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Software Technologies: Applications and Foundations

STAF 2018 Collocated Workshops
Toulouse, France, June 25–29, 2018
Revised Selected Papers

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Preface

This volume contains the technical papers presented at the eight workshops collocated with the 2018 edition of the STAF (Software Technologies: Applications and Foundations) federation of conferences on software technologies. The workshops took place at ENSEEIHT (National Higher School of Engineering in Electrical Engineering, Hydraulics, and Digital Sciences) in Toulouse, France, during June 25–29, 2018.

The STAF 2018 conferences and workshops brought together leading researchers and practitioners from academia and industry to advance the state of the art in practical and foundational advances in software technology. They address all aspects of software technology, from object-oriented design, testing, mathematical approaches to modelling and verification, transformation, model-driven engineering, aspect-oriented techniques, and tools. The satellite workshops provided a highly interactive and collaborative environment to discuss emerging areas of software engineering, software technologies, model-driven engineering, and formal methods.

The eight workshops whose papers are included in this volume are (organizers are indicated too):

- **CoSim-CPS 2018** – Second International Workshop on Formal Co-Simulation of Cyber-Physical Systems, June 26, 2018
 - Cinzia Bernardeschi (University of Pisa, Italy)
 - Peter Gorm Larsen (Aarhus University, Denmark)
 - Paolo Masci (HASLab/INESC TEC and Universidade do Minho, Portugal)
- **DataMod 2018** – 7th International Symposium “From Data to Models and Back,” June 25–26, 2018
 - Antonio Cerone (Nazarbayev University, Kazakhstan)
 - Riccardo Guidotti (KDDLab, ISTI-CNR, Pisa, Italy)
 - Oana Andrei (University of Glasgow, UK)
- **FMIS 2018** – 7th International Workshop on Formal Methods for Interactive Systems, June 25–26, 2018
 - Yamine Aït Ameer (IRIT, Université de Toulouse, France)
 - Philippe Palanque (IRIT, Université de Toulouse, France)
- **FOCLASA 2018** – 16th International Workshop on Foundations of Coordination Languages and Self-Adaptive Systems, June 26, 2018
 - Jean-Marie Jacquet (University of Namur, Belgium)
 - Jacopo Soldani (University of Pisa, Italy)
- **GCM 2018** – 9th International Workshop on Graph Computation Models, June 27, 2018

- Hans-Jörg Kreowski (Universität Bremen, Germany)
- **MDE@DeRun 2018** – Model-Driven Engineering for Design-Runtime Interaction in Complex Systems, June 28, 2018
 - Hugo Bruneliere (IMT Atlantique and LS2N, Nantes, France)
 - Romina Eramo (University of L'Aquila, Italy)
 - Abel Gomez (Universitat Oberta de Catalunya, Spain)
- **MSE 2018** – Third International Workshop on Microservices: Science and Engineering, June 25, 2018
 - Antonio Bucchiarone (Fondazione Bruno Kessler, Trento, Italy)
 - Sophie Ebersold (IRIT, Université de Toulouse, Toulouse, France)
 - Florian Galinier (IRIT, Université de Toulouse, Toulouse, France).
- **SecureMDE 2018** – First International Workshop on Security for and by Model-Driven Engineering, June 25, 2018
 - Salvador Martinez (CEA-LIST, LISE laboratory, Paris, France)
 - Jordi Cabot (SOM Research Lab, ICREA-UOC, Barcelona, Spain)
 - Domenico Bianculli (University of Luxembourg, Luxembourg).

We would like to thank each organizer of the eight workshops at STAF 2018 for the interesting topics and resulting talks, as well as the respective Program Committee members and external reviewers who carried out thorough and careful reviews, created the program of each workshop, and made the compilation of this high-quality volume possible. We also thank the paper contributors and attendees of all workshops. We would like to extend our thanks to all keynote speakers for their excellent presentations. We also thank the developers and maintainers of the EasyChair conference management system, which was of great help in handling the paper submission, reviewing, and discussion for all workshops, and in the preparation of this volume. Finally, we would like to thank the organizers of STAF 2018, Jean-Michel Bruel and Marc Pantel, for their help during the organization of all workshops, as well as ENSEEIHT and the IRIT laboratory that hosted the workshops.

October 2018

Manuel Mazzara
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Abstracts of Invited Talks

Testing Autonomous Robots in Virtual Worlds

Hélène Waeselynck

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Abstract. Autonomous robots have decisional capabilities allowing them to accomplish missions in diverse and previously unknown environments. The mission-level validation of such systems typically involves test campaigns in the field, which are costly and potentially risky in case of misbehavior. In this talk, I will discuss an alternative approach based on simulation: the robot is immersed in virtual worlds, and can be tested in a wide variety of situations without incurring damage. I will take the example of testing the autonomous navigation of outdoor robots. I will share the insights and results gained from two case studies: Mana, an academic rough-terrain robot developed at LAAS-CNRS, and Oz, an agricultural robot for autonomous weeding developed by Naïo Technologies.

Keywords: Autonomous systems · Software testing · Simulation

Data-Driven Analysis of User Interface Software in Medical Devices

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User interface software in medical devices is responsible for smooth and safe use of a device. In advanced systems such as robotic-assisted surgery, user interface functions can be highly sophisticated, e.g., involve the detection and translation of doctors' hands movements into micro-movements of robotic arms, allowing doctors to perform complex surgeries that were not possible before.

