COMPREHENSIVE RESUME

1. Name: Raymond C. Montgomery

2. Education – BS in Aerospace Engineering, 1963, University of Alabama
MS in Aerospace Engineering, 1964, University of Alabama
PhD in Aerospace Engineering, 1970, VPI&SU

3. Relevant Professional Training

Flight ratings: single-engine private pilot, instrument; glider;
Linear Multivariable Control, 1986;
Laser Safety, 1988;
Basic MSC NASTRAN, 1989;
Robotics and Telerobotics, 1991;
Introduction to Fourier Optics, 1991;
Model Reference Adaptive Control, 1992;
DADS (Dynamic Analysis and Design System), 1992;
Hands-On Fuzzy Logic, 1994;
Topics in Multivariable Control, 1994;
C++ Programming, 1994;
Intro Object Oriented Programming, 1994;
Advanced Object Oriented Programming, 1994;
Developing Reusable Software, Software Design, 1995;
Mathematica, 1995;
Nonlinear Dynamics and Control, 1996;
Digital Avionics Systems, 1996;
Systems Thinking, 1997;
MSC NASTRAN Dynamic Elements, 1997;
MSC NASTRAN Superelements, 1997;
COTR Training, 1997;
Discrete-Time Linear and Nonlinear Modeling and Control, 1997;
FORTRAN 90, 1998;
ISO Software Engineering Process, 1998;
LMS Training, 1999;
Essentials of Biology, 1999;

Risk Management and Fault Tree Analysis, 2000;

Topics in Engineering, 2000;

Techfest 2000, 2000;

Videogrammetry, 2000;

Private Pilot Ground School Review, 2000;

Instrument Ground School Review, 2001.

4. Professional Experience

a. Present Assignment: Dr. Montgomery's primary research assignment is to develop the fundamental understanding of innovative effectors for aircraft that can extend the operating flight envelope. Most recently he has been the COTR of a contract to Physical Sciences Inc. to use pulsed, vortex-generating jets (PVGJs) to defer stall and allow controlled flight in the stall regime. A full-span model of the B-2 aircraft, called the Global Strike model, has been fitted with twelve PVGJs. The jets were ganged to operate together, in two groups of six on either wing. Dr. Montgomery directed the design of the model and has participated in initial wind tunnel testing in the Stability Tunnel at VPI&SU. In the tests the model was rapidly slewed through a large angle of attack range using the Dynamic Pitch Plunge and Roll Rig of the tunnel and active control using a control computer driving the PVGJs demonstrated elimination of stall through the maneuvers.

The model is currently at Langley, and Dr. Montgomery is retrofitting it for independent operation of all jets. In that way he hopes to achieve smooth and predictable six degree of freedom control in the high lift stall regime. Fundamental understanding is being developed by Dr. Montgomery via Computational Fluid Dynamics and is required to design effective real-time control systems that can handle these effectors as independent entities. The immediate plan is to test the Global Strike Model in the Airborne Systems Competency 12-foot tunnel to validate and complete the understanding developed to this time.

Because of his expertise in Control/Structure Interaction (CSI), in June 2001 Dr. Montgomery was asked to conduct the initial CSI investigation (prior to the JSC V&V design cycle) for the International Space Station Assembly Flight 12 A. The JSC contact is Louis Nguyen, JSC, Code M, who is the primary funding source for the activity. Dr. Montgomery is the Langley technical leader. When this mission is complete the ISS will be the largest and most flexible object every put into orbit and will utilize the Alpha Rotation Joints to rotate the large PV arrays for the first time. The job is to examine the CSI environment of the configuration for all operations that have to be conducted during the assembly mission as well as the ISS configuration after the Shuttle has departed. Operations include Shuttle docking and assembly operations using RMS, SSRMS, and EVA. The goal is to identify any CSI issues as early as possible. If any problems are uncovered. Dr. Montgomery

will propose solutions and evaluate them with a team of individuals at Langley: Dr. Montgomery (Leader), Paul Cooper (GWU professor), and Adrienne Battle (GWU JIAFS fellow).

Because of the HyperX Mishap, Dr. Montgomery was asked to redirect his efforts in support the Investigation, which took priority. So from June 2001 until Jan 2002 the time spent on the ISS project was only the time required to lead the Langley effort.

