NASA-CR-193616

ANALYSIS OF THE HARRIER FOREBODY/INLET DESIGN USING COMPUTATIONAL TECHNIQUES

NASA Ames Research Center
Cooperative Agreement No. NCC 2-714

Final Report for the Period
March 1, 1991 – August 31, 1993

Submitted by Chuen-Yen Chow, Principal Investigator

Department of Aerospace Engineering Sciences
University of Colorado
Boulder, Colorado 80309-0429

NUMERICAL SIMULATION OF COMBINED EXTERNAL/INTERNAL TRANSONIC FLOW ON THE FOREBODY/INLET OF THE AV-8B HARRIER II

by

Stephen J. Mysko III

B.S., Rutgers University, 1989

M.S., University of Colorado, 1990

A thesis submitted to the

Faculty of the Graduate School of the

University of Colorado in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

Department of Aerospace Engineering Sciences

1993

SUMMARY

Under the support of this Cooperative Agreement, computations of transonic flow past the complex forebody/inlet configuration of the AV-8B Harrier II have been performed. The actual aircraft configuration was measured and its surface and surrounding domain were defined using computational structured grids. The thin-layer Navier-Stokes equations were used to model the flow along with the Chimera embedded multi-grid technique. A fully conservative, alternating direction implicit (ADI), approximately-factored, partially flux-split algorithm was employed to perform the computation. An existing code was altered to conform with the needs of the study, and some special engine face boundary conditions were developed. The algorithm incorporated the Chimera technique and an algebraic turbulence model in order to deal with the embedded multi-grids and viscous governing equations. Comparison with experimental data has yielded good agreement for the simplifications incorporated into the analysis. The aim of the present research was to provide a methodology for the numerical solution of complex, combined external/internal flows. This is the first time-dependent Navier-Stokes solution for a geometry in which the fuselage and inlet share a wall. The results indicate the methodology used here is a viable tool for transonic aircraft modeling.

The work described above has been included in a thesis by Stephen J. Mysko III, which was submitted in May, 1993, to the University of Colorado in partial fulfillment of the requirements for the Ph.D. degree. A copy of the thesis is attached as the final report of this research project.