[Prof. Dr. Raffaela Mirandola // **Self-Adaptive Software Intensive Systems**]

From September 2023, I'm Full Professor at KIT. I was Full Professor at Politecnico di Milano until September 2023. I am an active member of the scientific community and I regularly serve in international program committees and as a referee for top-ranked journals. I'm Special Issue co-Editor Journal of System and Software. I have organized several international conferences as Program Chair (SEAMS 2021 and 2023, ECSA 2015, ICPE 2011, QoSA2009) and co-organized two Dagstuhl Seminars.

My main research interests are in: (i) Software quality requirements modeling, analysis and verification, (ii) Formal methods for (self-)adaptive dependable IT systems, (iii) Model-driven software engineering and the application of the theories, approaches and techniques specific to the above research areas to service-oriented and component-based systems, adaptive systems, mobile systems, and cloud computing. The research has been funded by several national and international projects.

In the last 12 years, I have published three papers in the IEEE Trans. on Software Engineering, one paper on IEEE Trans. on Reliability, one paper on the ACM Trans. on Computing Education, two papers on the ACM Trans. on Adaptive and Autonomous Systems, and two papers on Future Generation Computer Systems. In total, I have published 180+ peer-reviewed papers in international journals and conferences/ symposia.

// Insights into future research

Software-driven autonomous and heterogeneous systems are becoming widely available as an open-ended collection of systems, collaborating to improve our lives. However, our world is dynamic, user behaviour changes and computer and communication infrastructures fail due to unforeseen events, including malicious attacks. Consequently, the need for our technical systems to automatically adapt to new situations and counter unforeseen events and deal with imprecise data is increasing considerably.

To achieve their full potential, these adaptive autonomous systems must be resilient, i.e., they must continue to provide the required functionality despite the uncertainty, change, faults, failure, adversity, and other (anticipated and unforeseen) disruptions present in their real-world operating environments. Numerous methods for developing resilient (adaptive) autonomous systems have been independently proposed or are being explored by different projects worldwide.

The ability of adaptive autonomous systems to achieve their goals in open real-world environments can be further increased by making them antifragile. Antifragile systems benefit from exposure to uncertainty and disruption, by learning from encounters with such difficulties, so that they can handle future oc-

currences of similar types of uncertainty and disruption faster, more efficiently, with less loss of functionality and lower user impact, etc. The inspiration for antifragility comes from nature, where antifragile systems are ubiquitous. For example, the immune system responds to exposure to pathogens by producing antibodies that help protect against future infections. The engineering of adaptive autonomous systems with analogous antifragility capabilities has been advocated recently but this promising research area is currently underexplored.

Despite recent advances in autonomous technologies, the research on resilient adaptive autonomous systems remains fragmented, and the research on antifragile autonomous systems is in its infancy. As these closely related research areas play a key role in the realisation of the societal and economic benefits of autonomous systems, it is now key to devote effort and to identify synergies across these disciplines to shape the research in the next future.

// Selected Publications

Camilli M., Mirandola R., Scandurra P.: Enforcing Resilience in Cyber-physical Systems via Equilibrium Verification at Runtime. ACM Transactions on Adaptive and Autonomous Systems, online first, https://doi.org/10.1145/3584364

Alasmari N., Calinescu R., Paterson C., Mirandola R.: Quantitative verification with adaptive uncertainty reduction. Journal of Systems and Software, Elsevier 188: 111275 (2022). doi: https://doi.org/10.1016/j.jss.2022.111275

Alongi F., Bersani M. M., Ghielmetti N., Mirandola R., Tamburri D. A.: Event-sourced, observable software architectures: An experience report. Software: Practice and Experience, Wiley, vol.52, no10, pp 2127-2151, 2022. https://doi.org/10.1002/spe.3116

Bersani M. M., Camilli M., Lestingi L., Mirandola R., Rossi M. G., Scandurra P.: Architecting Explainable Service Robots Proceedings of the 17th European Conference on Software Architecture, ECSA2023, to appear

Bersani M. M., Camilli M., Lestingi L., Mirandola R. , Rossi M. G.: Explainable Human-Machine Teaming using Model Checking and Interpretable Machine Learning Proceedings of the 11th IEEE/ACM International Conference on Formal Methods in Software Engineering Formali SE2023, pp. 18-28. https://doi.org/10.1109/Formali-SE58978.2023.00010.

Camilli M., Mirandola R., Scandurra P.: Taming Model Uncertainty in Self-adaptive Systems Using Bayesian Model Averaging. Proceedings of the International Symposium on Software Engineering for Adaptive and Self-Managing Systems, SEAMS2022, pp. 25-35.https://doi.org/10.1145/3524844.3528056

Acosta M., Hahner S., Koziolek A., Kühn T., Mirandola R., Reussner R. H.: Uncertainty in coupled models of cyberphysical systems. Proceedings of the 25th International Conference on Model Driven Engineering Languages and Systems: Companion Proceedings, MODELS 2022, pp. 569-578. https://doi.org/10.1145/3550356.3561539

Grassi V., Mirandola R., Perez-Palacin D.: Towards a Conceptual Characterization of Antifragile Systems. Proceedings of the 20th International Conference on Software Architecture, ICSA Companion 2023, pp. 121-125. https://doi.org/10.1109/ICSA-C57050.2023.00036

// Website

https://sasis.kastel.kit.edu