For the HyperX Mishap Investigation, Dr. Montgomery served as a substitute member of the Mishap Investigation Board (MIB) and later served as the leader of the Controls investigation at Langley. This required coordination between Orbital Sciences Corp (OSC), the HyperX program office through John Martin, the Aero controls group led by Walt Englund, and the Aeroservoelasticity Group led by Boyd Perry as well as technical work. The technical work that he individually accomplished was to evaluate the vehicle models used by OSC in certifying the Pegasus/HyperX for launch and examine and certify the code used in the OSC 6-DOF simulations. Reports that document this work are available to NASA and OSC only because of the sensitive nature of the Investigation (See item 10-a-3 citations 1 and 2 below.) The Langley team reported to MIB member, Frank Bauer of GSFC. Luat Nguyen was the Langley supervisor for the activity.

The HyperX MIB activity closed out in mid January 2002. After that the ISS project will be a higher priority than testing of the Global Strike Model. This is dictated by the schedules for the 12-A launch.

b. Previous Professional Positions (Last ten years only):

From February 1965 to Present: Aero-Space Technologist NASA Langley Research Center – In this position, Dr. Montgomery is responsible for the formulation and implementation of plans for conducting research into atmospheric and orbital vehicle control and modeling. This includes the development of high fidelity modeling methodology to effectively represent aircraft/spacecraft of interest, model order reduction theory to facilitate design activities, control design and syntheses, algorithm development, implementation and evaluation of candidate concepts, restructurable control methodology development, and optimization of selected concepts.

From January 1999 to Present: Member the IEEE Spectrum Editorial Board – This position requires presenting an annual report at the Editorial Board meeting. The report presents recommendations for hiring of the editorial staff and on technology forecasts in Electrical and Electronics Engineering. The most recent report submitted by Dr. Montgomery was on recent accomplishments in nanobiotechnology.

From January 1995 to May 1995: Adjunct Professor, Mechanical Engineering, ODU – Taught a graduate course in Modern Control Theory.

5. Significant Scientific/Engineering Accomplishments

This is a list, which includes a brief descriptive title followed by a reference number (#), or numbers (#s) of supporting documentation (located under the Formal Refereed Publication item of section 10). Brief comments are added where needed, for each entry:

1) Construction of the MSFC Robotic Arm Testbed, # 2. Researchers at Langley, Rockwell International (Downey, CA), and Control Dynamics (Huntsville, AL) have used the facility to investigate the use of end-point controllers to eliminate payload vibrations resulting from Space Shuttle RMS arm operations

2) Design of the Torque Wheel Actuators to minimize Controls/Structures Interaction, # 4. The technology reported in the citation was used to design the torque wheel actuators used in the MiniMast, later the COFS I experimental apparatus. The apparatus was a 20m truss, built to space requirements with space hardware, and mounted vertically in building 1293. The actuators were installed on a plate at the top and used for research in actively suppressing structural dynamics disturbances.

3) Incorporation of reliability considerations in the placement of control system components, #s 14 and 15.

4) Fast algorithms for adaptive identification and control of structural dynamics systems, #s 13,16, 17, 19, 20, 22, 23, 26, and 29. A film clip illustrating adaptive control with least square lattice filters is available from Dr. Montgomery.

5) Use of the trailing edge surfaces for 3-Axis attitude control of the Space Shuttle in early entry, # 25.

6) Distributed adaptive control of structural dynamics systems, #s 27 and 35.

7) Adaptive control of the F8-DFBW aircraft, # 37.

8) Evaluation of Analytic Redundancy Management (ARM) for the F8-DFBW aircraft and eventual ARM flight test, # 38.

9) The first use of optimal decision theory to improve flight control system reliability using analytic redundancy between dissimilar components, # 39.

10) Innovator of Terminal Imbedding, a method for solving optimization problems by imbedding the solution in a field of solutions, # 42.

11) Aircraft flight control design procedures to accommodate flying quality specifications, #s 40 and 43.

12) First dynamic analysis of the deep stall, a pitch-up problem of T-tailed transports, # 43.

6. Scientific/Engineering Leadership (listed in order from present to past)

Langley Lead for the Controls Structures Interaction evaluation of the International Space Station Assembly Flight 12A (JSC Technical Lead is Louis Nguyen) Dr.

