



Christopher C. Flanigan

Expertise

Mr. Flanigan's expertise is in the static, dynamic, and aeroelastic analysis of aerospace systems. He has special background in using NASTRAN for special purpose and large-scale analyses. He is experienced in the particular requirements of Space Shuttle payload integration.



Education

Massachusetts Institute of Technology, Cambridge, MA
Master of Science in Aeronautics and Astronautics, 1976

Massachusetts Institute of Technology, Cambridge, MA
Bachelor of Science in Aeronautics and Astronautics, 1975

Business Experience

Quartus Engineering Incorporated, San Diego, CA
1997-present.

Co-founder of Quartus Engineering Incorporated. Vice President of Engineering.

Structural Dynamics Research Corporation (SDRC), San Diego, CA
1982-1997.

Manager of Advanced Test and Analysis consulting services. Project Manager for many aerospace projects including Titan/Centaur Independent Verification and Validation, Space Shuttle payload loads analyses, aircraft and missile flutter analyses, solid rocket motor analysis and test, test/analysis correlation, and mobile C3I shelter shock isolation. Responsible for Western Operations software library.

General Dynamics Convair Division, San Diego, CA
1976-1982.

Senior dynamics engineer involved with mode synthesis and dynamics response of launch vehicles; flutter analysis of cruise missiles; dynamics of large space structures; structural analysis of superconducting magnets; transient response of space shuttle payloads. Principal engineer for NASTRAN and member of the GD Finite Element Committee.

Product Experience

Space Shuttle: Developed modal synthesis methods, NASTRAN DMAP applications, and custom software for synthesizing payloads to the NSTS models. Performed coupled loads analyses for many NSTS payloads including Galileo, Advanced Communication Technology Satellite (ACTS), Tethered Satellite System (TSS), and Space Station *Freedom* payloads.

Space Shuttle SRB: Developed finite element models and analysis techniques for static, dynamic, and buckling analyses of the STS solid rocket booster. Models of up to 300,000 DOF were processed using special superelement methods.

Test/Analysis Correlation: Developed and implemented advanced methods for test/analysis correlation using NASTRAN and CORDS program. Performed test/analysis correlation for STS Centaur, STS SRB, and Transfer Orbit Stage model surveys.

Titan IV Centaur Independent Verification and Validation: Project manager for developing independent models and analysis methods for verifying and validating structural dynamics and loads for the Centaur upper stage of the Titan IV launch vehicle.

Satellite Antenna: Determined modes and responses of antenna reflectors for the Spacenet and DBS communication satellites.

Airplane Flutter: Performed preliminary and detailed flutter analysis of the Piaggio P180 Avanti turboprop business airplane.

Mobile Command, Control, Communications, and Intelligence System: Analysis of shelter and equipment rack isolation systems to predict loads and deflections for nuclear, air transport, and road environments.

NASTRAN: Performed a variety of special developments in support of NASTRAN. Wrote several DMAP sequences to provide additional or improved results calculation. Taught basic class in NASTRAN analysis and advanced courses in DMAP, Superelement, and Rigid Formats. Investigated accuracy of Superelement methods for dynamic analysis.

Spacecraft: Performed transient analyses for the International Solar Polar Mission and Galileo spacecraft combined to the STS/Centaur vehicle.

Launch Vehicles: Implemented modern mode synthesis methods and analysis procedures for the Atlas launch vehicle. Developed several interface programs to integrate NASTRAN to special purpose programs. Performed gust response analysis for the Atlas/NDS-6 mission and system modes calculation for the Atlas/DMSP program. Developed residual flexibility approach for liftoff analysis of Commercial Titan launch vehicles. Performed IV&V loads analysis for Intelsat VI and Skynet/JCSat satellites.

Deployable Space Structure: Calculated modes and dynamic response of a 100 meter deployable beam attached to the Space Shuttle.



RIM Data Base: Developed a variety of applications using the Relational Information Manager data base system from the NASA IPAD project. Interfaced RIM to NASTRAN for the storage and manipulation of modal and transient analysis results.

Large Space Structures: Investigated dynamic characteristics of large space structures up to 1000 meters in length.

