Final Report

A Program of Research and Education in Astronautics

NASA GRANT NCC1-331

For the Period

January 1, 1999 through December 31, 2003

NASA Tech Officer — John Paulson

GW Principal Investigator — Robert Tolson, Professor

School of Engineering and Applied Science
The George Washington University
Washington, D. C. 20052

Results of Program

Since its inception in January 1999, the program has provided support for 1 faculty, 1 research faculty, 1 research scientist and a number of graduate student researchers. A total of 33 Graduate Research Scholar Assistants were fully or partially supported by this award, of these, 30 have completed their MS degree program. The program has generated 25 MS theses and numerous publications/ presentations. This Grant has been funded a total of $[redacted]

Award History

01/01/99 – 11/30/99	New Grant – Funding: [redacted]
12/01/99 – 11/30/00	Supplement 1 – Renewal -Funding: [redacted]
08/29/00 – 11/30/00	Supplement 2 – Funding: [redacted]
12/01/00 – 11/30 01	Supplement 3 – Renewal – Funding: [redacted]
12/01/01 – 12/31/02	Supplement 4 – Change in end date and additional funding: [redacted]
02/07/02 – 12/31/02	Supplement 5 – Incremental Funding: [redacted]
04/16/02 – 12/31/02	Supplement 6 – Incremental Funding: [redacted]
08/09/02 – 12/31/02	Supplement 7 – Incremental Funding: [redacted]
09/19/02 – 12/31/03	Supplement 8 – Reduction to award history and funding history due to error on Supplement 3: [redacted]
12/31/02 – 12/31/02	Supplement 9 – To reduce award history and funding history to reflect final audited numbers: [redacted]

Total: [redacted]

Participants and Activities

Participants during this period included:

Robert H. Tolson, Professor and Principal Investigator
Paul A. Cooper, Research Professor
Robert C. Blanchard, Lead Research Scientist
Graduate Research Scholar Assistants

Activities:

A List of seminars presented is given in Appendix A.
A list of publications and presentations is given in Appendix B.
The Graduate Research Scholar Assistants supported in whole or in part under this award and their initial employer upon graduation from GW are listed in Appendix C.

APPENDIX A

SEMINARS PRESENTED

1. J. W. Mohr, "An Efficient Triangular Shell Finite Element for Thick Composites and Sandwich Laminates," July 26, 2000.

2. J. K. Strickland, "Development of a Bank Reversal Control Law for a Martian Aerocapture Guidance Algorithm," July 24, 2000.

3. T. J. Bozung, "Shuttle Orbiter Infrared Image Calibration using Thermocouple Data," February 1, 2001.

4. M. D. Billing, "Analytical Simulations of Energy Absorbing Impact Sphere for Mars Sample Return Earth Entry Vehicle," July 23, 2001.

5. A. M. Dwyer, "Modeling of the Mars Atmosphere for Monte Carlo Simulations of the Mars Odyssey Aerobraking Mission," July 23, 2001.

6. L. R. M. Giersch, "Pathfinder Photogrammetry Research for Ultra-Lightweight and Inflatable Space Structures," July 31, 2001.

7. A. D. Sullins, "Heat Transfer in High Porosity Open Cell Nickel Foam," August 7, 2001.

8. M. T. Powers, "Material Characterization of Polyurethane Foam Under Hydrostatic Loading," August 22, 2001.

9. Y. M. Savranskaya, "Model Development and Performance Analysis of Flying Flexible Fixture," August 22, 2001.

10. J. L. Hanna, "Approaches to Autonomous Aerobreaking at Mars," August 23, 2001.

11. Z. Q. Chavis, "Development of a Plume Model and Application to Mars 2001 Odyssey Aerobraking," June 21, 2002.

12. P. P. Zomkowski, "Preliminary Design and Analysis of the GIFTS Instrument Pointing System," June 24, 2002.

13. C. G. Lang, "Finite Element *A Posteriori* Error Estimation for Heat Conduction," August 21, 2002.

14. J. E. VerHage, "Design and Simulation Methodologies for Radiation Shielding Using an Immersive Environment," August 6, 2002.

15. B. R. Rogillio, "Bending Instabilities of Ultra-Lightweight Inflatable Rigidizable Thin Walled Composite Columns," August 13, 2002.

