Learning Dynamical Systems with Bifurcations*

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Abstract

Progress in robotics research has permitted to recreate complex and robust motions, but restricted mostly to one type of dynamics at a time. To expand the range of practicable motions, there is an interest in learning multiple behaviors and smoothly selecting the appropriate one.

We use a dynamical system approach to offer robust control of the robot. We take advantage of the Hopf bifurcation to formulate a dynamical system with a periodic and non-periodic behavior, encoded in a single model. We express the parameters with the goal of reconfiguration and control of each during operation.

We describe an optimization method to identify the parameters of the introduced dynamical system and we test the resulting dynamics on a 7 DOF KUKA LWR 4+ robotic manipulator. We reproduce the dynamics of both synthetic and kinesthetic trajectories and we show how we can switch between periodic and discrete motions by means of a parameter.

Index Terms

Learning and Adaptive Systems, Learning from Demonstration, Model Learning for Control, Motion Control, Optimization and Optimal Control.

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