2SC5893 – Intelligent system for automated control of air traffic

Instructors: Lina Ye
Department: DOMINANTE - INFORMATIQUE ET NUMÉRIQUE
Language of instruction: FRANCAIS
Campus: CAMPUS DE PARIS - SACLAY
Workload (HEE): 40
On-site hours (HPE): 27,00

Description
Safety-critical systems in the avionics field are subject to strict time and reliability constraints. Their development therefore requires engineering techniques that take these characteristics into account as early as possible in their life cycle. This EI is therefore interested in the design of models of intelligent systems to control air traffic and the verification of important safety properties. These systems are composed of highly interacting components that are parallel and synchronous. All these subsystems are subject to verification to ensure their own functionality. For example, it is essential to demonstrate the absence of deadlock and the possibility for each to ensure correct operations compatible with their own time constraints.

Quarter number
ST5

Prerequisites (in terms of CS courses)

ST5: Industrial complex and critical systems with preponderant software

Syllabus

Based on the informal description of the safety-critical system, the students are asked to use a semi-formal modelling approach to capture and structure safety requirements and then to transform into a formal model (e.g., timed automata) before applying model-checking techniques for the formal verification purposes. An optional part is dedicated to develop a tool to detect a type of unrealistic scenarios in models, which can very often disturb the results of model checkers like UPPAAL.

Class components (lecture, labs, etc.)
One-week project integrating ST5 course content with demonstrative, active and discovery methods.

Grading
report and defense

Course support, bibliography

1. Alur. Alur, R., Dill, D.L. A theory of timed automata. Journal of Theoretical Computer Science 126(2), page: 183–235, 1994
2. Christel Baier and Joost-Pieter Katoen, Principles of Model Checking (Representation and Mind Series). TheMIT Press, 2008.
3. Gerd Behrmann, Alexandre David, Kim Guldstrand Larsen. A Tutorial on Uppaal. Formal Methods for the Design of Real-Time Systems, International School on Formal Methods for the Design ofComputer, Communication and Software Systems, SFM-RT, page:200-236, 2004.
4. Patricia Bouyer, Uli Fahrenberg, Kim Guldstrand Larsen, Nicolas Markey, Joël Ouaknine, James Worrell,Model Checking Real-Time Systems. Handbook ofModel Checking, page:1001-1046, 2018.
5. Patricia Bouyer, François Laroussinie, Nicolas Markey, Joël Ouaknine, James Worrell, Timed Temporal Logics.Models, Algorithms, Logics and Tools, page: 211-230, 2017.
6. Nicolas Navet and Stephan Merz, Modeling and Verification of Real-Time Systems (1st ed.). Wiley-IEEE Press, 2008.

Resources
WIFI, PROJECTOR
UPPAAL

Learning outcomes covered on the course
Students need to know and understand how to design a safety system with informal and formal approaches by ensuring safety requirements.

Description of the skills acquired at the end of the course
Students must be able to exploit their resources (e.g. their own knowledge), master the work environment, achieve goals by producing results and also develop self-help and sharing with others in the group.