Cruise Missiles: Performed a variety of dynamic response analyses for the Sea-and-Ground-Launched cruise missiles. Analyses included shock response aboard submarines and surface ships; deployment trajectories and loads for the parachute recovery system; flutter analysis of a composite material wing; and shock and vibration response for the missile launchers (surface-, ship-, and ground-launched versions).

Custom Software: Developed several custom software programs for modal transient analysis (EZTRAN), hydroelastic analysis (HYDRO), data recovery matrices (DRM), test-analysis models (TAMTOOLS), test-analysis correlation (CORDS), and analysis postprocessing (STUMP).

Awards

MCP Team Achievement Award, Hughes Space and Communications Company, 1996.

Services Excellence Award, Structural Dynamics Research Corporation, WRO ATA, 1996.

Outstanding Contribution to AIAA National Level, AIAA San Diego Section, 1994.

Honorable Mention, Technical Paper, 1992 MSC World Users Conference, May 18-22, 1992.

Honorable Mention, Paper Presentation, 1991 MSC World Users Conference, March 11-15, 1991.

Best Technical Paper, SDRC Technology Conference, July 18-20, 1990.

Best Technical Paper, 1990 MSC World Users Conference, March 26-30, 1990, Los Angeles, California.

1982-1983 Young Engineer of the Year, AIAA San Diego Section.

Affiliations

Senior member, American Institute for Aeronautics and Astronautics (AIAA)

Member, Society for Experimental Mechanics (SEM)



Publications

Flanigan, C.C., "Role of Structural Analysis for *SpaceShipOne* and the Ansari X-Prize," 2006 Spacecraft and Launch Vehicle Dynamic Environments Workshop.

Flanigan, C.C., and Stabb, M.C., "An Assessment of MSC.NASTRAN Residual Vector Methodology for Dynamic Loads Analysis," 18th International Modal Analysis Conference, San Antonio, Texas, February 7-10, 2000.

Flanigan, C.C., "Modal Testing Basics: FEM for the Test Engineer," 18th International Modal Analysis Conference, San Antonio, Texas, February 7-10, 2000.

Flanigan, C.C., and Nielsen, D., "Updated Dynamic Analysis Methods for the Space Shuttle Solid Rocket Motor," 1999 MSC.NASTRAN World Users Conference, Long Beach, California.

Flanigan, C.C., "Status and Future Outlook of Correlation and Model Updating," keynote address for the 16th SEM International Modal Analysis Conference, Santa Barbara, California. February 2-5, 1998.

Flanigan, C.C., "Model Reduction Using Guyan, IRS, And Dynamic Methods," 16th International Modal Analysis Conference, Santa Barbara, California, February 2-5, 1998.

Flanigan, C.C., and Stabb, M.C., "Aeroelastic Design and Analysis of Winged Launch Vehicles," AIAA 96-1230, AIAA Dynamics Specialists Conference, Salt Lake City, Utah, April 18-19, 1996.

Flanigan, C.C., and Stabb, M.C., "Comparison of Automated Methods for Optimum Accelerometer Selection," 13th International Modal Analysis Conference, Detroit, Michigan, February 12-15, 1995.

Flanigan, C.C., "Accurate Enforced Motion Analysis Using MSC/NASTRAN Superelements," 1994 MSC/NASTRAN World Users Conference, Orlando, Florida, June 20-24, 1994.

Flanigan, C., and J. Freymiller, "Using Dynamic Expansion to Improve Test-Analysis Correlation," 12th International Modal Analysis Conference, Honolulu, Hawaii, January 31-February 3, 1994.

Flanigan, C., and D. Hunt, "Integration of Pretest Analysis and Model Correlation Methods for Modal Surveys," 11th International Modal Analysis Conference, Kissimmee, Florida, February 1-4, 1993.

Flanigan, C., J. Habermeyer, and D. Hunt, "Test and Analysis Challenges for Large Space Structures," IAF-92-0316, 43rd Congress of the International Astronautical Federation, Washington, D.C., August 28-September 5, 1992.

Flanigan, C.C., "Hydroelastic Analysis of Incompressible Fluids Using SDRC I-DEAS and MSC/NASTRAN," 1992 MSC/NASTRAN World Users Conference, Dearborn, Michigan, May 18-22, 1992.

