Extensions to Pantoja's Algorithm

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Pantoja's algorithm is a remarkably economical, but quite complicated, method for calculating the Newton step for the direct form of the optimal control problem (i.e. where controls at each time step are treated as independent variables). We shall review some properties of this algorithm and show how the use of automatic differentiation can make its implementation more attractive by providing the required second derivatives both relatively painlessly and accurately (which is important since they subsequently appear in a large number of linear algebra operations). Finally we show that there exists a similar algorithm for computing the Newton step for the indirect form of the optimal control problem, which uses the Pontryagin approach to reduce it to a two-point boundary-value problem in terms of the initial adjoint variables (or certain equivalent initial control-related quantities).

This is a joint paper with Mike Bartholomew-Biggs