Multiscale Model of the Traffic Flow in a Roundabout with Optimal Velocity Control

A. De Marchi[1] and **M. Gerdts**[2]

Abstract: Management of networked transportation systems, such as vehicular traffic flow and supply chain, is of growing interest. Our talk focuses on mathematical modelling, numerical simulation and optimization of traffic flow in a roundabout, as an example of road network. Human drivers, with their behaviour and target, and the interactions among them are responsible for the overall system dynamics.

An interesting approach to model such a system is based on the measure-theoretic framework introduced by Piccoli et al. (*Time-Evolving Measures and Macroscopic Modeling of Pedestrian Flow*, 2011), that allows to seamlessly couple micro- and macroscale interactions among vehicles. In fact, exploiting this idea, vehicles exist as both discrete agents and a continuous stream, at the same time, and these two levels of description share information. The resulting mathematical model is a system of strongly coupled PDE-ODE with non-local flux term.

We will show investigations in the direction of optimal control through space-dependent drivers' desired speed. This OCP could be adopted to steer the traffic flow dynamics, e.g., in order to minimize the total travel time. Similarly to the direct single shooting method, system evolution and corresponding cost functional are estimated through the simulation of the aforementioned multiscale model. Numerical results obtained with this simulation-based optimization process will be reported.

Finally, questions about the dependence of the optimal control on the levels of description will be addressed. We believe that the use of both a multiscale model and optimization techniques could give insights into meaningful and promising approaches for modeling and control of traffic flow of vehicles or other target-oriented agents.

[1,2] Department of Aerospace Engineering
Institute of Mathematics and Applied Computing
University of the Federal Armed Forces at Munich
Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany
{*alberto.demarchi, matthias.gerdts*}*@unibw.de*