16. P. E. Escalera, "Conceptual Design of the Mars Atmospheric Explorer," November 8, 2002.

17. D. W. Fiala, "Shape Memory Alloy Control of a Tensegrity Structure," December 4, 2002.

18. L. Kay-Bunnell, "Orbit Determination Accuracy for Comets on Earth-Impacting Trajectories," May 1, 2003.

19. B. P. Anderson, "Spacecraft-Ballute Interactions Using Continuum and Rarefied Computational Analysis," June 12, 2003.

20. M. R. Werner, "Interferometer Design Considerations for Application to Extremely Low Visual Magnitude Near-Earth Objects," July 25, 2003.

21. A. L. Martin, "Methodology for Reduced Monte Carlo Simulations with Application to Mars Science Laboratory Entry," August 5, 2003.

22. C. W. Brunner, "Conceptual Design of a Communications Relay Satellite for a Lunar Sample Return Mission," June 23, 2004.

23. P. W. Stumpf, "The Development of a Model to Predict the Loads Acting on a Disk-Gap-Band Parachute During Inflation," July 26, 2004.

24. R. C. Witt, "Performance Evaluation of a Sun-Mars Lagrange Point Autonomous Navigation Network," July 26, 2004.

25. B. A. Smith, "Probabilistic Parameter Uncertainty Analysis of Single Input Single Output Control Systems," July 29, 2004.

APPENDIX B

PUBLICATIONS AND PRESENTATIONS

1. M. Powers, "Material Characterization of Polyurethane Foam Under Hydrostatic Loading," Presented: AIAA Mid-Atlantic Region I Student Conference, Morgantown, WV, April 6-7, 2001.

2. N. Hotchko, "Design of a Separation Mechanism for the Langley Glide Back Booster Small Launcher System," Presented: AIAA Mid-Atlantic Region I Student Conference, Morgantown, WV, April 6-7, 2001.

3. M. D. Billings, E. L. Fasanella, S. Kellas, "Impact Test and Simulation of Energy Absorbing Concepts for Earth Entry Vehicles," Presented: 42nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Seattle, WA, April 16-19, 2001. Published: AIAA 2001-1602.

4. E. L. Fasanella, M. D. Billings, "Dynamic Finite Element Predictions for Mars Sample Return Cellular Impact Test #4," Published: NASA/TM-2001-211-23 ARL-TR-2539, June 2001.

5. A. M. Dwyer, P. E. Escalera, J. L. Hanna, C. D. Hernandez, "Supporting Oasis Life (SOL) MCCS/MAV," Presented: NASA MarsPort Engineering Design Student Competition 2001, Kennedy Space Center, FL, May 7, 2001.

6. A. D. Sullins, K. Daryabeigi, "Effective Thermal Conductivity of High Porosity Open Cell Nickel Foam," Presented: 35th AIAA Thermophysics Conference, Anaheim, CA, June 11-14, 2001. Published: AIAA 2001-2819.

7. B. M. Anderson, J. E. Nealy, G. D. Qualls, P. J. Staritz, J. W. Wilson, M.-HY. Kim, F. A. Cucinotta, W. Atwell, G. De Angelis, J. Ware, A. E. Persans, "Shuttle Spacesuit (Radiation) Model Development," Presented: 31st International Conference on Environmental Systems (ICES) Orlando, FL, July 9-12, 2001. Published: Paper Number 01ICES-2363.

8. G. D. Qualls, J. W. Wilson, C. Sandridge, F. A. Cucinotta, J. E. Nealy, J. H. Heinbockel, C. P. Hugger, J. VerHage, B. M. Anderson, W. Atwell, N. Zapp, R. Barber, "International Space Station Radiation Shielding Model Development," Presented: 31st International Conference on Environmental Systems (ICES), Orlando, FL, July 9-12, 2001. Published: Paper Number 01ICES-294.

9. R. C. Blanchard, R. G. Wilmoth, C. E. Glass, N. R. Merski, Jr., S. A. Berry, T. J. Bozung, A. Tietjen, J. Wendt, D. Dawson, "Infrared Sensing Aeroheating Flight Experiment: STS-96 Flight Results," Published: Reprinted from Journal of Spacecraft and Rockets, Vol. 38, No. 4, pp. 465-472.