Montgomery leads a three member team to accomplish this task. See item "4 a)" above.

Langley Technical Lead in Controls for the X-43 Mishap Investigation This required coordination between the Aero group lead by Walt Englund, the HyperX project office, Goddard Space Flight Center, and the Aeroservoelasticity Branch as well as independent, individual research to validate the models used by OSC in certifying flight readiness of the X-43.

Langley Technical Lead for the NASA X-Vehicles Avionics/Autonomous Landing Review This task required reviewing the X-Vehicles programs (X-37, X-34) in coordination with MSFC and reporting to the Langley Center Director.

Langley Technical Lead for the Lockheed Martin Launch Vehicle (LMLV) mishap investigation This task required coordination between many researchers at Langley and the review activities at Lockheed Martin (Denver, CO) Dr. Montgomery was the Langley on-site reviewer responsible for writing and closing review items with Lockheed Martin. The final review presentation was to Samual L. Venneri at NASA headquarters. Dr. Montgomery and John Malone attended from Langley.

Langley Lead for the Code QP final flight readiness review of the Space Shuttle/MIR Docking Flight (Other members of the review team were Andy Von Flotow (Flotow Associates), Raymond de Gaston (Vitro Corp), and A. Miles Wintnah, Code QP rep) This was a follow on to the next item as an independent, four person, Code QP review team.

Langley Technical Lead in Controls for Space Shuttle/MIR Docking This activity required reviewing the planned Shuttle/MIR rendezvous and docking operations, the Russian docking mechanisms, astronaut training procedures, and batch and real-time simulations used with the goal of determining whether or not the docking load requirements would be violated.

NASA Technical Lead for the Joint LaRC/MSFC Robotics Ground Testbed – This involved 11 team members distributed at MSFC, Control Dynamics (Huntsville), and Rockwell (Downey). Dr. Montgomery was the team leader. The job was to build a robotics testbed that simulated the Space Shuttle RMS arm in its vibration characteristics and test end-point controller mechanisms on the testbed.

Langley Co-Principle Investigator in Controls – For the MiniMast experiment (COFS I Ground Test Facility) – This involved leading a team to design and build the 60 ft-lb torque wheel used in the MiniMast experiment and certifying that the facility was "ready for research". COFS II was a flight project, initially proposed to follow the COFS I ground research. It was proposed as a hoop-column reflector deployed from the payload bay of the Space Shuttle. Cost overruns caused NASA to cancel the project.

Team Leader for the CASES evaluation – A team of 5 individuals was formed to evaluate whether or not Langley should support the CASES flight experiment proposed by MSFC as a replacement for COFS II. CASES was an X-ray astronomy reflector that was deployed from the Space Shuttle payload bay using an Astromast. The group's job was to determine if CSI research could be conducted on CASES.

Group Leader for the Spacecraft Controls Branch – The group included 11 LaRC employees and contractors, and was subdivided into a remote sensing subgroup, a SCOLE subgroup, and a the LaRC/MSFC robotic arm test facility subgroup.

Controls Principal Investigator for the Langley Flexible Beam, and Grid Experiments, and SCOLE (Spacecraft COntrols Lab Experiment) – These were experimental apparatus that were designed to be facilities to support CSI work on elementary structures. SCOLE was a large, flat, steel plate to which was attached a structurally dynamics representation of an offset feed antenna. It was supported by a cable and had 5 degrees of freedom. The first optical system to measured motions of SCOLE was developed in this activity.

Langley Technical Lead for the Space Shuttle Backup Flight Control System Design, (NASA Special Achievement Award, 1978) – In the original Rockwell design of the Space Shuttle flight control system a software failures could result in a stoppage of all flight computers. Because of Dr. Montgomery's work in ARM development, he was asked to be a member of a four person panel reporting to Dr. Christopher Kraft on modifications of the Space Shuttle flight control system to address the issue. The other panel members were W. H. Phillips (Langley), Sy Rubenstein (Rockwell), and Fred Haise (Space Shuttle and Apollo-13 Astronaut.) The panel recommended that a completely independent Back-up Flight Control System (BFCS) be installed on the Space Shuttle programmed with flight code using an independently designed flight control system developed by the Draper Lab. Subsequently Rockwell modified their design and Dr. Montgomery assembled a team at Langley using the real-time simulation facilities in building 1268A and an external hybrid computer in building 1232 to evaluate the Draper control laws for the BFCS. Space Shuttle Astronaut H. Hartsfield evaluated the Langley BFCS simulator and recommended that a Langley washout filter be incorporated in the Draper design to improve Shuttle handling in turns.

