"Self-Improving System Integration" – Preface for the SISSY'16 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 entire 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 modelling, analysis, and infrastructure for designing and maintaining ICT infrastructures has continued to motivate the research community over the last decades – founding on the ideas of the Autonomic Computing initiative. The "Self-Improving System Integration" (SISSY) workshop serves as a platform to discuss novel approaches to system-of-systems integration and testing by applying principles from the domain of self-adaptive and self-organising systems. 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 IEEE International Conference on Self-Adaptive and Self-Organising Systems (SASO). The second instance was part of the IEEE International Conference on Autonomic Computing (July 7th, 2015 in Grenoble, France). The following proceedings give an overview of the third instance held together with ICAC in Würzburg, Germany (July 19th, 2016). The collection of contributions reflects the diversity of the different aspects of self-integration: Eight contributions have been accepted for presentation and publication.

The first one describes the basic problem class. In their paper entitled "An Organic Computing Perspective on Self-improving Systems Integration," *Tomforde et al.* present an architectural concept to master interwoven systems that is based on the ideas of Organic Computing.

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 "Towards Self-Improving Activity Recognition Systems Based on Probabilistic, Generative Models." This is accompanied by a thorough analysis of the applicability and availability of concepts for self-improvement at runtime in SISSY systems. The paper by *Krupitzer et al.* focuses on this question and is entitled "Comparison of Approaches for Self-Improvement in Self-adaptive Systems". In the third contribution related to self-optimisation, *Sommer et al.* utilise an ensemble learning technique to gain a better efficiency in Cloud Computing environments: "Predictive Load Balancing in Cloud Computing Environments Based on Ensemble Forecasting".

The next block of contributions investigated more abstract concepts related to self-improving system integration. *Wang* presented an approach to learning precondition-free and conditional actions, the paper is entitled: "Towards Dynamic Epistemic Learning of Actions for Self-Improving Agents and Multi-Agent Systems". In addition, *Bahle et al.* emphasised the impact of including e.g. human experts within the self-improvement cycle. By building up a cooperative of autonomous learning systems, an interactive self-improvement cycle is presented that originates in the autonomy of the systems themselves. Their paper is entitled "Lifelong Learning and Collaboration of Smart Technical Systems in Open-Ended Environments – Opportunistic Collaborative Interactive Learning". *Landauer and Bellman* also highlighted the need to cooperate in distributed systems with a major focus on the resulting models – the paper is called "Model-Based Cooperative System Engineering and Integration". Finally, *Kantert et al.* used an application scenario from the wireless sensor network domain to discuss the utilisation of social concepts, such as trust and forgiveness, to allow for reliable cooperation in the presence of uncertain interaction partners. Their paper is entitled "Improving Reliability and Reducing Overhead in Low-Power Sensor Networks using Trust and Forgiveness".

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

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