

Embedded Systems (ISAE-ENSEEIH)

Accredited by the Conférence des Grandes Écoles

Aims

Toulouse has one of the greatest concentrations of Embedded Systems industry in Europe with the major aerospace and equipment manufacturers working either for the aeronautical, space or car industry, including Airbus, CNES, Astrium, Continental, Thalès, etc. Embedded Systems have become essential in several kinds of product in daily life. Embedded Systems encompass a broad class of systems and are actively involved in all domains, from transport systems (aeronautics, space, road, rail and sea), to energy sectors (e.g. nuclear and chemical) and also to communication systems (e.g. mobile phones and PDAs).

The Embedded Systems Master Program is a one-year professional course, designed by the ENSEEIHT and ISAE partners, with the support of the embedded systems industry.

Aware of the real need for a multidisciplinary approach, the program prepares students with in-depth and comprehensive knowledge of the underlying technologies involved in embedded systems. The program focuses on both theoretical and concrete aspects. It aims at:

- developing competencies, at system level design for the development of Embedded-Systems, based on strong basics of complementary subjects, such as electronics, computer science, energy conversion and management, automatic control, telecommunications and networks,
- developing the system approach through integrated projects to Master specific methods and tools applied to the following domains: aeronautics, space, automobile or multimedia.

The training for this Master's degree is multidisciplinary. It covers all hardware, software and control issues of Embedded Systems within an integrated system based perspective.

Organization

Heads of Program:

- Prof. Janette CARDOSO
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- Prof Jérôme HUGUES
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→ Prof. Jean-Luc SCHARBARG

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Duration of studies: One year full time

Beginning of classes: September

Location: ISAE, campus SUPAERO and ENSEEIHT

Teaching language: English

Pedagogical approach

First semester: an academic session of around 360 h, provided by permanent professors of ISAE and ENSEEIHT and experts from industry bringing current knowledge and experience, including: lectures, tutorials, and labs, a multidisciplinary project of 75 h that aims at integrating the academic session into an industrial case study.

Second semester: students have to conduct a professional thesis in aerospace industry or in laboratory, in France or abroad, supervised by a tutor from the host organisation and from ISAE or ENSEEIHT. Thesis is concluded by the preparation of a report and an oral dissertation in front of jury.

Syllabus

Embedded Systems require collaborative training approach with a broad spectrum interweaving experts from all concerned fields: electronics, energy, computer science, networks and control systems.

The academic session of the Master program consists of a 550-hour program covering the five disciplinary fields while focusing on the architectural aspect:

Initial Part - Standardisation - 23 h

Laplace and Fourier Transformers, Transfer functions, frequency response, basic principles of stability, Analogic and digital electronic circuits, Distributed circuits and transmission wires, Physical principles of energy conversion, Computer based operations

Part 1 - Computer science - 52 h

Real time language, Architecture description language, Real time operational systems

Part 2 - Control systems - 56 h

Design and Validation of DES, Feedback Control, Signal Processing

Part 3 - Electronics - 70 h

Digital representation of analog signal, Microprocessor and DSP architecture, Architecture and conception of digital integrated systems, Hardware and software co-design, Emission/Reception architecture

Part 4 - Energy - 58 h

Actuator and converter control, Electromechanical and static energy converters, Autonomous energetic systems, Embedded electrical network

Part 5 - Networks - 56 h

Embedded networks: an introduction, Specific buses and networks, Real time networks, Design and validation of real time protocols, Architecture of fault-tolerant buses

Part 6 - Embedded systems engineering - Applications - 58 h

Real time control of a space system, Hybrid Systems, System Engineering, Real time control of a mechatronics system, Networked control systems

Part 7 - Embedded systems engineering - Courses - 100 h

System Dependability, Certification, Computer Safety, Optimization, Electromagnetic compatibility, Mechatronics integration

Part 8 - ISAE Information system user - Introduction - 2,5 h

Part 9 - Multi-disciplinary project - 75 h

Career opportunities

Embedded Systems offer challenging career opportunities. The Master is designed either for young graduates or more experienced engineers, who require a postgraduate program to enhance their technical and management skills. This Master concerns any industrial sectors where embedded systems are used: aeronautics, space, road, rail and sea, energy industry, communication systems, etc.

Career opportunities in this area are numerous and are growing in a variety of large and small companies. This Embedded Systems Master qualifies our students for employment as designers, developers, research engineers including project managers in design and development of innovative embedded systems. Jobs in consulting companies are also accessible after graduation in this domain.

Witness

Sandeep Joshi, India, Graduated in 2010,

My experience with ISAE and Toulouse is something I would cherish for a long time. When I first got an admit from ISAE I was a little bit hesitant about accepting the admit as I had a perception that it will be impossible to manage in France without good knowledge of French and I did not know a single word of French when I got the admit. However, I decided to take up the challenge and as if to support my decision I was also selected for the prestigious Thales academia scholarship. I took-up a course in basic French @ the Alliance Francaise Bangalore, which helped to a certain extent during my early days in France. Coming to the course itself, it has a good blend of hardware and software modules along with other interdisciplinary modules. The best part of the course was the practical (lab) work which provides a better understanding of the concept. Also since the time allocated for these lab sessions is short one has to make effective utilization of every minute in the lab. Every lab session is evaluated with a report which again helps the students to improve their writing and analytical skills. The course involves extensive use of tools like MATLAB, Simulink, Windriver Workbench and Xilinx ISE which is an added advantage in the job market.

Finally, working in tandem and competing with the students from France made me improve my analytical and time-management skills. Overall, it was a good multi-lingual and multi-cultural experience.

Last but not the least, Toulouse is a nice peaceful city with friendly people and a lot of Aerospace Research organizations, which makes it an ideal place for study. I'm extremely thankful to Thales, French Ministry and ISAE for sponsoring my course and giving me an opportunity to sharpen my professional and academic skills».