Langley Principal Investigator for ARM – Subsequent to publication of item 4 in the previous section, Dr. Montgomery was funded to monitor a NASA contract to the Draper Laboratory and a grant to MIT to conduct a preliminary evaluation ARM for flight-testing on the F8-DFBW aircraft. After that NASA decided to select Draper as the prime contractor for the ARM flight test on the DFBW aircraft. This required leadership in coordination between multiple NASA centers and multiple contractors to achieve a viable product. Dr. Montgomery subsequently served as a consultant to Dryden to insure the implementation was suitable, specifically reviewing the Software Specifications Document for the flight test. He later participated in the Dryden Flight Research Center ARM flight control system design review at Draper. The system was first flight tested at Edwards AFB in September of 1979. Subsequently Draper has successfully incorporated the technology into the A10 aircraft. Hence, a technology that was initiated at Langley, and subsequently

developed by NASA, is now available to flight control designers to enhance the reliability of their product.

7. Professional Scientific/Engineering Service

Current Membership, Rendering Scientific Judgement, Special Activities

1) Registered Professional Engineer, Virginia
2) Assistant Professor in Aerospace and Ocean Engineering, 1970-71.
3) Associate Fellow, American Institute of Aeronautics and Astronautics (AIAA)
4) Senior Member, Institute of Electrical and Electronics Engineers (IEEE)
5) Curriculum Examiner, Howard University: The Graduate School of the Arts and Sciences, 1990.
6) Member, AIAA Guidance and Control Technical Committee, 1976-1979.
7) Member and Chairman, AIAA Space Automation and Robotics Committee on Standards, 1988-1995.
8) Technical Associate Editor, IEEE Transactions on Automatic Control, 1986-88
9) Research Proposal Reviewer for Agenzia Spaziale Italania (Italian Space Agency), 2000
10) Session chairman and co-chairman for several AIAA conferences
11) Organized several sessions at IEEE conferences
12) Member of Planning Committee and Treasurer for IEEE Southeastcon
13) Paper and Book Reviews – reviewer for: book publishers Prentice-Hall International, UK and John Wiley & Sons; the International Journal of Modeling and Simulation; International Journal of Robust and Nonlinear Control; J. Aircraft, J. Guidance, Control, and Dynamics; the, IEEE Transactions; the IEEE Spectrum; and, and AIAA Guidance, Navigation, and Control Conference papers.
14) Served on several NASA editorial committees for many NASA TPs and TRs.
15) Reviewer for NASA NRA and SBIR proposals.
16) Mentor to GWU JIAFS graduate (MS) student (2001-present)
17) Judge of the FIRST Robotics Competition Oral Presentations, New Horizons Technical Institute for the past several years
18) Judge AIAA 2002 Student Conference
19) **8. Inventions, Patents:**
20) U.S. Patent No. 4913534: Awarded on April 3, 1990 to S. Lafleur and R. C. Montgomery. Title: Real-Time Dynamic Holographic Image Storage Device Application No. 318217 filed on March 2, 1989.

9. Honors, Awards, Recognition, Elected Memberships

1) Special Achievement Award – for Outstanding Contributions to the Safe Conduct of NASA Flight Research and Support through the Provision of Timely, Unique, and Superior Control Law Design Expertise. August 1997.