Flanigan, C., A. Abdallah, and R. Manella, "Implementation of the Benfield-Hruda Modal Synthesis Method in MSC/NASTRAN," 1992 MSC/NASTRAN World Users Conference, Dearborn, Michigan, May 18-22, 1992.

Flanigan, C., and D. Botos, "Automated Selection of Accelerometer Locations for Modal Survey Tests," 10th International Modal Analysis Conference, San Diego, California, February 3-6, 1992.

Kammer, D.C., and C.C. Flanigan, "Development of Test-Analysis Models for Large Space Structures Using Substructure Representations," Journal of Spacecraft and Rockets, March-April, 1991, Volume 28, Number 2, pp. 244-250.

Freed, A.M., C.C. Flanigan, "A Comparison of Test-Analysis Model Reduction Methods," 8th International Modal Analysis Conference, Orlando, Florida, January 29 - February 1, 1990.

Flanigan, C.C., "A Residual Flexibility Approach to Launch Vehicle Liftoff Loads Analysis," AIAA 89-1336, 30th AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Mobile, Alabama, April, 1989.

Flanigan, C.C., "Correlation of Finite Element Models Using Mode Shape Design Sensitivity," 9th International Modal Analysis Conference, Firenze, Italy, April 15-18 1991.

Flanigan, C.C., "Development of the IRS Component Dynamic Reduction Method for Substructure Analysis," AIAA 89-1336, 32nd AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics, and Materials Conference, Baltimore, MD, April 8-10, 1991.

Flanigan, C.C., "Advanced Coupled Loads Analysis Using MSC/NASTRAN," 1991 MSC/NASTRAN World Users Conference, Los Angeles, California, March 11-15, 1991.

Flanigan, C.C., "Implementation of the IRS Dynamic Reduction Method in MSC/NASTRAN," 1990 MSC/NASTRAN World Users Conference, Los Angeles, California, March 26-30, 1990.

Flanigan, C.C., "Efficient and Accurate Procedures for Calculating Data Recovery Matrices," 1989 MSC/NASTRAN World Users Conference, Los Angeles, California, March 13-17, 1989.

Brillhart, R.D., D.L. Hunt, C.C. Flanigan, R. Guinn, R. Hull, "Transfer Orbit Stage Modal Survey - Model Correlation," 7th International Modal Analysis Conference, Las Vegas, Nevada, January 30 - February 2, 1989.

Brillhart, R.D., D.L. Hunt, C.C. Flanigan, R. Guinn, R. Hull, "Transfer Orbit Stage Modal Survey - Measurement of Free-free Modes and Residual Flexibility," 7th International Modal Analysis Conference, Las Vegas, Nevada, January 30 - February 2, 1989.

Flanigan, C.C., "Test-Analysis Correlation Using Design Sensitivity and Optimization - Does It Work?" Society of Automotive Engineers, SAE Technical Paper Series 881531, Aerospace Technology Conference and Exposition, Anaheim, California, October 3-6, 1988.



Flanigan, C.C., "Accurate and Efficient Mode Acceleration Data Recovery for Superelement Models," 1988 MSC/NASTRAN World Users Conference, Los Angeles, California, March, 1988.

Flanigan, C.C., "Test-Analysis Correlation Using Design Sensitivity and Optimization," Society of Automotive Engineers, SAE Technical Paper Series 871743, Aerospace Technology Conference and Exposition, Long Beach, California, October 5-8, 1987.

Flanigan, C.C., "Test-Analysis Correlation of the STS Centaur Using Design Sensitivity and Optimization Methods," 5th International Modal Analysis Conference, London, England, April, 1987.

Kammer, D.C., C.C. Flanigan, W. Dreyer, "A Superelement Approach to Test-Approach Model Development," 4th International Modal Analysis Conference, Los Angeles, California, February 3-6, 1986.

Flanigan, C.C., "An Alternate Method for Mode Acceleration Data Recovery in MSC/NASTRAN," 1981 MSC/NASTRAN World Users Conference, Los Angeles, California, March, 1981.

Flanigan, C.C., "Methods for Calculating and Using Modal Initial Conditions in MSC/NASTRAN," 1980 MSC/NASTRAN World Users Conference, Los Angeles, California, March 1980.

Last updated on January 18, 2008

