Cyber-Physical Systems Engineering – CPSE Labs 2016

Programme

9.45 – 10.00 Welcome – *Jerémie Guiochet (LAAS), Christel Seguin (ONERA)*

10.00 – 10.30 CPS Engineering Labs - A Network of Design Centres - *Holger Pfeifer (fortiss)*

The European "Smart Anything Everywhere" (SAE) initiative supports the innovation on smart digital systems thanks to networks of competence centres. The ecosystems built under these initiatives are based on collaboration between researchers, large industries and SMEs which will help to transfer knowledge and resources available to a much wider group of companies. SMEs and middle size companies can experiment with new technologies, try them out in their processes and work together with the suppliers of the technology to adapt it totheir specific needs. CPSE Labs is an innovation action within SAE and provides an open forum for sharing platforms, architectures and software tools for the engineering of dependable and trustworthy CPS.

CPSE Labs partners provide access to a broad range of state-of-the-art CPS design technologies and expertise in various CPS fields, including Internet of Things, industrial automation and control, autonomous vehicles, e-maritime applications, and model-based techniques for collaborative engineering and safety analysis and monitoring.

Since its start in 2015, CPSE Labs has initiated a number of fast-track industrial experiments that have been selected through competitive open calls. In these experiments, engineering and technology firms evaluate, use, and adapt the CPS design technologies and platforms supported by CPSE Labs, and build demonstrators to validate specific innovation objectives.

10.30 – 11.00 CPSE Labs Design Centre Germany North: Functional Safety in Maritime System Development, Learning from Automotive - *Ingo Stierand (OFFIS)*

For the automotive and avionics domains exist well established standards that regulate the development of safety related systems as well as methods and processes supporting system development along on these regulations. We present initial ideas on how methods and processes could be cast into the maritime domain based on the Maritime Architecture Framework.

11.00 – 11.30 Break

11.30 – 12.00 CPSE Labs Design Centre France: Applying Safety methods to automated runway light inspection – *Augustin Desfosse (Sterela)*

The CPS system studied in this experiment is an autonomous robotic system for airfield lighting control developed by Sterela. The measurement of the light intensity determines whether or not the runway can be open to air traffic. Currently, human operators perform the control but this is a painful and unpleasing task: it has to be done late at night (from 1am to 4am) and may cause eye strain. The task would thus be a perfect fit for robotic operation. However, today, no robot is authorized on airports due to safety issues. The aim of the experiment is to assess the safety-related technologies provided by the CPSE Labs Design Center France. It studies their ability to help Sterela demonstrate that the robots can be safety deployed on airports. These technologies include model-based safety analysis (HAZOP-UML and Altarica), safety monitoring (SMOF), analysis of worst-case execution time (MAUVE), and a testing framework based on the

simulator MORSE. The presentation will be focussed on the results obtained for the first stage of the overall process with HAZOP-UML.

12.00 – 12.30 CPSE Labs Design Centre France: BIP-Genom3 Framework for developing and validating robotic software– *Jacques Combaz (VERIMAG), Felix Ingrand (LAAS)*

In this work, we integrated the BIP modelling framework within GenoM3. GenoM3, is an evolution of GenoM which is templates based and allows to synthesize functional modules using different middleware (pocolibs, ROS-Comm, etc.). The codels (C or C++ code provided by the developer to perform the expected processing) libraries are synthesized independently of the middleware, still the overall GenoM generic parts of a functional module are synthesized targeting a particular framework and a particular middleware. We developed the appropriate GenoM3 templates to make the BIP module model automatically generated from the GenoM description (tasks, requests and posters) and associated codels.

To illustrate this approach, we implemented a complete set of functional modules using GenoM3/BIP to perform basic navigation tasks. Some oine V&V have been done on this set of functional modules to show that particular properties are satisfied (deadlock freedom, etc.).

13.00 – 14.00 Lunch

14.30 – 15.00 CPSE Labs Design Centre UK: CPSBuDi, Multidisciplinary design of Cyber-Physical Systems for smart energy control in buildings and districts - *Zoe Andrews (Newcastle University)*

The CPSBuDi experiment integrates a wide range of modelling and simulation tools for the purpose of designing control systems for managing energy in buildings. Tools to be integrated cover all aspects of the Cyber-Physical System, including computation, physics, energy management and building design. The experiment will build on existing co-simulation technologies, expanding the range of tools that can be co-simulated and specialising the technologies to the smart buildings application domain. The resulting co-design and co-simulation tool will be validated via a case study where the aim is to design a control system for obtaining more energy efficient buildings.

15.00 – 15.30 CPSE Labs Design Centre Germany South: Integration of Co-Simulation Methods into a real-time Platform for CPS - *Vincent Aravantinos (fortiss)*

The development of CPS intrinsically requires that various engineering domains collaborate between each other: computer engineering, control system design, mechanics, thermodynamics, among others. Therefore various stakeholders, various teams, various tools and various techniques have to be synchronized in order to ensure that the development matches its objectives.

Nowadays, the various subsystems corresponding to these various domains and stakeholders undergo several transformations during the development: e.g., a mechanical subsystem is first modelled using a tailored simulation tool; when the model is satisfying enough a prototype is made out of it, till it becomes (part of) the final product. At every step it is necessary to check that the new artefact (model, prototype, or product) embodying the subsystem still behaves as expected when integrated with the other subsystems.

This experiment aims to facilitate the development of cyber-physical systems (CPS) by decoupling system architecture from experimentation over various phases of the system development through the support of (real-time) co-simulation approaches. Concrete objectives include:

- transfer of co-simulation approaches to HiL test systems
- incrementally replacing virtual components by physical components
- demonstration of a consistent CPS design
- application of ACOSAR project ACI real-time system interface

15.30 – 16.00 Break

16.00 – 16.30 CPSE Labs Design Centre Germany South: Experiments on Adaptive Production Systems-
Holger Pfeifer (fortiss)

The importance of software in industrial automation is continuously increasing. New approaches to the development and maintenance are needed to cope with the growing complexity of control software for future automation systems. The Germany South Design Centre, hosted by fortiss in Munich, provides a Framework for Distributed Industrial Automation & Control called 4DIAC, which is an open source solution for the programming of programmable logic controllers (PLCs) according to the standard IEC 61499. We have started a number of innovation experiments with various industrial and academic partners, which build on 4DIAC to develop new solutions for a range of applications, including:

- the development of an industrial control system for energy load management in a biogas plant,
- augmenting legacy machine tools for embedding in a cloud manufacturing environment,
- a platform for real-time big data driven proactive manufacturing,
- the development of a new toolset that enables interoperability within the manufacturing information value chain.

16.30 – 17.00 Workshop Conclusions