

Pseudospectral train motion parameter estimation



Problem description

Train Trajectory Optimizers are algorithms that constitute a key element of energy-efficient railway applications like Driver advisory systems, Automatic Train Operation and Energy-Efficient Timetabling. However, these algorithms have to be calibrated in order to be able to reproduce and predict the train motion dynamics accurately. Consequently, train motion calibration algorithms are essential for guaranteeing a good performance of such applications.

Calibrating a Train Trajectory Optimizer requires an accurate estimation of the input parameters of the differential equation that models the train motion. To this end, the main objective of this project is to develop a Train Motion Parameter Estimation algorithm based on a direct transcription method, the pseudospectral discretization. Such an algorithm can be used for calibrating several applications in the railway industry, leading ultimately to a more precise railway operation and planning, to optimize the network capacity, to increase the punctuality rates and to provide an overall better service for passengers and freight companies.

Assignment

- Develop an optimal parameter estimation algorithm based on a direct transcription method
- Prepare and filter data
- Perform an experimental study
- Write a report and a scientific paper

References

Nikola Bešinović, Egidio Quaglietta, Rob M.P. Goverde (2013). A simulation-based optimization approach for the calibration of dynamic train speed profiles. *Journal of Rail Transport Planning & Management*, 3, 126-136. <http://dx.doi.org/10.1016/j.jrtpm.2013.10.008>

Paul Williams & Pavel Trivailo (2005): Optimal parameter estimation of dynamical systems using direct transcription methods. *Inverse Problems in Science and Engineering*, 13:4, 377-409 <http://dx.doi.org/10.1080/17415970500104499>.

Background

A student is expected to have knowledge and interest in mathematical optimization, data analysis, programming and has basic knowledge of railway transport, such as provided in CIE5803 Railway Traffic Management. The project builds on recent developments of the Digital Rail Traffic Lab with NS. It can be performed as final thesis project or research project. The research will be performed within NS.

Information

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