

ANDERSON, WILLIAM J.

PROFESSOR
AEROSPACE ENGINEERING
THE UNIVERSITY OF MICHIGAN

EDUCATION

Ph. D.	Aeronautics	Caltech	1963
M. S.	Aeronautical Engineering	Iowa State University	1958
B. S.	Aeronautical Engineering	Iowa State University	1957

EMPLOYMENT

Professor, Aerospace Engineering Dept., University of Michigan, 1965- present
Founder and President , Automated Analysis Corporation, Ann Arbor, MI 1982-present
Founder and President, Online Training, Inc., Ann Arbor, MI 1994-present
1st Lt., United States Air Force, Wright-Patterson AFB, OH, 1962-1965
Aerospace Engineer, Boeing Airplane Co., Seattle, Summer, 1957
Jr. Engineer, Chance Vought Aircraft, Dallas, Summers, 1954, 55, 56

EXPERIENCE

Prof. Anderson has spent his technical career in teaching and doing research on structural dynamics. He has been interested in combined fluid/solid problems since his early aeroelasticity work with Prof. Y. C. Fung at Caltech on panel flutter. In recent years, Prof. Anderson has worked with optimization, particularly in frequency and mode shape control. He has been interested in the dynamics of balloons, and has served on the NASA Technical Review Committee for Wallops Islands Balloon Projects Branch.

Following his Ph. D. degree from Caltech, Prof. Anderson served three years as a 1/Lt at the Air Force Aerospace Research Laboratories, at Wright-Patterson AFB. At the time, this laboratory was the top research facility for structures and fluid mechanics in the Air Force. (It has since been combined with the Flight Dynamics Laboratory). His work was on the flutter of thin-skinned cylinders, typical of the ICBM's of that era. He did both theory and experiment. His wind tunnel tests were carried out at the 2 foot supersonic tunnel at Wright-Patterson AFB.

Prof. Anderson joined The University of Michigan Aerospace Dept. in 1965, and has been a professor there since. The department is a traditional Aerospace department with options in structures, fluid dynamics, propulsion, flight mechanics, control and design. Prof. Anderson has written approximately 50 journal articles, and has collaborated with other professors in the fluids and flight mechanics areas in about 1/4 of these.

Dr. Anderson consulted with Brooks & Perkins Corp. in Livonia Michigan, the world's largest pallet maker for air drop, from approximately 1978-1983 on problems of cargo-

handling systems in the C-130 aircraft. He worked on pallet design and floor roller systems and took part in tests that certified the structural integrity of the C-130 floor after modification for the cargo delivery system.

Current research topics of interest to Prof. Anderson include the dynamics of high-altitude balloons (including added mass effects), optimization of structures, control of natural frequencies and modes, and aeroelastic mode tracking.

Prof. Anderson, working with Israel Taback of NASA, explained for the first time an unusual form of balloon oscillation, called "stair-stepping" three years ago. By comparing the buoyant frequency of a zero-pressure, helium-filled balloon with the Vaisalla-Brunt frequencies (clear air vibrations), he found a coincidence in frequency starting at the tropopause. This was precisely the altitude at which the oscillations started, and showed the resonant character of the motion.

The question of added mass is important in balloon oscillations, and caused Prof. Anderson to pioneer in the use of acoustics to calculate the added mass. The problem is solved as a coupled vibration problem of a balloon moving (as a rigid body) in the acoustic field of air surrounding it. An eigenvalue problem is solved, and the inertia terms associated with the air become the added mass. This method will be useful in parachute problems with complex shapes, because the boundary element acoustic method can model such complex shapes, whereas classical methods fail.

Dr. Anderson has had industrial experience through summer jobs and the founding of corporations. He founded Automated Analysis Corporation in 1982, a numerical analysis company which employed 300 people in 4 states and had revenues of \$21 M/yr. This company is well known for simulation of mechanical and fluid systems and marketed the COMET series of boundary element and acoustic codes. Dr. Anderson founded a second company in 1994, Online Training, Inc., to exploit a new invention in the multimedia area. He and his son worked out a way to present lectures on compact discs wherein the figures can be annotated with sketches, equations, etc. three lecture series have been released, covering the finite element courses taught by Prof. Anderson at The University.

