NOSNOC a Software Package for Nonsmooth Numerical Optimal Control

TECHNISCHE UNIVERSITÄT DARMSTADT

Proposal for a Proseminar

Solving differential equations is an essential task in many fields. In control theory in particular, differential equations play a key role in describing dynamic systems. Since analytical solutions are difficult or even impossible to obtain, one must rely on numerical solutions instead. Thus, many different solution methods such as the Runge-Kutta methods are covered in basic undergraduate math lectures. To obtain high accuracies, these methods rely on high convergence rates, which can be derived using Taylor approximations. This, however, requires smooth dynamics and the presence of discontinuities causes the convergence rate to collapse to one, leading to inaccurate solutions.

This problem gets more complex if optimal control problems with nonsmooth systems are considered. These are usually solved using direct approaches, such as direct single or multiple shooting, requiring a numerical solution of the underlying differential equations. Therefore, it is common to consider only smooth dynamics and to neglect nonsmooth parts of a system e.g., Coulomb friction in a pendulum.

In 2022 an open-source software package called NOSNOC for NOnSmooth Numerical Optimal Control[1] was released. This allows the user to explicitly address nonsmooth systems with state-of-the-art algorithms. The aim of this proseminar is to explore the functionality of this package and to research and present the underlying theory. Optionally, the student can also present a small example for a use case of this package.

Useful Skills:

Knowledge:	Numeric for ODEs, Optimal Control
Language:	English or German

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[1] https://github.com/nurkanovic/nosnoc