2) Time-Off Award – 40 hours for Outstanding Contributions to the LLV#1 (Lockmart Launch Vehicle #1 – Launch Preparation Tiger Team. March 3, 1997.
3) Certificate of Commendation from the Commonwealth of Virginia – for participation in the Residential Governor's Schools Program, 1994 and 1995.
4) Time-Off Award – 20 hours for Technical Contributions Made as a Member of the Shuttle/MIR Dynamics Loads Methodology Independent Review Team, Sept 1994.
5) Time-Off Award – 16 hours for displaying excellent team initiative and skill in meeting deadlines in the evaluation of a large number of proposals in response to an NRA for Advanced Concepts, July 1994.
6) Superior Accomplishment Award – for superior performance, excellent leadership, and superb vision in chairing the Langley Guidance, Navigation, and Control Technical Committee (1991-1993).
7) Outstanding Performance Award – Nov 1, 1991 through Oct 31, 1992
8) Certificate of Appreciation for Leadership of the LaRC Guidance, Navigation, and Control Technical Committee. 1991-1992.
9) Dual Career Ladder Award for Technical Excellence – For Technical leadership in the research and development of distributed control techniques for large flexible space structures, February 1989.
10) Outstanding Performance Award – January 1989
11) Superior Accomplishment Award – Superior Research in Support of the Controls-Structures Interaction Program, 1986.
12) Group Achievement Award – to R. C. Montgomery for Rapid and Successful Development of the First Very Large, Flexible Space-Structure Control Facility, 1984
13) Special Achievement Award -- for Introducing a Methodology for Incorporating Reliability into Control System Designs, July 1983
14) Special Achievement Award -- November 1978 for Contributions in the fields of adaptive and learning control theory
15) Special Award in May 1978 for the Space Shuttle Approach and Landing Flight Test
16) Semifinalist for the Government Wide 1977 Arthur S. Fleming Award
17) Outstanding Performance Award -- April l973
18) Runner Up for the H. J. E. Reid Award -- February 1973
19) Special Achievement Award -- October 1970 for Contributions in Optimal Control Theory.

10. Work Product List

a) Traditional publications

1. Formal refereed publications

1) AIAA Space Automation and Robotics Committee on Standards, R. C. Montgomery, Chairman: Standard Vocabulary for Space Automation and Robotics, AIAA S-066-1995, 1995, ISBN: 1563471329.

2) Montgomery, R. C., P. A. Tobbe, J. Weathers, D. Ghosh, and J. L. Garrison: A Testbed for Research on Manipulator Coupled Active Spacecraft. 1993 AIAA Guidance, Navigation, and Control Conference, August 9-11, 1993, Monterey, California, AIAA paper No. 93-3712.

3) Abu-Saba, Elias, G., W. M. McGinley, and R. C. Montgomery: Dynamic Analysis of Truss-Beam System. ASCE Journal of Aerospace Engineering, Vol. 4, No. 4, pp. 347-355, October 1991. ISN 0893-1321, CODEN: JAEEEZ

4) Montgomery, R. C., Ghosh, D., and Kenny, S. P.: Analytic and Simulation Studies on the use of Torque-Wheel Actuators for the Control of Flexible Robot Arms. ASME DSC-Vol. 31, pp. 55-60, November 1991.

5) Scott, M. A., Warnaar, D., Ghosh, D., and R. C. Montgomery: A Control System Design and Evaluation Procedure for A Potential Flight Experiment -- CASES. Proceedings of the AIAA Guidance, Navigation, and Control Conference, August 20-22, 1990, Portland, Oregon.

6) Montgomery, R. C. and D. Ghosh: On the Use of Distributed Sensing in Control of Large Flexible Spacecraft. ASME DSC-Vol. 20, November 1990, pp. 7-12.

7) Montgomery, R. C.; and Williams, J. P.: Analytic Redundancy Management for Systems with Appreciable Structural Dynamics. Chapter 10 of Text Book, *Fault Diagnosis in Dynamic Systems – Theory and Applications.* Edited by Ron Patton, Paul Frank, and Robert Clark, Prentice Hall International (UK), London, 1989.

8) Montgomery, R. C. and Shanhar, J.: Analytic Redundancy Management for Systems with Appreciable Structural Dynamics. Proceedings of the IFAC Advanced Information Processing in Automatic Control. July 3-7, 1989, Nancy, FR.

9) Sparks, D. W., Jr., Montgomery, R. C., Elder, R. C., and D. B. Lenox: Parameter Identification for Vibration Control of SCOLE. ASME DSC-Vol. 18, November 1988.

10) Montgomery, R. C., Shenhar, J., and Williams, J. P.: On-Line Identification and Attitude Control for SCOLE. AIAA Guidance, Navigation and Control Conference, Monterey, CA, August 17-19, 1987.

