ID de Contribution: **28** Type: **Non spécifié**

Dionysos.jl: a Modular Platform for Smart Symbolic Control

jeudi 5 octobre 2023 17:00 (30 minutes)

We introduce Dionysos, a highly modular package for solving optimal control problems for complex dynamical systems using state-of-the-art and experimental techniques from symbolic control, optimization, and learning. More often than not with Cyber-Physical systems, the only sensible way of developing a controller is by discretizing the different variables, thus transforming the model into a simple combinatorial problem on a finite-state mathematical object, called an abstraction of this system. Although this approach offers in principle a safety-critical framework, the available techniques suffer important scalability issues. In order to render these techniques practical, it is necessary to construct smarter abstractions that differ from classical techniques by partitioning the state-space in a non trivial way. Dionysos features optimal control problems definitions, that is a description of both the mathematical system and of a desired closed-loop behaviour. More importantly, it also features several abstraction-based optimal control strategies. In Dionysos, these strategies are seen as solvers, and inherit from JuMP and MathOptInterface powerful and convenient optimization framework. Given a problem and a method, Dionysos is then able to solve the problem and output/visualize the obtained closed-loop dynamics using existing visualization tools such as RecipesBase. It is built on top of existing Julia packages such as HybridSystems, MathematicalSystems, LazySets and IntervalArithmetics. Examples in the code also make use of RigidBodyDynamics, MeshCat and MechanismGeometries. In this talk, we will present Dionysos' structure, and go through the different modules of the package. We will also illustrate Dionysos by showing how it performs on famous examples in control theory such as DC-DC converters and path planning problems. Finally we will present the performance of our package on these examples, illustrating the power resulting of the combination of an efficient programming language and state-of-the-art theoretical methods.

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Classification de Session: Julia & Scientific Computing