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

Data Compression through Boundary Representations of Tomography Problems

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Abstract: Tomography problems are a class of shape reconstruction inverse problems. Possible application examples are inclusion identification using Maxwell's Equations or Antenna and Horn Design in acoustics. Following a non-harmonic approach, one has to solve a transient PDE constrained tracking type optimization problem, where the unknown to be found is the geometry of the domain. Consequently, one has to face the data management challenges of making the primal state accessible to the adjoint solver when solving the reverse or adjoint problem.

Although using the geometry as the unknown typically introduces additional difficulties such as diffeerentiating the mesh deformation chain, continuous shape derivatives can be used to derive boundary integral expression of the derivative of the objective with respect to the domain, a property stemming from the Hadamard-Zolésio Structure theorem. With respect to the data management for the transient adjoint, these boundary representations also allow discarding interior values of the primal solution, leading to new data compression strategies for the dual solver by exploitation of the structure of shape optimization problems in general. The talk concludes with applications in loud speaker design and electromagnetism.