11) Sundararajan, N. and R. C. Montgomery: Adaptive and Learning Systems - Theory and Applications, K. S. Narendra, Editor. Contributed Chapter entitled - Progress in Adaptive Control of Flexible Spacecraft Using Lattice Filters. Plenum Press, New York - London, 1986.

12) Montgomery, R. C., Williams, J. P., Lazarus, T. L., and P. E. Nelson: Control Effectiveness Characterization for State Estimation and Control of a Highly Flexible Grid. AIAA Guidance, Navigation and Control Conference. Williamsburg, VA, August 18-20, 1986, pp. 488-492.

13) Sundararajan, N. and R. C. Montgomery: Progress in Adaptive Control of Flexible Spacecraft Using Lattice Filters. Included in Applications of Adaptive Control, Plenum Press, 1985.

14) Montgomery, R. C. and W. E. Vandervelde: Reliability Considerations in the Placement of Control System Components. Translated into Russian - Originally published in the J. of Guidance, Control, and Dynamics.

15) Montgomery, R. C.; and W. E. Vander Velde: Reliability Considerations in the Placement of Control System Components. Journal of Guidance, Control, and Dynamics, Volume 8, Number 3, May-June, 1985, pp. 411-412.

16) Sundararajan, N. and R. C. Montgomery: Experiments Using Lattice Filters to Identify The Dynamics of A Flexible Beam. J. Dynamic Systems, Measurement and Control, Vol. 107, September 1985, pp. 187-191.

17) Sundararajan, N.; Montgomery, R. C.; and Williams, J. P.: Adaptive Identification and Control of Structural Dynamics Systems Using Recursive Lattice Filters. NASA Technical Paper, NASA-TP 2371, January 1985.

18) Montgomery, R. C.; and Williams, J. P.: The Use of Distributed Microcomputers in the Control of Structural Dynamics Systems. Mini and Microcomputers in Control, Filtering, and Signal Processing, Edited by M. H. Hamza, ACTA Press, Anaheim*Calgary*Zurich, pages 140-144, ISBN 0-99096-066-1,1984.

19) Sundararajan, N., Williams, J. P., and R. C. Montgomery: Adaptive Modal Control of Structural Dynamics Systems Using Recursive Lattice Filters. AIAA J. Guidance, Control, and Dynamics, Vol. 8, No. 2, March-April 1985, pp. 223-229.

20) Montgomery, R. C. and Sundararajan, N.: Identification of the Dynamics of a Two-Dimensional Grid Structure Using Least Square Lattice Filters. J. Astronautical Sciences, Volume 33, Number 1, January-March, 1985, pp. 35-48.

21) Meirovitch, L.; Baruh, H.; Montgomery, R. C.; and Williams, J. P.: Nonlinear Natural Control of an Experimental Beam. Journal of Guidance, Control, and Dynamics. July-August 1984, p. 437.

22) Sundararajan, N.; and Montgomery, R. C.: Adaptive Control of a Flexible Beam Using Least Square Lattice Filters. IEEE Transactions on Aerospace and Electronic Systems, vol. AES-20, no. 5, Sept. 1984, pp. 541-546.

23) Sundararajan, N.; Williams, J. P.; and Montgomery, R. C.: Adaptive Modal Control of Structural Dynamics Systems Using Recursive Lattice Filters. AIAA Guidance and Control Conference, Seattle, WA, August 20-22, 1984.

24) Meirovitch, L.; Baruh, H.; Montgomery, R. C.; and Williams, J. P.: Nonlinear Natural Control of an Experimental Beam. AIAA J Guidance, Control, and Dynamics. July-August 1984, p. 437.

25) Brown, L. W. and R. C. Montgomery: Space Shuttle Separate Surface Control-System Study. NASA Technical Paper, NASA-TP 2340, July 1984.

26) Sundararajan, N.; and Montgomery, R. C.: Identification of Structural Dynamics Systems Using Least-Square Lattice Filters. J. Guidance, Control, and Dynamics. Volume 6, Number 5, September-October 1983, pp. 374-381.

