Preface to MPM4CPS 2020: 2nd International Workshop on Multi-Paradigm Modeling for Cyber-Physical Systems

Tackling the complexity involved in developing truly complex, designed systems is a topic of intense research and development. Systems complexity has drastically increased once software components were introduced in the form of embedded systems, controlling physical parts of the system, and has grown into Cyber-Physical Systems (CPS), where the networking aspect of the systems and their environment are of specific interest. The complexity faced when engineering CPSs is mostly due to the plethora of cross-disciplinary design alternatives and inter-domain interactions. To date, no unifying theory nor system design methods, techniques, or tools to design, analyze, and ultimately deploy CPSs exist. Individual (physical systems, software, and network) engineering disciplines offer only partial solutions and do not match for the complexity observed in CPS.

Multi-Paradigm Modeling (MPM) offers a foundational framework for gluing the various required disciplines together in a consistent way. The inherent complexity of CPSs is broken down by specifying each aspect of the system at the most appropriate level of abstraction, which allows for the modelling of different views on the system, each expressed in appropriate modeling formalisms. MPM offers processes and tools that can combine, couple, and integrate each of the views that compose a system. MPM encompasses many research topics - from language engineering (for DSLs, including their (visual) syntax and semantics), to processes to support multi-view and multi-abstraction modeling, simulation for system analysis, and deployment.The added complexity that CPSs bring compared to embedded and software-intensive systems requires looking at these new applications and how MPM techniques can be applied or adapted for them, tying together multiple domains. Many remaining research questions require answers from researchers from different domains, as well as a unified effort from researchers that work on supporting MPM techniques and technologies.

The MPM4CPS workshop series aims at further advancing the state-of-the-art as well as defining the future directions of this emerging research area by bringing together world experts from academia and industry. The second edition of the Workshop on Multi-Paradigm Modeling for Cyber-Physical Systems (MPM4CPS) was held virtually as part of the satellite events of the IEEE/ACM 23th International Conference on Model-Driven Engineering Languages and Systems (MODELS 2020).

The workshop received 11 submissions. From these 11 submissions received, the following 4 were accepted as full papers in the proceedings and as presentations during the workshop:

* René Schöne, Johannes Mey, Sebastian Ebert and Uwe Assmann: Connecting conceptual models using Relational Reference Attribute Grammars.
* Asmaa Niati, Cyrine Selma, Dalila Tamzalit, Hugo Bruneliere, Nasser Mebarki and Olivier Cardin: Towards a Digital Twin for Cyber-Physical Production Systems: A Multi-Paradigm Modeling Approach in the Postal Industry.
* Moharram Challenger and Hans Vangheluwe: Towards employing ABM and MAS integrated with MBSE for the lifecycle of sCPSoS.
* Jerome Hugues, Anton Hristosov, John J. Hudak and Joe Yankel: TwinOps – DevOps meets Model-Based Engineering and Digital Twins for the engineering of CPS.

In addition, we accepted 3 lightning talks with extended abstracts:

* Romain Franceschini, Bentley Oakes, Simon Van Mierlo, Moharram Challenger and Hans Vangheluwe: Towards Adaptive Abstraction for Continuous Time Models with Dynamic Structure.
* Liam Walsh, Juergen Dingel and Karim Jahed: Toward a Web-Based Client-Agnostic Hybrid Model Editor.
* Sándor Bácsi, Zoltán Theisz, Gergely Mezei, Ferenc A. Somogyi and Dániel Palatinszky: Step-wise refinement in multi-paradigm modeling.

We would like to thank the MODELS 2020 organization, in particular Houari Sahraoui and Eugene Syriani for giving us the opportunity to organize this workshop as well as the workshops chairs Nelly Bencomo and Mathieu Acher, who were always very helpful and supportive.

Many thanks go to the reviewers and the members of the Program Committee for their timely and detailed reviews and for their help in choosing and suggesting improvements of the selected papers:

* Rima Al-Ali, Charles University
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* Moharram Challenger, University of Antwerp
* Antonio Cicchetti, Mälardalen Research and Technology Centre (MRTC)
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* Ferhat Erata, Yale University
* Rahele Eslampanah, University of Antwerp
* Esther Guerra, Universidad Autónoma de Madrid
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* Sebastian Herzig, Caltech/Jet Propulsion Laboratory
* Gabor Karsai, Vanderbilt University
* Stefan Klikovits, National Institute of Informatics Tokyo
* Letitia W. Li, BAE Systems
* Hana Mkaouar, Télécom Paris, Institut Polytechnique de Paris
* Eva Navarro-Lopez, University of Manchester
* Oksana Nikiforova, Riga Technical University
* Ahsan Qamar, Ford Motor Company
* Akshay Rajhans, Mathworks
* Arend Rensink, Universiteit Twente
* Bran Selic, Malina Software Corporation
* Eugene Syriani, Université de Montréal
* Martin Törngren, KTH Royal Institute of Technology
* Clark Verbrugge, McGill University
* Manuel Wimmer, JKU Linz, Austria
* Andreas Wortmann, RWTH Aachen University

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Last but not least, our thanks go to our Steering Committee members:

* Hans Vangheluwe (University of Antwerp – Flanders Make, Belgium)
* Pieter J. Mosterman (MathWorks, USA)
* Jeff Gray (University of Alabama, USA)
* Vasco Amaral (Universidade NOVA de Lisboa, Portugal)

MPM4CPS 2020 was particularly challenging to organize (in line with many other workshops and conferences) due to the COVID-19 pandemic and we thank everyone who helped in addition to make the first virtual edition of MPM4CPS possible.

Moussa Amrani, Dominique Blouin, Julien DeAntoni, Simon Van Mierlo and Manuel Wimmer

MPM4CPS 2020 Workshop Organizers