Constrained Derivative-free Optimization of a Two Shaft Generic Turbofan Engine

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Abstract

We would like to present our software package ECDFO (Equality-Constrained Derivative-Free Optimization) which applies a model-based trust-region SQP algorithm. ECDFO was extended to handle bound constraints as this is essential if we want to apply the optimizer to real-life applications. Derivative-free optimization algorithms are widely used in practice for several reasons: the explicit evaluation of the derivatives may be impossible, very time-consuming or very inexact. The algorithm ECDFO has shown competitive performance on analytical test problems, compared to other publicly available derivative-free optimization software packages. Here, the software package ECDFO is applied to the optimization of an aero engine performance model of a two shaft generic turbofan engine. The objective is to minimize the thrust specific fuel consumption with respect to several thermodynamic design parameters and, subject to several bound- and equality-constraints. In order to provide some insight into the optimization problem, results of a parametric study on the problem conducted prior to the optimization are presented briefly. The simulation of the aero engine performance model is performed by the simulation code GTlab-Performance, developed at the German Aerospace Center (DLR). The optimization package ECDFO is compared to the two publicly available optimization codes ALGENCAN (Augmented Lagrangian Line Search Method using Finite Differences Gradients) and ALPSO (Augmented Lagrange Multiplier Particle Swarm Optimizer as a purely derivative-free optimization method). Convergence histories of the objective function and the non-linear constraints are presented.

References

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