

Constrained Optimal Control Methods for Vehicle Control Problems in Intelligent Transportation Systems

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In this seminar I will overview the research activities at the Mechatronics Group of the S2 Department in Chalmers, detailing only a few of them in the context of *vehicle dynamics control* and *autonomous and semi-autonomous vehicles*. The seminar will consist of two main parts.

The *first part* will focus on *vehicle dynamics control*. In particular, we will consider the problem of maximizing the regenerative braking in *Fully Electric and Hybrid Vehicles*, while preserving the yaw stability on slippery surfaces. We will then formulate the problem of suppressing the lateral instability of the towed units and the tail swings in *Long Combinations of Heavy Vehicles* during high speed overtaking maneuvers. We will solve the two problems as Receding Horizon Control (RHC) problems, highlighting theoretical challenges and presenting preliminary experimental results.

In the *second part* of the seminar, we will first formulate the problem of designing *transition logics* from autonomous to manual driving mode in semi-autonomous vehicles. A general *threat assessment and decision and control* framework for semi-autonomous vehicles will be presented and demonstrated through experimental results obtained in a *lane departure prevention* application. We will finally focus on the problem of designing *decentralized control algorithms in multi-vehicle formations* (platoons). We will present the ongoing research activities and our achievements in the Grand Cooperative Driving Challenge (GCDC) (<http://www.gcdc.net>) 2011 along with our goals for the GCDC 2012 and 2013.

Keywords: Dynamical systems, Constrained Optimal Control, Model Based Control, Autonomous and Semi-Autonomous Vehicles, Active Safety Systems

Short Bio

Paolo Falcone received the “Laurea” degree in Computer Engineering in 2003 from the University of Naples “Federico II”, Italy. In 2007 he received the PhD degree in Automatic Control from the University of Sannio, Benevento, Italy, advised by Prof. Francesco Borrelli. On 2008 he has been appointed Assistant Professor (Forskarassistent) in the Mechatronics group at the Department of Signals and Systems of the Chalmers University of Technology, in Gothenburg, Sweden, where is currently Associate Professor (Docent). His research interests include constrained optimal control methods, automotive control and intelligent transportation systems. He serves as reviewer for the following journals and conferences: IEEE Transactions on Automatic Control, IEEE Transactions on Control Systems Technology, Automatica, Control Engineering Practice (Associate Editor), International Journal of Robust and Nonlinear Control, IEEE Conference on Decision and Control, IEEE American Control Conference (Associate Editor in ACC’12).