

Numerical Methods for Mixed–Integer Optimal Control

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Abstract: We present numerical methods for optimal control problems with integer valued control functions. We minimize an objective functional of Bolza type in a multistage formulation subject to differential algebraic equations, path and control constraints, interior point inequalities and equalities, stage transition conditions and integer constraints on some of the parameters resp. control functions. The focus of the methods developed lies on binary valued control functions.

Our novel approach is based on direct multiple shooting. It uses rigorous lower and upper bounds obtained by a combination of a problem reformulation and relaxation technique. The control discretization grid is modified adaptively and a penalty term homotopy is applied to obtain integer values.

We present applications of our method from different areas. Namely, the optimal operation of a subway train with discrete operation modes, the inhibition of cell receptors to reset the phase of calcium oscillation in a signal transduction pathway and time- and tray-dependent reusage of waste cuts in batch distillation processes.

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