Reduced Direct Multiple Shooting Algorithms for Optimization and Control of Large-scale Dynamic Processes

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Abstract: The talk reviews direct multiple shooting methods for nonlinear state and control constrained optimal control problems and describes recent advances in the treatment of large-scale processes including real-time optimization.

Emphasis is put on Newton-like methods that exploit constraints of the optimization problem to reduce the number of directional derivatives of the solution of the differential equations to a minimum. It is shown how an intertwining of methods of algorithmic differentiation for the model equations and so-called Internal Numerical Differentiation can be used to efficiently set up the reduced QPs of the Newton-like optimization algorithms.

The performance of the methods is demonstrated by applications from chemical engineering including the capacity maximization of a catalytic tube reactor leading to an optimal control problem with a transient 2D PDE subject to path constraints to avoid hot spots and the nonlinear model predictive control of a highly nonlinear thermally coupled destillation column for the separation of a ternary mixture.

The talk is based on joint work with H.G. Bock, M. Diehl, P. Kühl and A. Schäfer.

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