Abstract:

We consider optimal control problems where the control variable appears linearly in the dynamics and objective function. This class of optimal control problems is encountered in various applications in chemical and mechatronic engineering, in economics and in biomedicine. The necessary conditions of optimality, the Pontryagin Maximum Principle, then implies that the optimal control is either of bang-bang or singular type. Bang-bang controls are discontinuous control functions whose values switch between the extreme points of the convex control region, whereas singular controls can take values in the interior of this region.

We discuss optimization methods where switching times of the control can be directly optimized. The implementation is based on an approach suggested by Dr. Y. Kaya. We briefly discuss sufficient optimality conditions and sensitivity analysis. The main focus of the talk is on several applications that illustrate theory and numerics.

Biosketch:

Prof Helmut Maurer is the leader of the Optimization and Optimal Control group at the Numerical Analysis and Applied Mathematics Institute in the University of Muenster. His research focuses mainly on numerical methods for solving optimal control problems subject to control and state constraints. To prove the optimality of a computed solution candidate, he has developed second-order sufficient optimality conditions (SSC) in a form which is apt for numerical verification. He has also studied sensitivity analysis of optimal control problems, which is an important application of SSC. In this context he has obtained results on solution differentiability of optimal solutions with respect to parameters, which served as a tool in implementing real-time control techniques. He has also devised numerical methods for computing the parametric sensitivity derivatives of optimal solutions.