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Editorial

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This special issue contains selected papers submitted in response to a call on Formal Methods for Robotics. Given the role robots are expected to play in our lives, it is all the more critical that principled software engineering techniques can support engineers in developing safe and sound robots. Unlike traditional cyber-physical systems, robots are mobile and autonomous, and may operate in unstructured environments. Such requirements pose challenges for the applicability and scalability of modelling and verification techniques.

We sought original contributions on the broad use of formal techniques specialised for the domain of robotics. Out of seven submissions received, three papers were selected following multiple rounds of refereeing. They cover a range of different techniques, including controller synthesis and verification.

Collaborative Models for Autonomous Systems Controller Synthesis, by Douglas Fraser, Ruben Giaquinta, Ruth Hoffmann, Murray Ireland, Alice Miller and Gethin Norman, proposes an approach for synthesising optimal search stragies for Unmanned Aerial Vehicles (UAVs) using the probabilistic model-checker PRISM. A detailed mathematical model is used for simulation, whose results are used to inform the transition probabilities of a Markov Decision Process. Importantly, a strategy using symmetry is also proposed to scale the technique to larger search areas.

PuRSUE—From Specification of Robotic Environments to Synthesis of Controllers, by Marcello M. Bersani, Matteo Soldo, Claudio Menghi, Patrizio Pelliccione, and Matteo Rossi, proposes a domain-specific language (PuRSUE-ML) for modelling robotic applications, with controllers automatically synthesised via an encoding as Timed Game Automata (TGA). The high-level language allows the specification of concepts of relevance to mobile robots, including modelling of the environment, agents, and missions. The model-checker Uppaal-Tiga is used to synthesise the controllers.

Formal Verification of Robotic Cell Injection Systems upto 4-DOF using HOL Light, by Adnan Rashid and Osman Hasan, formalises and verifies the correctness of the dynamics of a robotic cell-injection system up to four degrees of freedom (4-DOF). Such systems are used to automatically deliver controlled amounts of substances into biological cells. The formalisation is carried out in Higher-Order Logic (HOL), and the interactive theorem prover HOL Light is used for verification.

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