Developing sophisticated software with zero defects is notoriously a hard problem. In the medical domain the problem is particularly delicate, as software defects can ultimately result in patient harm. Recent estimates on incidents with medical devices indicate an escalating trend, with software defects being constantly one of the top causes of incidents since 2016, and accounting for 22.8% of medical device recalls in the first quarter of 2018¹. To date, several studies have been carried out providing an aggregate view of software defects in medical devices. A detailed analysis of the nature and impact of user interface software defects has not been performed yet. Such detailed analysis would bring powerful insights that can be used by developers to better understand latent software defects and identify them in advance, before incidents happen.

In this talk, I will present a study conducted in collaboration with the US Food and Drug Administration that aims to quantify and classify user interface software defects in the current generation of medical devices. The study involved a systematic and detailed analysis of nearly 8,000 medical devices recall records published by the FDA from September 2012 to August 2015. A medical device recall is a corrective action initiated by the manufacturer to fix critical defects in a device already in the market. Each recall record includes a semi-structured description of the reason for the recall and the corrective action performed by the manufacturer. I will discuss the analyzed dataset, including analysis method, challenges faced while performing the analysis, obtained results, and opportunities for improvement.

¹ https://www.stericycleexpertsolutions.com/wp-content/uploads/2018/08/ExpertSolutions_RecallIndex_Q22018.pdf.

Safe Composition of Software Services

Gwen Salaün

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Composition of software is a crucial topic in many different computer science areas such as Software Architectures, Component-Based Software Engineering, Web services, cloud computing, Internet of Things, etc. Composition is however a difficult task for several reasons. There is a need first for models of the services and of the way these services interact together. Several levels of expressiveness can be considered in this model (signature, behaviour, semantics, quality of service). Each facet brings different issues from a composition perspective. In this talk, we have a specific focus on behavioural models for service composition. Once a model is properly defined, one can design a composition by defining connections or bindings among the involved services. Building such a composition is error-prone and several kinds of mismatch can arise. Analysis techniques are thus required in order to validate the composition and ensure that before the composition is deployed it works correctly. Beyond models and automated verification techniques for validating service composition, we also present in this talk two different ways to develop composition of services, namely, top-down and bottom-up development processes. Last but not least, we illustrate these techniques for supporting the modelling and composition of services with a concrete approach developed in the context of the Internet of Things.

Computational Oncology: From Biomedical Data to Computational Models, and Back

Giulio Caravagna

Centre for Evolution and Cancer,
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Keynote Speaker of DataMod 2018

Cancer is a disease responsible for around 8 million deaths per year (around 13% of all deaths in 2008), and whose worldwide impact is projected to continue rising, with an estimated 13 million deaths in 2030 (as of an estimate by the World Health Organisation). Finding a cure to cancer is definitely challenging, as there are as many different types of cancer as human cells, and the progression of the disease is heterogeneous across individuals. Often, histologically identical tumours have few genetic features in common, and thus reconciling heterogeneity across tumour types and patients is one of the main areas of research in the community.

In the last years, thanks to the development of new high throughput sequencing technologies that measure the genomic content of cancer cells at different resolutions, the new field of Cancer Evolution has emerged. In this field, carcinogenesis is described as an evolutionary process driven by the accumulation of genomic aberrations, and complex methodologies are used to retrieve the life history of analysed tumours. At a broad level, this opens up for the opportunity to create models that recapitulate heterogeneity, and that elucidate how genomic events orchestrate diseases initiation and progression. So doing, we can anticipate a cancer's next step, and eventually implement personalised treatment strategies that are tailored to each patient.

Computational modelling is one of the key methodologies used in Cancer Evolution. In this talk, I will give a brief introduction to the problems in the field, from a computer science perspective. I will overview some of the major computational challenges, and the kind of data can be used to approach them. The talk will span from (very basic) cell/cancer biology, to a discussion of what types of mathematical models can be used to describe cancer growth/therapy, and what Data Science challenges we have to face to implement successful strategies for cancer data analysis.

Microservices, Microservices, Microservices?

Antonio Brogi

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Abstract. In this talk, we first tried to critically discuss some of the motivations and characteristics of microservices and some of the potentially huge advantages offered by their adoption for managing enterprise applications.

One of the main motivations for adopting microservices is the need to shorten the lead time for new features and updates, by accelerating rebuild and redeployment and by reducing chords across functional silos. Another main motivation for adopting microservices is the need to scale, quickly and effectively.

Microservices architectures define applications as sets of services, each running in its own container, communicating with lightweight mechanisms, built around business capabilities, decentralizing data management, independently deployable, horizontally scalable, and fault resilient.

In the second part of the talk, we showed how a simple formalization of the main properties of microservices can be fruitfully exploited to drive the refactoring of existing applications.

After introducing a simple modelling of microservices architectures as graphs formed by services, databases, and connectors, we discussed how some distinguishing properties of microservices can be associated with antipatterns, and how such antipatterns can be associated with refactoring patterns.

The last part of the talk was devoted to discuss how the complexity and overhead introduced by microservices can make their adoption truly effective only for a certain scale of applications and enterprises.

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