上海交通大学自动化系
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A comprehensive framework for (data-driven) symbolic control

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摘要:

As control engineers, modelling is a fundamental part of our job. But do we know exactly what modelling means? In particular, when designing a controller on a computerized digital twin of a real system, how can we formally guarantee properties of the actual system, based on the behavior of the controlled digital twin? Symbolic control and formal methods constitutes a subfield of control Engineering, with a strong influence from Theoretical Computer Science. In this community, people strive to build models that are *formally* equivalent to the system they want to control, so that any desired property of the latter can be guaranteed by proving that the model satisfies it. It is thus natural that rigorous definitions of a model have emerged in that community. These definitions are better stated in terms of abstract 'simulation relations', that must hold between a system and its model. Surprisingly, more than one definitions coexist, and different authors use different simulation relations. In this talk, I'll first survey classical and recent results in symbolic control, with an emphasis on the notion of simulation relation. I'll show that simulation relations can be classified and defined in a 'do it yourself' fashion, as a function of the controller architecture that one requires for the final solution. As a by-product, I will present new simulation relations, that are useful for leveraging modern optimization-based tools from control theory, or that enable a data-driven approach.

简介:

Raphael Jungers is a Professor at UCLouvain, Belgium. His main interests lie in the fields of Computer Science, Graph Theory, Optimization and Control. He received a Ph.D. in Mathematical Engineering from UCLouvain (2008), and a M.Sc. in Applied Mathematics, both from the Ecole Centrale Paris, (2004), and from UCLouvain (2005). He has held various invited positions, at the Université Libre de Bruxelles (2008-2009), at the Laboratory for Information and Decision Systems of the Massachusetts Institute of Technology (2009-2010), at the University of L´Aquila (2011, 2013, 2016), at the University of California Los Angeles (2016-2017), and at Oxford University (2022-2023). He is a FNRS, BAEF, and Fulbright fellow. He has been an Editor at large for the IEEE CDC, Associate Editor for the IEEE CSS Conference Editorial Board, and the journals NAHS (2015-2016), Systems and Control Letters (2016-2017), IEEE Transactions on Automatic Control (2015-2020), Automatica (2020-). He is currently serving as a Senior Editor for NAHS. He was the recipient of the IBM Belgium 2009 award and a finalist of the ERCIM Cor Baayen award 2011. He was the co-recipient of the SICON best paper award 2013-2014, the HSCC2020 best paper award, the NAHS 2020-2022 best paper award, and an ERC 2019 laureate.