universities are:

- Brandenburg University of Technology Cottbus- Senftenberg, Germany,
- Technical University of Liberec, Czech Republic,
- Poznan University of Technology, Poland,
- Silesian Technical University, Gliwice, Poland,
- Tallinn University of Technology, Estonia.

These partners have started to join their efforts in high-level technical education. This means that each university has its own educational program at the Master- and PhD level, but the comprehensive overview on design and test technology for dependable hardware / software systems is made available to students by a jointly organized program of tutorials, seminars and workshops. Associated partners that also participate actively are:

- Leibniz Institute for Innovative Microelectronics (IHP) of Frankfurt / Oder, Germany,
- Fraunhofer-Institute for Integrated Circuits (IIS), Department of Electronic Design Automation (EAS), Dresden, Germany.

Industrial partners that may offer industrial training for doctoral- and master students are:

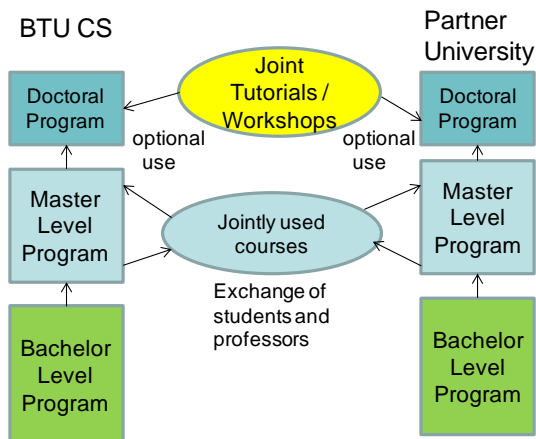
- EADS-Astrium GmbH, Bremen, Germany
- Infineon Technologies AG, Munich, Germany,
- Intel Mobile Communications GmbH, Munich.

The tutorial program includes not only block-tutorials given by professors of the participating universities, but it also includes tutorials given by external international experts in the field. The main topics addressed in tutorials and workshops are:

- Test, verification and fault diagnosis,
- Built-in self test technologies,
- On-line-test, error detection and fault-tolerant computing,
- Design verification for hardware and software,
- Hardware re-configuration and self repair,
- Distributed systems and sensor networks,
- Computer networks and communication,
- Design models and design languages.

Doctoral students will collaborate within topic-oriented working groups guided by experienced professors:

- Test and design verification (Prof. Jaan Raik),
- FPGA-based system design (Prof. Zdenek Pliva),
- Analog and mixed signal systems design (Prof. Adam Dabrowski),
- Software and compiler technologies (Prof. Petra Hofstedt),
- On-line-test, fault tolerance and self repair (Prof. H. T. Vierhaus).



Organization of Collaborative Studies in the Area of Dependable HW/SW Systems

Mutually organized seminars and workshops also serve to bring together students from the participating universities for discussion and analysis of common problems and solutions. Researchers from other universities participate as associated partners. The participating universities form a “PhD committee” which helps to conduct and supervise this system of courses. The members of this committee may also participate in oral assessments of students, but all the examinations are administrated and supervised by one of the participating universities. Students have electronic access to all course materials from past and present courses and tutorials, which already make a unique collection of precious state-of-the-art documentation hardly found elsewhere. All courses and all course material are in English. The organisation of this jointly organized program of studies is supported by the German Academic Exchange Service (DAAD) as part of their program in “strategic partnerships and networks”.

How to Join

Persons who are interested to join are welcome as students or as active contributors. Prospective PhD students should have a master-level university degree in areas such as:

- Electrical / electronic engineering,
- Computer science / computer engineering,
- Information technology.

The basic programs of study are organized by the participating universities. Contact persons are:

- Prof. Dr. Ondrej Novak or Prof. Dr. Zdenek Pliva for TU Liberec (Czech Republic),
ondrej.novak@tul.cz,
zdenek.pliva@tul.cz
- Prof. Dr. Raimund Ubar or Prof. Dr. Jaan Raik for Tallinn University of Technology (Estonia),

- raiub@pld.ttu.ee, jaan@pld.ttu.ee
- Prof. Dr. Adam Dabrowski or Dr. Pawel Pawlowski for Poznan University of Technology (Poland),
adam.dabrowski@put.poznan.pl
- Prof. Dr. Edward Hryniewicz or Dr. Adam Pawlak, for Silesian Technical University (Poland)
Edward.Hryniewicz@polsl.pl,
Adam.Pawlak@polsl.pl
- Prof. Dr. H. T. Vierhaus or Prof. Dr. Petra Hofstedt for BTU, Cottbus (Germany),
htv@informatik.tu-cottbus.de,
hofstedt@informatik.tu-cottbus.de

Prospective students should have a look at the professors and their research areas at the potential host university, then make contact and identify possible areas of research. The program so far has no resources for paying grants to students. However, students, after identification of a PhD supervisor and the prospective research area, will have good chances to obtain grants from national organisations such as the German Academic Exchange Service (DAAD) (not for German applicants!). Brandenburg University of Technology started offering a specific program of studies towards a “PhD in Dependable Systems” from the fall of 2012. See BTU’s web pages at:
<http://www.tu-cottbus.de/btu/en/gradschool/>

What Candidates Will Get

Candidates get the chance to obtain an internationally recognized doctoral (or PhD) degree. The normal length of studies is about 3-4 years, depending on specific university regulations. Chances for industrial and / or academic careers are excellent.

Acknowledgment

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