Data-driven control of hybrid systems and Chance-Constrained optimization

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Abstract:

Control systems are increasingly complex, often at the point that obtaining a model for them is out of reach. In some situations, (parts of) the systems are proprietary, so that the very equations that rule their behaviour cannot be known. On the other hand, the ever-growing progress in hardware technologies often enables one to retrieve massive data, e.g. from embedded sensors. Because of these evolutions, control theory is moving from a model-based towards a model-free paradigm.

For Linear Time-invariant systems, classical results from Identification theory provide a rather straightforward approach. However, these approaches become useless (or at least inefficient) if one relaxes the strong assumptions they rely upon (linearity, gaussian noise, etc.). This is especially the case in safety-critical applications, where one needs guarantees on the performance of the obtained solution.

Despite these difficulties, one may sometimes recover firm guarantees on the behaviour of the system. This may require to change one's point of view on the nature of the guarantees we require. I will provide examples of such results for different control tasks and different complex systems, and will raise the question of theoretical fundamental barriers for these problems.

Bio: Raphael Jungers is a Professor at UCLouvain, Belgium, currently on sabbatical leave at Oxford University. 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), and at the University of California Los Angeles (2016-2017).

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 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, and an ERC 2019 laureate.

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