PROFESSIONAL AND HONOR SOCIETIES

Senior Member, American Institute of Aeronautics and Astronautics, 1957-present

Member, Society for Applied Mechanics, 1985-present

Member, American Textbook Authors Association, 1990-present

Member, Sigma Xi, 1962-present

Member, Phi Kappa Phi, 1958-present

Member, Tau Beta Pi, 1956-present

Member, Sigma Gamma Tau, 1956-present

Member, Scabbard and Blade, 1956-57

Member, Arnold Air Society, 1956-57

PUBLICATIONS

"Added Mass of High-Altitude Balloons," coauthor, AIAA International Balloon Technology Conference, Albuquerque, Oct 8-10, 1991. *AIAA Journal of Aircraft*, in print.

"Wing Mass Formula for Twin Fuselage Aircraft," coauthor, *Journal of Aircraft*, Sept./Oct., 1992, pp. 907-914.

"Higher Order Eigenpair Perturbations," coauthor, *AIAA Journal*, July, 1992.

"Improvement of Normalization Methods for Eigenvector Derivatives," coauthor, *AIAA Journal*, June, 1992.

"Wing Mass Formula for Subsonic Aircraft," coauthor, Technical Note, *Journal of Aircraft*, July/Aug, 1992.

"Reduction of Contact Stress by use of Relief Notches," coauthor, *Experimental Mechanics*, September, 1991.

"Structural Optimization Incorporating Centrifugal and Coriolis Effects," coauthor, *AIAA Journal*, October, 1991, pp. 1743-1750.

"Structural Optimization including Centrifugal Effects," coauthor, *Finite Elements in Analysis and Design*, May, 1991.

"Oscillation of High Altitude Balloons," coauthor, Technical Note. *Journal of Aircraft*, September, 1991.

"An Experimental Study of Stress Singularities at a Sharp Corner in a Contact Problem," coauthor, *Experimental Mechanics*, Sept. 1990.

"Transmission Line Interpretation of the Finite Element Mesh for a Wave Propagation Problem," coauthor, *International Journal for Numerical Methods in Engineering*, Vol. 21, 1985.

"Finite Element Solution for Electromagnetic Scattering from Two-Dimensional Bodies," coauthor, *International Journal for Numerical Methods in Engineering*, Vol. 21.

"Generalized Dynamic Reduction in Finite Element Dynamic Optimization," coauthor, *AIAA Journal*, Vol. 22, No. 11, November 1984 pp. 1616-1617.

"Inverse Perturbation Method for Structural Redesign with Frequency and Mode Shape Constraints," coauthor, *AIAA Journal*, Vol. 22, No. 9, September, 1984.

"Nonlinear Inverse Perturbation Methods in Dynamic Analysis," coauthor, *AIAA Journal*, Vol. 21, No. 9, Sept. 1983, pp. 1310-1316.

"Nonlinear Inverse Perturbation Methods in Dynamic Redesign," coauthor, Proceedings of Conference on Finite Element Methods and Technology, Pasadena, CA, March, 1983.

"Inflight Aircraft Vibration Modes and their Effect on Aircraft Radar Cross-Section," coauthor, *Journal of Aircraft*, Vol. 18, No. 3, March 1981 (Technical Note).

"Nonlinear Vibrations of Three-Layer Beams with Viscoelastic Cores, II: Experiment," coauthor, *Journal of Sound and Vibration*, Vol. 60, No. 4, October 1978.

"Equations for Nonlinear, Nonplanar Motions of Buckled Beams," coauthor, *Journal of Sound and Vibration*, Vol. 58, June 1978.

"An Electromagnetic Forcing Device," coauthor, *Experimental Mechanics*, Vol. 18, No. 5, May 1978.

"Equilibrium and Stability of a Whirling Rod-Mass System," coauthor, *International Journal of Nonlinear Mechanics*, Vol. 12, July 1977.

"An Experimental Study of the Large Deformation of Plastic Hinges," coauthor, *International Journal of Solids and Structures*, Vol. 13, 1977.

"Equilibrium and Stability of a Circularly Towed Cable Subject to Aerodynamic Drag," coauthor, *Journal of Aircraft*, Vol. 14, No. 7, July 1977.

"Nonlinear vibrations of three-layer beams with viscoelastic cores, I: Theory," coauthor, *Journal of Sound and Vibration*, Vol. 46, No. 1, May 1976.

"Nonlinear Vibrations of Three Layer Beams," coauthor, *Proceedings of Fifth Canadian Congress of Applied Mechanics*, May 26, 1975.

"Human Power Production in a Caged Situation," coauthor, *Journal of Aircraft*, Vol. 13, No. 6, February 1976.

