27th IFIP TC7 Conference 2015 on System Modelling and Optimization

Adaptivity and memory-reduced adjoints for optimization problems with parabolic PDE-constraints

# Adaptive Lossy Trajectory Compression for Optimal Control of Parabolic PDEs

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**Abstract:** For the solution of optimal control problems governed by parabolic PDEs, methods working on the reduced objective functional are often employed to avoid a full spatio-temporal discretization of the problem. The evaluation of the reduced gradient requires one solve of the state equation forward in time, and one backward solve of the adjoint equation. As the state enters into the adjoint equation, the storage of a full 4D data set is needed. If Newton-CG methods are used, two additional trajectories have to be stored. To get accurate numerical results, in many cases very fine discretizations in time and space are necessary, leading to a huge amount of data to be stored.

In this talk, we address lossy compression of such trajectories as a means to reduce these high demands of storage capacity and bandwidth, without a significant loss of accuracy or increase of computational complexity. The algorithms are based on a change of basis to reduce correlations in the data, combined with quantization. The resulting inexact data induces errors in the reduced gradient and reduced Hessian. We analyze accuracy requirements of different optimization methods and derive computable error estimates for the influence of lossy trajectory storage. We design an adaptive strategy for choosing appropriate quantization tolerances, and present numerical examples.