MSES Multi-element Airfoil Design/Analysis Software — Summary

16 May 94

MSES is a numerical airfoil development system. It includes capabilites to analyze, modify, and optimize single- and multi-element airfoils for a wide range of Mach and Reynolds numbers. The range of validity includes low-Reynolds numbers and transonic Mach numbers. Flows with transitional separation bubbles, shock waves, trailing edge and shock-induced separation can be predicted. Surface pressure and aerodynamic force predictions are accurate just past stall. Transition can be forced or predicted as part of the flow calculation.

Airfoil design is accomplished by interactive specification of surface pressures, with the resultant airfoil geometry being computed. Analysis calculations may be performed at any time during the design process. Automated calculation of angle-of-attack and Mach number sweeps is provided. All analysis results may be displayed graphically.

An interactive optimization driver is provided. Optimization procedures center on the iterative minimization of drag or any relevant objective function over one or more operating points. Arbitrary geometry mode shapes associated with the geometric degrees of freedom can be prescribed.

The numerical formulation of **MSES** consists of a finite-volume discretization of the steady Euler equations on an intrinsic streamline grid. The boundary layers and trailing wakes are described by a two-equation integral formulation with lagged-dissipation closure. The inviscid and viscous regions are fully coupled via the displacement thickness. The airfoil surfaces admit a solid-body boundary condition in the direct analysis mode, and a prescribed-pressure boundary condition in the inverse "design" mode. The overall system is solved using a full Newton method.

MSES is fairly computation-intensive, but on high-end workstations most of its functions can be executed interactively. It currently runs on DEC, IRIS, HP-9000, and RS/6000 workstation platforms, and uses X-Windows screen graphics and PostScript hardcopy.

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MSES is freely available for academic teaching and research use. Contact:

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