

FMfI2023 Poster Session

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Affiliation	National Institute of Informatics, Tokyo, Japan
Poster title	Inferring Switched Nonlinear Dynamical Systems
Abstract	<p>Identification of dynamical and hybrid systems using trajectory data is an important way to construct models for complex systems where derivation from first principles is too difficult. In this paper, we study the identification problem for switched dynamical systems with polynomial ODEs. This is a difficult problem as it combines estimating coefficients for nonlinear dynamics and determining boundaries between modes. We propose two different algorithms for this problem, depending on whether to perform prior segmentation of trajectories. For methods with prior segmentation, we present a heuristic segmentation algorithm and a way to classify the modes using clustering. For methods without prior segmentation, we extend identification techniques for piecewise affine models to our problem. To estimate derivatives along the given trajectories, we use Linear Multistep Methods. Finally, we propose a way to evaluate an identified model by computing a relative difference between the predicted and actual derivatives. Based on this evaluation method, we perform experiments on five switched dynamical systems with different parameters, for a total of twenty cases. We also compare with three baseline methods: clustering with DBSCAN, standard optimization methods in SciPy and identification of ARX models in Matlab, as well as with state-of-the-art identification method for piecewise affine models. The experiments show that our two methods perform better across a wide range of situations.</p>
Short Bio	<p>Dr. Jie An is a Project Assistant Professor at the National Institute of Informatics (NII) in Tokyo, Japan. From November 2020 to October 2022, he was a postdoctoral researcher working in the Rigorous Software Engineering Group at the Max Planck Institute for Software Systems (MPI-SWS), Kaiserslautern, Germany. Prior to that, he received a Ph.D. degree in Software Engineering from Tongji University, Shanghai, China in 2020. From 2017 to 2020, he was also a visiting Ph.D. student at the State Key Lab. of Computer Science, Institute of Software, Chinese Academy of Sciences.</p>