A Predictive Potential Field Concept for Shared Vehicle Guidance

Abstract of the PhD Thesis of Thorsten Brandt

Modern driver assistance systems are gradually engaging in vehicle guidance. Examples are systems for lane-keeping and for lane departure warning. For future assistance systems, e.g. for lane-change or evasion maneuvers, collision-free motion planning has to be addressed. This work combines motion planning and trajectory tracking into a unified framework of potential field methods for shared vehicle guidance between driver and assistance system. Therein, a so-called elastic band, originally introduced in robotics, acts like a virtual antenna, similar to the antennae of an insect, sensing trajectories of low hazards in the environment. Specifically for the automotive application, the motions of other traffic participants are also anticipated by extrapolation methods. The tracking algorithms consist of curvature based feedforward control in combination with a potential field based guidance controller, which is shown to be stable in the sense of Lyapunov. Besides that, a Lyapunov function provides bounds for the tracking error depending on the initial conditions and the parameters of the controller. The steering angle, proposed by the guidance system, is communicated to the driver via an assistance-torque at the steering wheel. In parallel, the driver's steering intension is incorporated to shape the planned trajectories. This interactive guidance concept is experimentally tested in a driving simulator. Therein, different configurations of the assistance torques are analyzed.