Adaptive discretization in optimal control of flows

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We present a systematic approach to error control and mesh adaptivity in the numerical solution of optimal control problems governed by the Navier-Stokes equations. By the Lagrangian formalism the optimization problem is reformulated as a saddle-point boundary value problem that is discretized by a Galerkin finite element method. The accuracy of the discretization is controlled by residual-based a posteriori error estimates. This general approach facilitates control of the error with respect to any quantity of physical interest. In solving an optimal control problem it is natural to control the quality of the discretization according to the given cost functional. Then, the sensitivity factors in the error estimate can directly be computed from the adjoint solution. For estimating the error in the control itself additional computation may be necessary. The main features of this method will be illustrated by some model cases related to drag and lift computation in laminar flows. This is joint work with Roland Becker.