Penalization of Singular Control Problems

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Optimal control problems applied to biological models tend to incorporate an objective function that increases quadratically with the control. However, the principle of parsimony would lead one to assume that the objective function should increase linearly with the control rate. Problems of this form tend to have a solution that contains a singular subarc, which can be difficult to solve both analytically and numerically. We are interested in solving these types of models entirely numerically without the computation of the derivatives of the switch function. In this case the numerical solution exhibits often chattering, that is not a part of the analytical optimal control. We propose to address this problem by adding a bounded variation term to the objective functional that will make the problem easier to solve numerically. In this talk, we discuss some solvable optimal control problems, compare the analytical solution to the continuous problem with the solutions obtained from a polyhedral active set algorithm (PASA) before and after penalization of the problem, and provide some empirical evidence that suggest that the solution to the discrete penalized problem converges to the continuous solution of the original problem with respect to the L1-norm.