“Self-Improving System Integration” – Preface for the SISSY14 Workshop

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Information and communication technology (ICT) pervades every aspect of our daily lives and changes our communities and all of our human interactions. It also presents exorbitant challenges to correctly design and integrate our resulting technical systems. For instance, the embedding of ICT functionality into more and more devices (such as household appliances or thermostats) leads to novel interconnections and a changing structure of the overall system. Not only technical systems are increasingly coupled, a variety of previously isolated natural and human systems have consolidated into a kind of overall system of systems – an interwoven system structure.

This change of structure is fundamental and affects the whole production cycle of technical systems – standard system integration and testing is not feasible any more. The increasingly complex challenges to develop the right type of modeling, analysis, and infrastructure for designing and maintaining ICT infrastructures has continued to motivate the SASO community. The “Self-Improving System Integration” (SISSY) workshop serves as a platform to discuss novel approaches to system of systems integration and testing by applying SASO principles. Of specific interest are approaches that allow for a continual process of self-integration among components and systems that is self-improving and evolving over time towards an optimised and stable solution.

The first instance of SISSY took place on September 8th, 2014, in London, UK, and was co-located with the SASO conference. The proceedings give an overview of current research activities within SISSY’s scope and on perspectives on how to develop self-integrating systems. The collection of contributions reflects the diversity of the different aspects of self-integration: Nine contributions have been accepted for presentation and publication.

The first one describes the basic problem class. In their paper entitled “Interwoven Systems: Self-improving Systems Integration,” *Bellman et al.* explain their understanding of an interwoven system and outline solution perspectives with a special emphasis on emerging questions for self-optimisation methods.

With the next block of contributions, self-optimisation and self-improvement move further into the focus. *Jänicke et al.* describe their concept in a multi-sensor scenario — their paper is called “Self-Adapting Multi-Sensor Systems: A Concept for Self-Improvement and Self-Healing Techniques.” This is accompanied by deeper insights into the applicability of different machine learning techniques in the context of self-adaptation, which is the basis to self-integration. The paper by *Idziak and Clarke* focuses on this question and is entitled “An Analysis of Decision-Making Techniques in Dynamic, Self-Adaptive Systems.” In the third contribution related to self-optimisation, *Landauer and Bellman* utilise a different scenario in the context of Cyber-Physical Systems to optimise process planning strategies: “Process Planning and Self-Improvement in Cyber-Physical Systems.”

Besides these learning and optimisation-oriented aspects of self-integration, architectures and techniques to solve the problem are discussed. Initially, *Tomforde et al.* introduce the term “Self-Reflection” as a basis for individual entities within an interwoven system that are capable of reasoning about their situation. In contrast to standard self-adaptation techniques, the authors state that self-reflection also includes reasoning about goals and is therefore much harder to achieve. Their paper “Know thyself – Computational Self-Reflection in Intelligent Technical Systems” presents an architectural concept that can be used as a basis for self-integration. *Brinkschulte et al.* explain their ideas on self-building embedded systems. They introduce an artificial DNA approach in their paper called “A Simulator to Validate the Concept of Artificial DNA for Self-Building Embedded Systems.” In a third paper, *Wildermann and Teich* discuss self-integration in the context of hardware systems, in particular in many-core environments: “Self-Integration for Virtualization of Embedded Many-Core Systems.”

Finally, technical trust is considered as an instrument to handle dynamic and unanticipated system structures. Within self-integrative environments, unreliable or even malicious elements might seize control of the interwoven system. These elements should become isolated to decrease their negative effects. To that end, *Kantert et al.* describe how to apply technical trust to an open system such as a Desktop Computing Grid and demonstrate how the core structure can be maintained in a self-organised manner. Their paper is entitled “Robust Self-Monitoring in Trusted Desktop Grids for Self-Configuration at Runtime.” Finally, *Edenhofer et al.* take a deeper look at possible attacks in such an open and heterogeneous environment. Their paper “Advanced Attacks to Trusted Communities in Multi-Agent Systems” gives an overview of standard stereotyped attacker types and then analyses more sophisticated strategies in detail.

We thank all authors for their contributions and we are looking forward to another round of exciting research at the next SISSY workshop.