11th International ERCIM/EWICS/ARTEMIS Workshop on Cyber-Physical Systems and Systems-of-Systems (DECSoS)

DECSoS 2016: The 11th ERCIM/EWICS/ARTEMIS Workshop on Dependable Embedded and Cyber-Physical Systems and Systems-of-Systems

European Research and Innovation Initiatives in the Area of Cyber-Physical Systems and Systems-of-Systems

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1 Introduction

The DECSoS workshop at SAFECOMP follows already its own tradition since 2006. In the past, it focussed on the conventional type of "dependable embedded systems", covering all dependability aspects as defined by Avizienis, Lapries, Kopetz, Voges and others in IFIP WG 10.4. To put more emphasis on the relationship to physics, mechatronics and the notion of interaction with an unpredictable environment, the terminology changed to "cyber-physical systems" (CPS) and "Systems-of-Systems" (SoS). Collaboration and co-operation of these systems with each other and humans, and the interplay of safety, security and reliability are leading to new challenges in verification, validation and certification/qualification respectively. Examples are e.g. the smart power grid with power plants and power distribution and control, smart transport systems (rail, traffic management with V2V and V2I facilities, air traffic control systems), advanced manufacturing systems ("Industry 4.0"), mobile co-operating autonomous robotic systems, smart health care, smart buildings up to smart cities and the like.

Society as a whole strongly depends on CPS and SoS - thus it is important to consider dependability (safety, reliability, availability, security, maintainability, etc.), resilience, robustness and sustainability in a holistic manner. CPS and SoS are a targeted research area in Horizon 2020 and public-private partnerships such as the ECSEL JU (Joint Undertaking) (Electronic Components and Systems for European Leadership), which integrates the former ARTEMIS (Advanced Research and Technology for Embedded Intelligence and Systems), ENIAC and EPoSS efforts, where industry and research ("private") are represented by the three industrial associations ARTEMIS-IA, AENEAS (for ENIAC, semiconductor industry) and EPoSS (for "Smart Systems Integration"), the public part are represented by the EC and the national public

authorities of the member states which take part in the ECSEL Joint Undertaking. Funding comes from the EC and the national public authorities ("tri-partite funding": EC, member states, project partners).

2   ARTEMIS/ECSEL: The European Cyber-Physical Systems Initiative

This year the workshop is co-hosted by the ARTEMIS and Horizon 2020 projects

- CRYSTAL ("Critical Systems Engineering Factories", http://www.crystal-artemis.eu),
- ARROWHEAD[1] ("Ahead of the Future", http://www.arrowhead.eu/),
- EMC2 ("Embedded Multi-Core systems for Mixed Criticality applications in dynamic and changeable real-time environments", http://www.artemis-emc2.eu/) and
- R5-COP ("Reconfigurable ROS-based Resilient Reasoning Robotic Co-operating Systems", http://www.r5-cop.eu/)
- CP-SETIS ("Towards Cyber-Physical Systems Engineering Tools Interoperability Standards", http://cp-setis.eu/), which is not an ARTEMIS but a Horizon 2020 project, funded only by the EC, but executed by ARTEMIS-IA members.

The recently started co-hosting ECSEL projects are AMASS (Safety & Security Multi-Concern Assurance), ENABLE-S3 (Automated Vehicles), IoSENSE (IoT and Industry 4.0) and SemI40 (Semiconductor - Industry 4.0).

ARTEMIS was one of the European, industry-driven research initiatives and is now part of the ECSEL PPP. The current ARTEMIS projects will, however, be continued according to the ARTEMIS rules, but managed by the ECSEL JU. The five co-hosting ARTEMIS projects are described briefly, the "newcomers" have just started this year so it was too early to present first results before the deadline Spring 2016:

R5-COP focuses on agile manufacturing paradigms and specifically on modular robotic systems. Based on existing and newly developed methods for a formal modelling of hardware and software components, R5-COP will support model-based design, engineering, validation, and fast commissioning. Using existing interface and middleware standards, R5-COP will strongly facilitate integration of components from various suppliers.

CRYSTAL, a large ARTEMIS Innovation Pilot Project (AIPP), aims at fostering Europe's leading edge position in embedded systems engineering by facilitating high quality and cost effectiveness of safety-critical embedded systems and architecture platforms. Its overall goal is to enable sustainable paths to speed up the maturation, integration, and cross-sector reusability of technological and methodological bricks in the areas of transportation (aerospace, automotive, and rail) and healthcare providing a critical mass of European technology providers. CRYSTAL will integrate the contributions of previous ARTEMIS projects (CESAR, MBAT, iFEST, SafeCer etc.) and further develop the ARTEMIS RTP (Reference Technology Platform) and Interoperability Specification.

