Numerical Solution of Optimal Control Problems with Explicit and Implicit Switches

A. Meyer[1], H. G. Bock[2], C. Kirches[3], and A. Potschka[4]

Abstract: We present a unified framework for the numerical solution of optimal control problems constrained by ordinary differential equations with both implicit and explicit switches. We present the problem class and qualify different types of implicitly switched systems. This classification significantly affects opportunities for solving such problems numerically. By using techniques from generalized disjunctive programming, we transform the problem into a counterpart one wherein discontinuities no longer appear implicitly. Instead, the new problem contains discrete decision variables and vanishing constraints. Recent results from the field of mixed-integer optimal control theory enable us to omit integrality constraints on variables, and allow to solve a relaxed optimal control problem. We use a first discretize, then optimize approach to solve the problem numerically. A direct method based on adaptive collocation is used for the discretization. The resulting finite dimensional optimization problems are mathematical programs with vanishing constraints, and we discuss numerical techniques to solve sequences of this challenging problem class.

[1,2,4] Interdisciplinary Center for Scientific Computing, Heidelberg University
Im Neuenheimer Feld 205, 69120 Heidelberg, GERMANY
{*andreas.meyer, bock, potschka*}*@iwr.uni-heidelberg.de*

[3] Institut für Mathematische Optimierung
Carl-Friedrich-Gauß-Fakultät
Technische Universität Carolo-Wilhelmina zu Braunschweig
Universitätsplatz 2, 38106 Braunschweig, GERMANY
c.kirches@tu-bs.de