2EL6010 – Model based design of critical embedded control systems

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Department: CAMPUS DE RENNES
Language of instruction: ANGLAIS
Campus: CAMPUS DE RENNES
Workload (HEE): 60
On-site hours (HPE): 35,00
Elective Category : Fundamental Sciences
Advanced level : Yes

Description

Critical embedded control systems are present in various industrial fields (factory 4.0, Avionics, Railways...) but also in our daily live (home automation, automotive, medical...).

These systems, which are often critical, are subject to robustness, operational reliability and qualification constraints. This requires the use of specification methods that optimize the design process and formally guarantees all properties, particularly safety ones. The development of certified languages and tools reduces project certification costs by simplifying critical control applications design and automating verification, qualifiable/certified code generation, and documentation generation.

The objective of this course is to present the different processes of critical systems design. Based on the skills acquired in the system modeling course (ST5), the different activities will illustrate the use of formal methods and models in the different stages from specification to solution design and code generation.

The courses also illustrate how the generated code is embedded on a hardware platform taking into account execution performance (time performance, sizing...). Integration, verification and validation processes will be also presented.

Quarter number

SG6

Prerequisites (in terms of CS courses)

Model Representations and Analysis

Syllabus
Introduction (critical systems, design, qualification, control systems, system development processes...)
Model-driven modeling and model transformation
Real time systems
System modeling and specification
Formal languages, synchronous languages,
Implementation of a control (Control of a Railways system) (see : https://youtu.be/BxieOtRYb9U)

Class components (lecture, labs, etc.)
lecture (12h), labs (21h), examen (2h)

Grading
written examination 1h (30%) project evaluation (70%)

Course support, bibliography
M. Klein, "A Practioners's Handbook for Real-Time Analysis : Guide to Rate Monoto-nic Analysis for Real-Time Systems", Kluwer Academic, Boston, 1993, ISBN 0-7923-9361-9.

Sanford Friedenthal , Alan Moore, Rick Steiner. « A Practical Guide to SysML, Second Edition: The Systems Modeling Language » (The MK/OMG Press), 2012

C. Bonnet et I. Demeure, "introduction aux systèmes temps réel", Hermes sciences. Paris 1999.

Richard Zurawski (Editor). Embedded Systems Handbook, Second Edition 2-Volume. June 25, 2009 by CRC Press Reference - 837 Pages - 225 B/W Illustrations ISBN 9781439807613

Resources

- lecture, labs.

This course contains few lectures. The design of a railway network system project will be used to implemente the theorical elements defined in the differents lectures.

Learning outcomes covered on the course
By the end of this course students will be able :

- to identify the real time aspects of an application, specify it and propose a design solution.
- propose software structures and implementation.
- to conduct performance analysis to demonstrate that the system can successively meet constraints and requiremennts.
- to perform the different phases of the design cycle
- to use a model based design approach.
- design project management

Description of the skills acquired at the end of the course

- identify the real time aspects of an application, specify it and propose a design solution is part of C1.1Examine a problem in full breadth and depth, within and beyond its immediate parameters, thus understanding it as a whole. This whole weaves the scientific, economic
  and social dimensions of the problem.
- propose software structures and implementation is part of C1.2Select, use and develop modelling scales, allowing for appropriate simplifying hypotheses to be formulated and applied towards tackling a problem.
- conduct performance analysis to demonstrate that the system can successively meet the system constraints is part of 3.6 Evaluate the efficiency, feasibility and strength of the solutions offered.
- perform the different phases of the design cycle is part of C1.4 Design, detail and corroborate a whole or part of a complex system and 3.6 Conceive of, design, implement and authenticate complex software.
- use a model based design approach C6.3 Conceive of, design, implement and authenticate complex software.
- design project management is part of C8.1 Work collaboratively in a team.