27) Johnson, C. R.; and Montgomery, R. C.: A Distributed System Adaptive Control Strategy. The World of Large Scale Systems. Edited by James D. Palmer and Richard Saeks, pp.- 140-152, IEEE Press, 1982.

28) Williams, Jeffrey P.; and Montgomery, Raymond C.: Simulation and Testing of Digital Control on a Flexible Beam. AIAA Guidance and Control Conference, August 9-11, 1982, San Diego, CA.

29) Sundararajan, N.; and Montgomery, R. C.: Adaptive Identification for the Dynamics of Large Space Structures. AIAA Guidance and Control Conference, August 9-11, 1982, San Diego, CA.

30) Thau, F. E.; Montgomery, R. C.; and Horner, G. C.: On-line Structural Parameter Identification. AIAA Paper No. 81-1846, Guidance and Control Conference, August 19-21, 1981.

31) Montgomery, R. C.: AGARDograph on Theory and Applications of Optimal Control in Aerospace Systems - Part III Applications, Chapter 3 - Management of Redundancy in Flight Control Systems Using Optimal Decision Theory. AGARDograph No. 251, Edited by Ir. Pieter Kant, printed by Harford House, London, July, 1981, pp. 11-3 through 11-12.

32) Montgomery, Raymond C.; and Lee, Peter S.: Optimal Regulation in Systems with Stochastic Time Sampling. NASA TP-1743, November 1980.

33) Oz, H.; Meirovitch, L.; and Montgomery, R. C.: On Maneuvering Large Flexible Spacecraft Using an Annular Momentum Control Device. 1980 AIAA Guidance and Control Conference, Danvers, Massachusetts, August 11-13, 1980.

34) Montgomery, R. C.: An Annular Momentum Control Device for the Maneuvering of a Large Flexible Spacecraft. AIAA Guidance and Control Conference, August 11-13, 1980, Danvers, MA.

35) Johnson, C. R.; and Montgomery, R. C.: A Distributed System Adaptive Control Strategy. IEEE Transactions on Aerospace and Electronic Systems, Volume AES-15, Number 5, page 601, September 1979.

36) Montgomery, R. C.; Mekel, R.; and Nachmias, S.: A Learning Flight Control System for the F8-DFBW Aircraft. AIAA Guidance and Control Conference, Palo Alto, California, August 7-9, 1978.

37) Dunn, H. J.: and Montgomery, R. C.: A Moving Window Parameter Adaptive Control System for the F8-DFBW Aircraft. Special Issue of the IEEE Journal on Automatic Control on the F-8 Advanced Law Research. Vol. AC-22, Number 5, Dec. 1976.

38) Montgomery, Raymond C.; Price, Douglas B.: Failure Accommodation in Digital Flight Control Systems Accounting for Nonlinear Aircraft Dynamics. AIAA J. Aircraft – Vol. 13, Number 2, Feb. 1976.

39) Montgomery, Raymond C.; Caglayan, Alper K.: Failure Accommodation in Digital Flight Control Systems by Bayesian Decision Theory. AIAA J. Aircraft – Vol. 13, NO. 2, Feb. 1976.

40) Montgomery, R.C.: Analytic Design of Digital Flight Controllers to Realize Aircraft Flying Quality Specifications. AIAA J. Aircraft, vol. 9, no. 7, pp. 456-460. July 1972.

41) Roberts, David A.; and Montgomery, Raymond C.: Development and Application of a Gradient Method for Solving Differential Games. NASA TN D-6502, November 1971.

42) Montgomery, Raymond C.: Optimal Control Using Imbedding of the Terminal Condition. NASA TR R-359, April 1971.

43) Montgomery, Raymond C.; and Hatch, Howard G., Jr.: Application of Differential Synthesis to the Design of Multi-axis Stability Augmentation Systems. AIAA J. Aircraft, July-August 1969, Vol. 6, No. 4, pp. 336-343.

44) Montgomery, Raymond C.: and Moul, Martin T.: Analysis of Deep-Stall Characteristics of T-Tailed Aircraft Configurations and Some Recovery Procedures. AIAA J. Aircraft, Vol. 3, No. 6, 1966, pp. 562-566.

