Karlsruher Institut für Technologie

Institut für Fahrzeugsystemtechnik
Institutsteil Fahrzeugtechnik
Leiter: Prof. Dr. rer. nat. Frank Gauterin

Rintheimer Querallee 2, Geb. 70.04
76131 Karlsruhe

http://www.fast.kit.edu/lff

Master Thesis

Optimization of Vehicle Speed Profiles to Improve Tire Wear & Energy Consumption Behaviors

Background

Speed is one of the most important factors that affects tire grip forces and the energy consumption of vehicle in real driving. A higher speed of vehicle always demands for a greater traction torque from electric motor / internal combustion engine as well as a greater tire grip force. For a given road and a given time limit, considering the state of road surface, like roughness, curvature and slope etc., it is possible to reduce tire wear & energy consumption by optimizing the speed profile of vehicle. There are sufficient research focusing on the fuel consumption of vehicle while tire wear is rarely noticed. Considering tire abrasion not only influences tire lifespan but also leads to non-exhaust particulate matter (PM), it is worth taking it into accout simultaneously.

Expected goals

- Complete the existing Dynamic Programming (DP) code with considering vehicle lateral dynamics & road information (e.g. width, grade, curvature, friction coefficient and so on). The code should be with high computing efficiency and the optimization time is expected to be short. In addition to DP, Newly programming with other globally optimization algorithms, like Pontryagin's Maximum Principle, Genetic Algorithm and so on, is also encouraged.
- For a given road and a given time limit, generate optimal speed profiles with less energy consumption and less tire wear (the priorities / weights of energy consumption and tire wear should be flexible and adjustable).

Planned works

- Do literature research and compare different optimization algorithms used in this area.
- Build a vehicle model (in MATLAB) considering its longitudinal & lateral dynamics. In addition, considering the optimization goals, tire model and engine model need to be refined.
- Integrate the vehicle model with DP algorithm. Besides, set up a reference group to show how advantageous the optimized speed profile is.
- Construct test-runs in IPG CarMaker to validate the former results (DP and the reference group).

Requirements

- Good at vehicle dynamics analysis and understanding of optimization algorithms is preferred.
- Good at programming with MATLAB and familiar with IPG CarMaker.

Start: Since now

Contacts: M.Sc. Zhang,Meng
Email: meng.zhang@partner.kit.edu