DEPARTMENT OF AEROSPACE ENGINEERING
COLLEGE OF ENGINEERING & TECHNOLOGY
OLD DOMINION UNIVERSITY
NORFOLK, VIRGINIA 23529

PREDICTION AND CONTROL OF VORTEX DOMINATED AND VORTEX-WAKE FLOWS

By

Osama Kandil, Principal Investigator

Final Report
For the period December 1, 1993 through December 1, 1995

Prepared for
National Aeronautics and Space Administration
Langley Research Center
Hampton, VA 23681-0001

Under
Research Grant NAG-1-994
Dr. C. H. Liu, Technical Monitor
FLDMD-Computational Aerodynamics Branch

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Submitted by the
Old Dominion University Research Foundation
P.O. Box 6369
Norfolk, Virginia 23508-0369

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PREDICTION AND CONTROL OF VORTEX DOMINATED AND VORTEX-WAKE FLOWS

OSAMA A. KANDIL*
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Old Dominion University, Norfolk, VA 23529

Accomplishments (12/1/93–12/1/95)

I. Publications

1. Kandil, O. A., Sharaf El-Din, H. H. and Liu, C. H., "Injection Active Control of Asymmetric Flows Around Slender Pointed Forebodies," First Industry/University Symposium on High Speed Civil Transport Vehicles (HSCTV), Greensboro, NC, December 4-6, 1994.

2. Kandil, O. A., Sharaf El-Din, H. H., and Liu, C. H., "Three Dimensional Solution of Pneumatic Active Control of Forebody Vortex Asymmetry," AIAA 95–0101, AIAA 33rd Aerospace Sciences Meeting, Reno, Nevada, January 1995. (A copy is attached.)

3. Kandil, O. A., Wong, T. C. and Liu, C. H., "Turbulent Flow Over a 747/747 Generator/Follower Configuration and Its Dynamics Response, AIAA 94–2383, AIAA Fluid Dynamics Conference, Colorado Springs, CO, June 20–22, 1994. (A copy is attached).

4. Kandil, O. A., Wong, T. C. and Liu, C. H., "Prediction of Near- and Far-Field Vortex-Wake Turbulent Flows," AIAA 95–3470–CP, AIAA Atmospheric Flight Mechanics Conference, Baltimore, MD, August 7-9, 1995. (A copy is attached).

5. Kandil, O. A., Sheta, E. F. and Massey, S. J., "Buffet Responses of a Vertical Tail in Vortex Breakdown Flows," AIAA Atmospheric Flight Mechanics Conference, Baltimore, MD, August 7-9, 1995. (A copy is attached).

II. Ph.D. Dissertation Produced:

"Simulation of Active Control of Asymmetric Flows Around Slender Pointed Forebodies," by Hazem H. Sharaf El-Din, December 1994. Director: Prof. Osama A. Kandil. Copies of the Ph.D. Dissertation have been delivered to Dr. C. H. Liu, Monitor.

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* Professor

III. National and International Presentations:

1. "Computational Assessment of Vortex-Wake/Plume Interaction," NASA Langley Near-Field Interaction Workshops, Holiday Inn, Hampton, VA, August 22-23, 1994. Prof. Kandil gave the presentation.
2. "Vortical Structures of Aircraft Wakes," International Colloquium on Vortex Flows, RWTH, Aachen, Germany, October 13-14, 1994, Dr. Liu gave the presentation.
3. "Injection Active Control of Asymmetric Flows Around Slender Pointed Forebodies," First Industry/University Symposium on High Speed Civil Transport Vehicles, Greensboro, NC, December 4-6, 1994, Prof. Kandil gave the presentation.
4. "Three Dimensional Solution of Pneumatic Active Control of Forebody Vortex Asymmetry," AIAA 33rd Aerospace Sciences Meeting, Reno, Nevada, January 1995. Prof. Kandil gave the presentation.
5. "Computational Modeling and Analysis of Near-Field Vortex-Wake/Exhaust Plume Interaction," 5th Annual Meeting on the Atmospheric Effects of Aviation, VA Beach, VA, April 24–29, 1995. Prof. Kandil gave the presentation.
6. "Turbulent Flow Over a 747/747 Generator/Follower Configuration and Its Dynamic Response," AIAA Fluid Dynamics Conference, Colorado Springs, CO, June 20–22, 1994. Prof. Kandil gave the presentation.
7. "Shock-Induced Vortex Breakdown on a Delta Wing," The Third International Congress on Industrial and Applied Mathematics (ICIAM 95), Hamburg, Germany, July 3-7, 1995. Prof. Kandil gave the presentation.
8. "Prediction of Near- and Far-Field Vortex-Wake Turbulent Flows," AIAA Atmospheric Flight Mechanics Conference, Baltimore, MD, August 7-9, 1995. Prof. Kandil gave the presentation.
9. "Buffet Responses of a Vertical Tail in Vortex Breakdown Flows," AIAA Atmospheric Flight Mechanics Conference, Baltimore, MD, August 7-9, 1995. Mr. Sheta gave the presentation.
10. "Prediction of Far-Field Vortex-Wake/Exhaust Plume Turbulent Flows and Vertical Tail Buffet Response due to Shock-Induced Vortex Breakdown Flows," Aerodynamics and Acoustics Methods Branch, NASA Langley Research Center, October 3, 1995. Prof. Kandil gave the presentation.

IV. Animation Movies Produced:

Two animation movies have been produced under this grant. The first is for Vertical Tail Buffet Response in Transonic Vortex Breakdown Flows and the second is for Vortex-Wake/Exhaust Plume Turbulent Flows. Copies of the movies have been delivered to Dr. C. H. Liu, Grant Monitor.

V. Graduate Students:

There are two Ph.D. students that were supported under this grant. They are:

1. Mr. Essam F. Sheta: He passed his Ph.D. qualifying examination in Fall 1995. His Ph.D. dissertation work is focused on Prediction and Validation of Buffet Responses of F/A-18 Twin Tail Configuration. He is expected to finish his Ph.D. work in December 1997.
2. Mr. Ihab Adam: He passed his Ph.D. qualifying examination in Fall 1995. His Ph.D. dissertation work is focussed on Vortex-Wake/Exhaust Plume Interaction behind Advanced Subsonic Aircraft and HSCT. He is expected to finish his Ph.D. work in 1997. Currently, he is supported by the Aerospace Engineering Dept.