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DEGREES

B.S., Aeronautical Engineering, Georgia Tech., 1955.

M.S., Aeronautical Engineering, Georgia Tech., 1956.

Ph.D., Aeronautics and Mathematics, Caltech., 1961.

PROFESSIONAL EMPLOYMENT

Professor of Applied Mathematics and Aeronautics & Astronautics, University of Washington, 1976-present.

Acting Chairman, Department of Applied Mathematics, University of Washington, 1986-1987, 1988-1990.

Professor of Aeronautics and Astronautics, University of Washington, 1971-present.

Associate Professor of Aeronautics & Astronautics, University of Washington, 1966-1971.

Assistant Professor of Aeronautics & Astronautics, University of Washington, 1964-1966.

Research Fellow in Aeronautics, Caltech, 1961-1964.

Aerodynamicist, Convair, Fort Worth, Texas, 1956-1957.

VISITING APPOINTMENTS

Fulbright-Hayes Visiting Lecturer in Applied Mathematics and Fluid Mechanics, Ecole Nationale Supérieure de Techniques Avancées and Ecole Polytechnique, Paris, 1975-1976.

Visiting Professor, Department of Theoretical Mechanics, University of Paris VI, 1971-1972.

CONSULTING

Los Alamos National Laboratory, Los Alamos, NM, 1974-1985.

Flow Research, Kent, Washington 1978-1980.

Mathematical Sciences Northwest, Bellevue, Washington 1974-1977.

McDonnell-Douglas Astronautics Company, Huntington Beach, California 1964-1974.

Douglas Aircraft Company, Santa Monica and Long Beach, California 1958-1964.

Ph.D. STUDENTS

D. Yong (2000)

L. Wang (1995)

M. Pernarowski (1990)

D.L. Bosley (1989)

R. Srinivasan (1989)

J. Yu (1988)

Y.P. Li (1987)

H.K. Li (1984)

C.L. Fenzen (1982)

J.M. Chapman (1977)

G. Pechuzal (1975)

S.C. Chikwendu (1971)

L.W. Mohn (1969)

J.E. Lancaster (1968)

RESEARCH INTERESTS

Development and application of perturbation techniques in nonlinear problems.

BOOKS & MONOGRAPHS

First Order Partial Differential Equations, in Handbook on Applied Mathematics, ed. by C.E. Pearson, Van Nostrand, 1974.

Perturbation Methods in Applied Mathematics, (with J.D. Cole), Springer-Verlag, 1981.

[*Partial Differential Equations: Analytical Solution Techniques*](#), Wadsworth/Brooks-Cole, 1990, Chapman & Hall, 1993.

[*Multiple Scale and Singular Perturbation Methods*](#), (with J.D. Cole), Springer-Verlag, 1996.

[*Partial Differential Equations: Analytical Solution Techniques, 2nd Edition, Springer-Verlag, 2000.*](#)

REFEREED ARTICLES

"Uniformly valid asymptotic representation for all times of the motion of a satellite in the vicinity of the smaller body in the restricted three-body problem," *Astron. J.*, **67**, pp. 204-211, 1962.

"Matched conic approximation to the two fixed force-center problem," (with P.A. Lagerstrom), *Astron. J.*, **68**, pp. 84-92, 1963.

"Earth-to-Moon trajectories in the restricted three-body problem," (with P.A. Lagerstrom), *J. Mécanique*, **2**, pp. 189-218, 1963.

"Comment on satellite motion about an oblate planet," (with J.F. Murphy), *AIAA J.*, **1**, pp. 1710-1711, 1963.

"Earth-to Moon trajectories with minimal energy," (with P.A. Lagerstrom), *J. Mécanique*, **2**, pp. 493-504, 1963.

"Nonplanar Earth-to Moon trajectories," (with P.A. Lagerstrom), *AIAA J.*, **4**, pp. 149-152, 1966.

"Satellite motion for arbitrary eccentricity and inclination around the smaller primary in the restricted three-body problem," (with M.C. Eckstein and Y.Y. Shi), *Astron. J.*, **71**, pp. 248-263, 1966.