CP-SETIS ("Towards Cyber-Physical Systems Engineering Tools Interoperability Standards") is a H2020 support-action-like IA which aims to leverage on these various initiatives mentioned in context of CRYSTAL by proposing and implementing sustainable cooperation and governance structures to (a) facilitate long-term and sustainable cooperation between all involved stakeholder organizations – End Users, Tool Vendors, Research Organizations, Standardization bodies, R&D projects, etc. – and (b) support extensions, advancements and formal standardization of the IOS.

ARROWHEAD, a large AIPP addressing the areas production and energy system automation, intelligent-built environment and urban infrastructure, is aiming at enabling collaborative automation by networked embedded devices, from enterprise/worldwide level in the cloud down to device level at the machine in the plant. The goal is to achieve efficiency and flexibility on a global scale for five application verticals: production (manufacturing, process, energy production and distribution), smart buildings and infrastructures, electro-mobility and virtual market of energy.

EMC^2 is up to now the largest ARTEMIS AIPP bundling the power of innovation of 100 partners from embedded industry and research from 19 European countries and Israel with an effort of about 800 person years and a total budget of about 100 million Euro. The objective of the EMC^2 project is to develop an innovative and sustainable service-oriented architecture approach for mixed criticality applications in dynamic and changeable real-time environments based on multi-core architectures.

It provides the paradigm shift to a new and sustainable system architecture which is suitable to handle open dynamic systems:

- Dynamic Adaptability in Open Systems, scalability and utmost flexibility,
- Utilization of expensive system features only as Service-on-Demand in order to reduce the overall system cost,
- Handling of mixed criticality applications under real-time conditions,
- Full scale deployment and management of integrated tool chains, through the entire lifecycle.

The AIPPs ARROWHEAD and EMC^2 are addressing "Systems-of-Systems" aspects in the context of critical systems, whereas CRYSTAL and CP-SETIS are devoting their major efforts towards creating a sustainable eco-system of a CRTP (Collaborative Reference Technology Platform) and the harmonization of efforts towards an IOS (set of standards, specifications and guidelines for tool interoperability).

3   This Year's Workshop

The workshop DECSoS'15 provides some insight into an interesting set of topics to enable fruitful discussions during the meeting and afterwards. The mixture of topics is hopefully well balanced, with a certain focus on cybersecurity & safety co-analysis and on modelling, simulation and verification. Presentations are mainly based on the ARTEMIS/ECSEL projects mentioned above and on nationally funded (basic) research respectively industrial developments of partners' companies and universities.

The session starts with an introduction and overview to the ERCIM/ EWICS/ARTEMIS DECSoS Workshop setting the European Research and Innovation scene. The first session on **Analysis, Test and Simulation** comprises four presentations: (1) An industrial case study on fault injection (Siemens and fortiss, Germany), (2) "Reliability assessment of mobile robotics systems" (R5-COP project), (3) "In-the-loop Simulations for Development and Test of a Complex Mechatronic Embedded System" (CRYSTAL project) and (4) "Gate-Level-Accurate Fault-Effect Analysis at Virtual-Prototype Speed" (German project EffektiV, Federal Ministry of Education and Research, BMBF).

The second session covers the **Automotive Domain** by three papers: (1) "The use of Standard SAE J3061 for Automotive Security Requirement Engineering" (EMC^2 project, SCRIPT project (Vienna Business Agency)), (2) "Dynamic Safety Contracts for Functional Cooperation of Automotive Systems" (Germany) and (3) "Time-of-Flight based Optical Communication for Safety-Critical Applications in Autonomous Driving" (EMC^2).

The session after lunch is dedicated to **Safety & Cybersecurity Analysis and Co-Engineering**: (1) The new hazard analysis technique STPA based on system thinking, as proposed by Nancy Leveson not long ago, is extended by STPA-SEC for safety and security co-analysis and evaluated in a practical use case (ECSEL project AMASS), (2) "Security Services for Mixed-Criticality Systems based on Networked Multi-Core Chips" describes the results of the DREAMS project (Framework Program FP7), and (3) "Analysis of Informed Attacks and Appropriate Countermeasures for Cyber-Physical Systems" allows modelling and analysis of cybersecurity attacks on CPS, as achieved through the German project SMARTEST funded by the Federal Ministry of Economic Affairs and Energy (BMWi).

The last session of the day is about large and small **Dependable Industrial Applications**: (1) "Advanced Security Considerations in the Arrowhead Framework" is about results of the ARROWHEAD project on secure collaborative automation, (2) "The Role of the Supply Chain in Cybersecurity Incidents at Drilling Rigs" covers an important safety and security topic in a complex safety and environmental critical industrial automation application, and (3) "Control of Cyber-Physical Systems using Bluetooth Low Energy and Distributed Slave Microcontrollers" covers the small (SME-related, low cost) side of dependable industrial CPS applications in industrial control.

We hope that all participants will benefit from the workshop, enjoy the conference and accompanying programs and will join us again in the future!

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