Distributed Online Multi-Objective Parameter Optimisation for Mechatronic Systems

Abstract of the Ph.D. thesis by Dipl.-Ing. Markus Deppe

The thesis evolved from the project SFB 376 “Massively Parallel Computing: Algorithms, Design Methods and Applications” of the “Deutsche Forschungsgemeinschaft” (DFG). Here the autonomous intersection management is used as a complex application which interconnects real-time multi-objective optimisation, massively parallel processing, and autonomous mechatronic driving.

The aim of the autonomous intersection management is a completely decentralized crossing of an intersection, with all vehicles being steered autonomously and single-handedly organizing their schedule that has to avoid standstills or collisions.
The thesis presents a concept for the distributed real-time multi-objective optimisation of mechatronic systems.

A new definition of functional modules called optimiser, evaluator and simulator helps to realise hierarchically organised applications of multi-objective optimisation that are compatible with the modular-hierarchical structure of mechatronic systems.

The concept comprises the definition of the necessary real-time behaviour and of two levels of parallel processing. Due to experiences with distributed real-time simulation of fine-grained models of mechatronic systems in the area of hardware-in-the-loop simulation, distribution is based on the coarse-grained optimiser-evaluator-simulator structure. The intersection management is used as an example to prove that an efficient parallel processing results from this distribution concept.