"Use of the energy integral to evaluate higher-order terms in the time-history of satellite motion," (with M.C. Eckstein and Y.Y. Shi), *Astron. J.*, **71**, pp. 301-305, 1966.

"The von Zeipel method and the two-variable expansion procedure," *Astron. J.*, **71**, pp. 878-885, 1966.

"Some limiting cases of the restricted four-body problem," (with L. Mohn), *Astron. J.*, **72**, pp. 959-963, 1967.

"Nonplanar Moon-to-Earth trajectories," (with J.E. Lancaster), *AIAA J.*, **6**, pp. 1986-1991, 1968.

"An asymptotic solution for a class of periodic orbits of the restricted three-body problem," (with J.E. Lancaster), *Astron. J.*, **73**, pp. 791-806, 1968.

"Numerical analysis of the asymptotic solution for Earth-to-Moon trajectories," (with G. Brachet), *AIAA J.*, **7**, pp. 885-889, 1969.

"Passage through resonance for a one-dimensional oscillator with slowly varying frequency," *SIAM J. Appl. Math.*, **20**, pp. 364-373, 1971.

"A perturbation method for hyperbolic equations with small nonlinearities," (with S.C. Chikwendu), *SIAM J. Appl. Math.*, **22**, pp. 235-258, 1972.

"On a model for reentry roll resonance," *SIAM J. Appl. Math.*, **26**, pp. 638-669, 1974.

"Supersonic-transonic flow generated by a thin airfoil in a stratified atmosphere," (with G. Pechuzal), *SIAM J. Appl. Math.*, **33**, pp. 8-33, 1977.

"Propagation of a laser beam in a time-varying waveguide," (with J.M. Chapman), *J. Appl. Phys.*, **49**, pp. 4722-4736, 1978.

"On the problem of sustained resonance," (with L. Lewin), *SIAM J. Appl. Math.*, **35**, pp. 738-754, 1978.

"Resonance in a weakly nonlinear system with slowly varying parameters," *Stud. Appl. Math.*, **62**, pp. 23-67, 1980.

"Adiabatic invariance and passage through resonance for nearly periodic Hamiltonian systems," *Stud. Appl. Math.*, **66**, pp. 95-119, 1982.

"Resonant modal interactions and adiabatic invariance for a nonlinear wave equation in a variable domain," (with H.K. Li), *Stud. Appl. Math.*, **71**, pp. 1-64, 1984.

"A review of the multiple scale and reductive perturbation methods for deriving uncoupled nonlinear evolution equations," (with C.L. Frenzen), *Wave Motion*, **7**, pp. 25-42, 1985.

"Perturbation techniques for oscillatory systems with slowly varying parameters," *SIAM Rev.*, **29**, pp. 391-461, 1987.

"Explicit Approximations for strictly nonlinear oscillators with slowly varying parameters with applications to free-electron lasers," (with Y.P. Li), *Stud. Appl. Math.*, **78**, pp. 111-165, 1988.

"The effects of wiggler taper rate and signal field gain rate in free-electron lasers," (with Y.P. Li), *IEEE J. Quantum Electron.*, **24**, pp. 598-608, 1988.

"Passage through the critical Froude number for shallow water waves over a variable bottom," (with J. Yu), *J. Fluid Mech.*, **204**, pp. 31-56, 1989.

"Sustained resonance in very slowly varying oscillatory Hamiltonian systems," (with D.L. Bosley), *SIAM J. Appl. Math.*, **51**, pp. 439-471, 1991.

"Free-electron lasers with very slow wiggler taper," (with D.L. Bosley), *IEEE J. Quantum Electron.*, **27**, pp. 1078-1089, 1991.

"Adiabatic invariance and transient resonance in very slowly varying oscillatory Hamiltonian systems," (with D.L. Bosley), *SIAM J. Appl. Math.*, **52**, pp. 494-527, 1992.

"Perturbation techniques for models of bursting electrical activity in pancreatic beta-cells," (with M. Pernarowski and R.M. Miura), *SIAM J. Appl. Math.*, **52**, pp. 1627-1650, 1992.

