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

A priori analysis of the backward Euler-Galerkin method for parabolic problems

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Abstract: It is a well known fact, that inf-sup stable Galerkin discretisations of linear continuous problem provide quasi-optimal approximations in the corresponding norms. For elliptic problems, this is known as Cea's Lemma. A priori error bounds are then typically obtained with the help of some (quasi)-interpolation.
We apply this principle to parabolic problems and prove inf-sup stability and thus quasi-optimality of space and time adaptive backward Euler-Galerkin discretisations. In a second step, we define a reasonable (quasi)-interpolation operator and conclude new a priori error bounds. In 1982 Dupont presented a counter example showing non-convergence of the backward Euler-Galerkin in the presence of spatial mesh changes. In this case, our bound contains an additional term, which is consistent with Dupont's observation.