Optimal control of a pendulum driven via frictional coupling

project/master thesis

For many engineering applications, friction is vital for their functionality. E.g. for walking and driving, the friction with the ground is exploited for locomotion. The goal of this project is to explore the optimal control of a pendulum driven via a frictional coupling, which exerts a moment M on the pendulum. The moment is due to friction and therefore depends on the difference between the angular velocity of the pendulum $\dot{\varphi}$ and the angular velocity of the driving shaft ω, which is the control input of the system, see Figure 1.

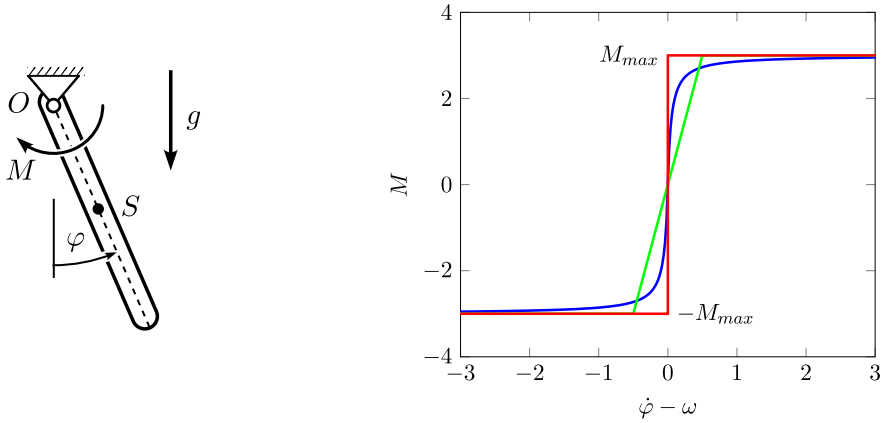

Figure 1: Left: pendulum driven by moment M. Right: Coulomb friction – (red) set-valued, (green) C^0-regularization and (blue) smooth regularization.

The chief difficulty when dealing with friction, is its nonsmooth caracteristics, i.e., the force law is set-valued and not differentiable at zero.

In this project, we aim at exploring various methods for solving an optimal control problem that defines an upswing trajectory. For that, the methods are implemented and their feasibility to solve the optimal control problem is analyzed. Finally, a comparison of the efficiency of the different methods is performed.

requirements

- "multibody dynamics" or "computational multibody dynamics".
- basic programming skills in e.g. Python, Matlab or C++.

contact

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