"Nonlinear evolution of small disturbances into roll waves in an inclined open channel," (with J. Yu), *J. Fluid Mech.*, **243**, pp. 575-594, 1992.

"The interaction of a strong bore with small disturbances in shallow water," (with J. Yu), *Stud. Appl. Math.*, **91**, pp. 247-273, 1994.

"Weakly nonlinear waves for a class of linearly unstable hyperbolic conservation laws," (with J. Yu and L. Wang), *SIAM J. Appl. Math.*, **55**, pp. 446-484, 1995.

"On the asymptotic solution of non-Hamiltonian systems exhibiting sustained resonance," (with D.L. Bosley), *Stud. Appl. Math.*, **94**, pp. 83-130, 1995.

"Asymptotic analysis of a class of three-degree-of-freedom Hamiltonian systems near stable equilibria," (with L. Wang and D.L. Bosley), *Physica D*, **88**, pp. 87-115, 1995.

"Asymptotic electron trajectories and an adiabatic invariant for a helical-wiggler free electron laser with weak self-fields," (with L. Wang), *Phys. Plasmas*, **3**, pp. 1162-1175, 1996.

"An asymptotic analysis of the 1:3:4 Hamiltonian normal form," (with L. Wang and D.L. Bosley), *Physica D*, **99**, pp. 1-17, 1996.

"Multiple-scale homogenization for weakly nonlinear conservation laws with rapid spatial fluctuations," (with D.L. Bosley), *Stud. Appl. Math.*, **101**, pp. 127-183, 1998.

"Weak nonlinear long waves in channel flow with internal dissipation," (with J. Yu and R. Haberman), *Stud. Appl. Math.*, **105**, pp. 143-163, 2000.

"Uniformly valid asymptotic approximation for certain nonlinear differential equations," (with J.D. Cole), *Proceedings of International Symposium on Nonlinear Differential Equations and Nonlinear Mechanics*, Academic Press, pp. 113-120, 1963.

"Numerical aspects of uniformly valid asymptotic approximations for a class of trajectories in the restricted three-body problem," (with P.A. Lagerstrom), *Celestial Mechanics and Astrodynamics*, AIAA, *Progress in Astronautics and Aeronautics Series*, **14**, pp. 3-33, 1964.

"The two-variable expansion procedure for the approximate solution of certain nonlinear differential equations," *Lectures in Applied Mathematics*, **7**, *Space Mathematics, Part III*, American Mathematical Society, pp. 206-275, 1966.

"A uniformly valid asymptotic representation of satellite motion around the smaller primary in the restricted three-body problem," (with M.C. Eckstein and Y.Y. Shi), *Methods in Astrodynamics and Celestial Mechanics*, AIAA, *Progress in Aeronautics and Astronautics Series*, **17**, pp. 183-198, 1966.

"Satellite motion for all inclinations around an oblate planet," (with M.C. Eckstein and Y.Y. Shi), *Symposium No. 25, IAU*, Academic Press, pp. 291-322, 1966.

"The planar motion of a Trojan asteroid," *Periodic Orbits, Stability and Resonances*, D. Reidel Publishing Company, pp. 286-303, 1970.

"Passage through resonance," *Singular Perturbations and Asymptotics*, Academic Press, pp. 191-222, 1980.

"The Sherman-Rinzel-Kizer model for bursting electrical activity in the pancreatic beta-cell," (with M. Pernarowski and R.M. Miura), *Differential Equation Models in Population Dynamics and Physiology*, Springer-Verlag, pp. 34-53, 1991.

"Weakly nonlinear conservation laws with source terms," *Mathematics Is for Solving Problems*, SIAM Publications, pp. 167-178, 1996.

"Normal component of induced velocity for entire field of a uniformly loaded lifting rotor with highly swept wake as determined by electromagnetic analog," (with W. Castles and H.L. Durham), National Advisory Committee for Aeronautics, Technical Report R-41, 1959.

"The two variable expansion procedure for the approximate solution of certain nonlinear differential equations," Douglas Aircraft Co., Santa Monica, CA, Report No. SM-42620, 1962.

"The motion of a radially deforming slender body of revolution in a perfect fluid," Ecole Nationale de Techniques Avancées, