

# 1st International Workshop on Autonomous Systems Design

ASD 2019, March 29, 2019, Florence, Italy

Edited by

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## ■ Preface

This volume contains the proceedings of the 1st International Workshop on Autonomous Systems Design (ASD 2019). The workshop is held in Florence, Italy on March 29, 2019, and is co-located with the 22nd Design, Automation and Test in Europe Conference (DATE 2019). ASD 2019 aims at exploring recent industrial and academic trends, methods and methodologies in autonomous systems design. The workshop is organized into regular sessions with peer-reviewed research papers selected from an open call, complemented by 4 invited talks and two distinguished keynote. The presented contributions addressed different topics on robotics, automated driving and frameworks for autonomous systems like Robot Operating System (ROS) and AUTOSAR Adaptive.

Selected papers are included in this volume and are categorized into 6 long papers and 3 interactive presentations. The presented papers discuss recent development approaches for autonomous systems involving the integration of ROS-based self-driving system (Autoware) using MATLAB/Simulink, advanced implementations of model predictive control systems and multi-view model-based design and verification approaches. Another important discussed topic is related to dependable autonomous systems design based on degradation cascades for sensor and communication failures in autonomous car platoons, applying STPA-based (System Theoretic Process Analysis) hazard analysis technique for the design of robust autonomous emergency braking systems under safety and security requirements, and the incorporation of self-awareness in the design of autonomous systems using dynamic formal data flow semantics.

The first invited talk will focus on the next generation of ROS frameworks developed to address the main challenge of seamless integration of deeply embedded devices considering resource-constrained computing platforms, non-ideal networks and real-time requirements. The second invited talk will address the dependability challenge by providing reliable control solutions in cloud computing provided under formal guarantees. The two last invited talks, are dedicated to present recent research activities and derived findings of research and industrial clusters in the field of autonomous driving. The activities of two large projects in the field will be presented, namely the UNICARagil project to demonstrate disruptive modular architectures for agile automated vehicle concept, and the CCC (Controlling Concurrent Change) project to investigate automated integration of critical applications using self-adaptation with self-protection based on contracting and self-awareness.

The workshop will host two distinguished industrial keynotes highlighting important challenges and recent trends in the fields of autonomous design. In his keynote "Challenges of Automated and Connected Driving", Thomas Form, Head of Electronics and Vehicle Research at Volkswagen AG, will talk about the challenges in automated driving regarding sensor technologies, redundancies as well as verification and validation questions. Masaki Gondo, CTO at eSOL, the company that provides POSIX/AUTOSAR/TRON RTOS will talk about AUTOSAR Adaptive as a standardized software platform specification for the highly automated and autonomous driving and emphasize the role of OS architectures in coping with recent challenges in the field.

This volume will present a short summary of the considered keynotes and invited talks in addition to the selected long and interactive presentation papers.







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## ■ Keynotes & Invited Talks

### **Keynote 1: Challenges of Automated and Connected Driving**

Speaker: Thomas Form, Head of Electronics and Vehicle Research, Volkswagen AG, Germany

In recent years, various publications and presentations from a lot of companies have shown the improvements in the sector of automated driving. The vehicle- and mobility-concept SEDRIC is a current example from the Volkswagen AG. However, for a release of these technologies there are several unresolved issues regarding sensor technologies, redundancies as well as verification and validation questions. Regarding sensors, the main objectives are miniaturization and reduction of system costs. Advantages and disadvantages of existing solutions have to be evaluated. In addition to economic aspects, ensuring the redundancy of the system is absolute necessary. Is, for example, Artificial Intelligence able to provide an independent second or third function path? Regarding verification and validation concepts, current discussions are focused on which scenarios have to be tested and how, in order to enable regulatory authorities to approve the release of automated driving functions? It is conceivable, that this is an automotive industry wide task that can only be solved in cooperation with all stakeholders.