10. A. M. Dwyer, R. H. Tolson, M. M. Munk, P. V. Tartabini, "Development of a Monte Carlo Mars-GRAM Model for Mars 2001 Aero-Braking Simulations," Presented: AAS/AIAA Astrodynamics Specialists Conference, Quebec City, Quebec, Canada, July 30-August 2, 2001. Published: Paper AAS 01-389.

11. J. L. Hanna, R. H. Tolson, "Approaches to Autonomous Aerobraking at Mars," Presented: AAS/AIAA Astrodynamics Specialists Conference, Quebec City, Quebec, Canada, July 30-August 2, 2001.

12. R. C. Blanchard, B. P. Anderson, S. S. Welch, C. Glass, S. A. Berry, N. R. Merski, D. W. Banks, A. Tietjen, and M. Lovern, "Shuttle Orbiter Fuselage Global Temperature Measurements from Infrared Images at Hypersonic Speeds," Presented: AIAA Atmospheric Flight Mechanics Conference, Monterey, CA, August 5-8, 2002.

13. J. L. Hanna, Z. Q. Chavis, and R. G. Wilmoth, "Modeling Reaction Control System Effects on Mars Odyssey." Presented: Astrodynamics Specialist Conference and Exhibit, Monterey, CA, August 5-8, 2002. Published: AIAA 2002-4934.

14. R. C. Blanchard, K. A. Boyles, G. J. LeBeau, and F. E. Lumpkin, "The Use of Virtual Sub-Cells in DSMC Analysis of Orbiter Aerodynamics at High Altitudes Upon Reentry." Presented: 41st AIAA Aerospace Sciences Meeting and Exhibit, Reno, NV, January 6-9, 2003. Published: AIAA 2003-1275.

15. B. P. Anderson, "Computational Continuum and Rarefied Flow Results for Ballute Applications." Presented: AIAA Mid-Atlantic Region 1 Student Conference, College Park, MD, April 11-12, 2003.

16. C. W. Brunner, "Conceptual Design of a Communications Relay Satellite for a Lunar Sample Return Mission." Presented: AIAA Mid-Atlantic Region I Student Conference, Virginia Polytechnic Institute and State University, VA, April 16-18, 2004.

APPENDIX C

Graduates	Employed by
Summer 2000	
Jeremy W. Mohr	Weitz, AZ
Justin K. Strickland	Raytheon, MD
Spring 2001	
Timothy J. Bozung	Stryker Instruments, MI
Summer 2001	
Marcus D. Billings	ATA Engineering, CA
Alicia M. Dwyer	ICASE @ NASA Langley
Louis R. Giersch	University of Kentucky, KY
Alan D. Sullins	Aerospace Corp, CA
Fall 2001	
Brooke M. Anderson	Swales @ NASA Langley
Benjamin E. George	USAF
Jill L. Hanna	ICASE @ NASA Langley
Michael T. Powers	Lockheed Martin Missiles & Space Systems, CA
Yelena M. Savranskaya	Aerospace Corp, CA
Summer 2002	
Zachary Q. Chavis	Pratt & Whitney, CT
Christapher G. Lang	NASA Langley @NASA Langley
Brendan R. Rogillio	Unknown
Joshua E. VerHage	Unknown
Paul P. Zomkowski	Aerospace Corp, CA
Fall 2002	
David W. Fiala	Unknown
Spring 2003	
Paul E. Escalera	Orbital Sciences Corp, VA
Linda Kay-Bunnell	Analytical Mechanics Assoc @ NASA LaRC
Summer 2003	
Brian P. Anderson	Combustion Research & Flow Technology, PA
Alex L. Martin	Aerospace Corporation, CA
Martin R. Werner	Spectrum Astro, AZ
Fall 2003	
Michael S. Judy	Unknown

Graduates	Employed by
Summer 2004	
Christopher W. Brunner	Iowa State University (DSc), IA
Matthew L. Carter	Unknown
Brett A. Smith	NASA Jet Propulsion Lab, CA
Paul W. Stumpf	NASA Jet Propulsion Lab, CA
Russell C. Witt	Honeywell International, FL
Fall 2004	
Michael F. Kirsch (Prof Engr)	The George Washington University