Shape optimization of airfoils for drag minimization over a range of operating conditions

A continuous adjoint formulation is used to determine an optimal airfoil shape which has the least drag coefficient between $\text{Re} = 10,000$ and $20,000$. An approach derived from concepts of robust design is employed for this purpose. A finite element method based on streamline-upwind Petrov/Galerkin (SUPG) and pressure stabilized Petrov/Galerkin (PSPG) stabilizations is used to solve both the flow and adjoint equations. The airfoil is parametrized via a Non-Uniform Rational B-Splines (NURBS) curve. The objective function is formulated on the basis of time-averaged drag coefficients. The objective function leads to a shape which is close to the NACA 0012 airfoil but has up to 20% lesser drag. L-BFGS algorithm is used as the optimizer in the present study.

Stichworte: Shape Optimization, Robust Design, Adjoint Methods, Airfoils

Dewey Dezimalklassifikation (Liste): 620 Ingenieurwissenschaften

Kongress- / Buchtitel: Proceedings CFD and Optimization 2011

Kongress / Zusatzinformationen: an ECCOMAS Thematic Conf.