### **Keynote 2: AUTOSAR Adaptive - Challenging the Impossible**

Speaker: Masaki Gondo, Software CTO at eSOL Co., Ltd., Japan

The vast researches related to autonomous driving seem steadily progressing - it no longer makes news to just have some research vehicle drive autonomously. However, bringing this technology to the market, with all the associated legal, societal, and ethical responsibilities, with justifiable cost efficiency, is hard at its best, and impossible at its worst. Furthermore, the automotive industry is facing drastic challenges in electric vehicles, connected services, which also heavily impact the whole vehicle architecture. AUTOSAR (AUTomotive Open System ARchitecture) is a worldwide development partnership of automotive interested parties. One of its latest challenges is to develop the software platform specification for the highly automated and autonomous driving, named AUTOSAR Adaptive Platform. This talk gives an overview of the challenges of such a platform, followed by the solution approach of AUTOSAR reflecting the industrial needs, and the overall architecture of AUTOSAR Adaptive. It also introduces a new multi-kernel OS technology the author develops, describing why such OS architecture is essential for coping with the challenge in the long run.



### **Invited Talk 1: Bringing the Next Generation Robot Operating System on Deeply Embedded Autonomous Platforms**

Speaker: Ralph Lange, Robert Bosch GmbH, DE

In the last decade, the Robot Operating System (ROS) has become the primary framework and middleware for robotics research and an important building block for the autonomous systems engineering in general. The Next Generation Robot Operating System (ROS 2) aims at strengthening this position by new mechanisms for resource-constrained computing platforms, non-ideal networks, real-time requirements and further fundamental needs from series development of autonomous systems. A particular challenge is the seamless integration of deeply embedded devices with ROS 2. In this talk, an overview to ROS 2 will be provided, followed by an analysis of basic issues for such seamless integration. As a solution, the micro-ROS stack will be presented in the second part of this talk. This includes an introduction to the up-coming DDS-XRCE middleware standard, a novel concept of system runtime configuration for ROS2 and micro-ROS, and early results on an extended API for predictable scheduling.

### **Invited Talk 2: Autonomous Data Center - Feedback Control for Predictable Cloud Computing**

Speaker: Martina Maggio, University of Lund, SE,

Cloud computing gives the illusion of infinite computational capacity and allows for on-demand resource provisioning. As a result, over the last few years, the cloud computing model has experienced widespread industrial adoption and companies like Netflix offloaded their entire infrastructure to the cloud. However, with even the largest datacenter being of a finite size, cloud infrastructures have experienced overload due to overbooking or transient failures. In essence, this is an excellent opportunity for the design of control solutions, that tackle the problem of mitigating overload peaks, using feedback from the computing infrastructure. Exploiting control-theoretical principles and taking advantage of the knowledge and the analysis capabilities of control tools, it is possible to provide formal guarantees on the predictability of the cloud platform. This talk introduces recent research advances on feedback control in the cloud computing domain. This talk discusses control solutions and future research for both cloud application development, and infrastructure management. In particular, it covers application brownout, control-based load-balancing, and autoscaling.

### **Invited Talk 3: An Approach to Automotive Service-oriented Software Architectures in a Multi-partner Research Project**

Speaker: Stefan Kowalewski, RWTH Aachen, DE

Novel software architectures will become necessary to cope with the short lifetime and innovation cycles of the technologies underpinning self-driving vehicles. In the UNICARagil project, seven German universities and six industrial partners join forces to research and demonstrate disruptive modular architectures for agile, automated vehicle concepts. As today's prevailing automotive electric, electronic and software architectures are mostly function-oriented and design-time integrated, they often are unsuitable for infield updates or system reconfiguration. In contrast, service-oriented software architectures are based on runtime integrated service and are a promising way forward. We present the lean and simple concept for service-orientation, that serves as the basis for the implementation of all vehicle functions in the UNICARagil vehicles.

### **Invited Talk 4: Controlling Concurrent Change- Design Automation for Critical Systems Integration**

Speaker: Rolf Ernst, TU Braunschweig, DE

Embedded systems for safety critical and high availability applications have moved from isolated components to highly integrated mixed criticality networked systems with numerous shared resources. The resulting function interference challenges the design process, in particular in autonomous systems which shall independently manage software updates and hardware reconfigurations. With support from the German DFG, a group of 8 PIs has investigated automated integration of critical applications using self-adaptation with self-protection based on contracting and self-awareness. Applications were driving automation and space robotics. The talk will review the results of the six year project and outline the demonstrations which will be exhibited at the workshop.

### **Support and Acknowledgement**

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