"Dynamic Instability of a Cable in Incompressible Flow," *AIAA Journal*, Vol. 11, May 1973.

"Forced Nonlinear Vibrations of a Damped Sandwich Beam," coauthor, *Journal of Sound and Vibration* (British), Vol. 17, No. 1, 1971.

"Eigenvalue Errors in the Method of Weighted Residuals," coauthor, *AIAA Journal*, Vol. 8, November 1970.

"Engineering Estimates For Supersonic flutter of Curved Shell Segments," coauthor, *AIAA Journal*, Vol. 8, 1970.

"Membrane Flutter Paradox - an Explanation by Singular Perturbation Methods," coauthor, *AIAA Journal*, Vol. 7, No. 9, September 1969.

"Supersonic Wind Tunnel Tests of Wavy-Walled Cylinders," *AIAA Journal*, Technical Note, Vol. 5, No. 3, March 1967.

"Oscillatory Pressures in an Idealized Boundary Layer with Application to Cylinder Flutter," *AIAA Journal*, Vol. 4, No. 5, May 1966.

CONFERENCE PROCEEDINGS

"Geometric Optimization in the Presence of Singularities," coauthor, 35th *AIAA/ASME/ASCE/AHS/ASC Structures, Structural Dynamics and Materials Conference*, Hilton Head, SC, Vol. 1, April, 1994.

"Numerical Analysis Concepts for Balloons," coauthor, *AIAA 32nd Aerospace Sciences Meeting & Exhibit*, Reno, NV, January 1994.

Application of Geometric Strain Method to Shape Optimization of Spring Retainer," *Proceedings of First International Conference on Computer Aided Design of Structures*, Southampton, UK, June, 1989.

"Linked Region Variable Technique in Structural Optimization, coauthor, "Proceedings of the *Seventh International Conference on Vehicle Structural Mechanics*, Detroit, MI, April 1988.

"Mode Shape and Frequency Analysis of a Turbine Blade Incorporating Centrifugal Effects," Proceedings of 1988 MSC/NASTRAN User's Conference, Los Angeles, March 1988.

"Use of Inertia Relief with Reflective Symmetry" coauthor, *Proceedings of 1988 MSC/NASTRAN User's Conference*, Los Angeles, March 1988.

"Large-Scale Education in Finite Element Methods," *Proceedings of the ASME pressure Vessel and Piping Conference*, New Orleans, LA, June, 1985.

"Modal Perturbation Methods for Marine Structures," coauthor *Proceedings of 90th Annual Meeting of the Society of Naval Architects and Marine Engineers*, New York, November 17-20, 1982.

"MSC/NASTRAN at The University of Michigan," *Proceedings of Conference on Finite Element Methods and Technology*, Pasadena, CA, March, 1982.

"Dynamic Validation of a Computer Simulation for Vehicle Crash," coauthor, *Proceedings of Second International Conference on Vehicle Structural Mechanics*, Southfield, Michigan April 1977.

"Whirling Cable Subjected to Viscous Drag," coauthor, 1974 International Conference on Finite Element Methods in Engineering, Sydney, Australia, August, 1974.

"Human Power Production in a Caged Situation," Proceedings of AIAA/MIT/SSA Second International Symposium on the Technology and Science of Low Speed and Motorless Flight}, Cambridge, MA, September 1974.

"Aeroelastic Stability of Plates and Cylinders," *Proceedings of the Eighth Annual Southeastern Conference of Theoretical and Applied Mechanics*, New Orleans, November 1969, Pergamon Press, New York (1970).

BOOKS, MULTIMEDIA AND VIDEO LECTURE SERIES

"Linear, Static Finite Element Analysis," A thirty hour multimedia lecture series on compact discs, Automated Analysis Corp., Ann Arbor, MI, 1994.

"Cyclic Symmetry," A ten hour video lecture series on tape, MacNeal-Schwendler Corp., Los Angeles, 1989.

"Design Sensitivities and Optimization," A twelve hour video lecture series on tape, MacNeal-Schwendler Corp., Los Angeles, 1986.

"Finite Elements in Mechanical and Structural Design: Dynamics and Nonlinear Analysis," A thirty hour video lecture series on tape, MacNeal-Schwendler Corp., Los Angeles, 1984.

"Linear Static Finite Element Analysis," A thirty hour video lecture series on tape, MacNeal-Schwendler Corp., Los Angeles, 1984.

MSC/NASTRAN Interactive Training Manual, John Wiley & Sons, NY, 1984.