Adjoint Consistent Implicit Peer Methods

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This talk is about the adjoint consistency of implicit two-step peer methods. In optimal control of differential equations there are essentially two approaches to generate an optimality system. The first-optimize-then-discretize approach means that the continuous optimality system is discretized, whereas the first-discretize-then-optimize approach solves the optimality system generated from the discretized optimal control problem. It is advantageous in optimal control, if these two approaches are interchangeable. Hence it is important that the discrete adjoint of a time discretization is consistent with the continuous adjoint equation.
While there are promising results for Runge-Kutta methods [Hager(2000)] and W-methods [Lang and Verwer(2011)], multistep methods are in general not adjoint consistent [Sandu(2008)]. In the talk first results for implicit peer methods are discussed. Consistency conditions and stability properties are presented for peer methods in the context of optimal control. Numerical experiments are given for some test problems.

References

[Hager(2000)] William W. Hager. Runge-Kutta-Methods in optimal control and the transformed adjoint system. *Numerische Mathematik*, 87: 247–282, 2000.

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[Sandu(2008)] Adrian Sandu. Reverse automatic differentiation of linear Multistep-Methods. *Advances in Automatic Differentiation, Lecture Notes in Computational Science and Engineering*, 64:1–12, 2008.