45) Montgomery, Raymond C.: Introduction to Linear System Analysis and Design by Use of State Vector Approach. NSF sponsored lecture at the Rensselear Polytechnic Institute, Spring 1970. Included as Chapter 10 of Performance and Dynamics of Aerospace Vehicles, NASA SP-258, 1971.

2. Conference papers and high-level oral presentations

1) Montgomery, R. C.: X-Vehicles Avionics/Autonomous Landing Review. Presentation to the Langley Research Center Director, April 2000.

2) Raney, David L., Montgomery R. C., L. L .Green, and M. A. Park: Flight Control Using Distributed Shape-Change Effector Arrays. 41st AIAA/ASME/ ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference and Exhibit, AIAA Paper No. 2000-1560, April 2000.

3) Park, Michael A., L. L. Green, R. C. Montgomery, and D. L. Raney, Determination of Stability and Control Derivatives Using Computational Fluid Dynamics and Automatic Differentiation, 17th AIAA Applied Aerodynamics Conference, Norfolk, Va., AIAA 99-3136, June 1999.

4) Scott, Michael A., R. C. Montgomery, and R. P. Weston: Subsonic Maneuvering Effectiveness of High Performance Aircraft Which Employ Quasi-Static Shape Change Devices. SPIE's 5th Annual International Symposium on Smart Structures and Materials, San Diego, California, March 1998.

5) Montgomery, R. C., P. A. Tobbe, Weathers J. M., and T. S. Lindsay: Simulation and Testing of a Robotic Manipulator Test-bed. Proceedings of the Tenth VPI&SU Symposium on Structural Dynamics and Control, May 8-10, 1995.

6) Montgomery, R. C., Ghosh D., Tobbe, P. A., Weathers, J., Manouchehri, D., and T. S. Lindsay: Testing of an End-Point Control Unit Designed to Enable Precision Control of Manipulator-Coupled Spacecraft. AIAA Space Programs and Technologies Conference and Exhibit, AIAA Paper No. 94-4612, September 1994.

7) Montgomery, R. C. and Howard Kaufman: Selected Topics in Robotics for Space Exploration, Proceedings of a workshop sponsored by the NASA Langley Research Center and the Center for Intelligent Robotic Systems for Space Exploration. NASA CP 10131, December 1993.

8) Quintero, R., P. Tchoryk, J. Kader, and R. C. Montgomery: Rendevous and Docking Scenarios for Guidelines and Standardization. AIAA Space Programs and Technologies Conference, September 1993.

9) Montgomery, R. C.: Simulation of the Attitude Determination System for Space Station Freedom. Station Freedom Attitude Control During Orbiter Berthing. Proceedings of the Ninth VPI&SU Symposium on Dynamics and Control of Large Structures. May 10-12, 1993. Blacksburg, Virginia, pp. 207-216.

10) Garrison, J. L., S-C. Wu, M. E. Demeo, and R. C. Montgomery: Space Station Freedom Attitude Control During Orbiter Berthing. Proceedings of the Ninth VPI&SU Symposium on Dynamics and Control of Large Structures. May 10-12, 1993. Blacksburg, Virginia, pp 243-254.

11) Montgomery, R. C.: A Tribute to Lawrence W. Taylor, Jr.: Ninth VPI&SU Symposium on Dynamics and Control of Large Structures. May 10-12, 1993. Blacksburg, Virginia.

12) Garrison, J. J., Montgomery, R. C., et al: Space Shuttle to Space Station Freedom Berthing Dynamics Research at the NASA Langley Research Center. 4th Conference on Intelligent Robotic Systems for Space Exploration, Rensselaer Polytechnic Institute, Troy, NY, September 30 - October 1, 1992

13) Barbieri, Enrique, Sean Kenny, and Raymond C. Montgomery: Nonlinear Modeling of a Long Flexible Manipulator and Control by Inertial Devices. Proceedings of the 1992 American Control Conference. June 24-26, 1992. pp. 1695- 1699.

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b) Software Products/Technology Transfer

1. Differential Synthesis, A program to design aircraft flight control systems to meet Flying Quality Specifications.
2. Real-Time Simulator for evaluating the Space Shuttle Back Up Control System.
3. Real-Time Simulator for the Experimental Beam and Grid Apparatus

c) **External Agreements:** ITA in progress with JSC on the ISS support for flight 12-A.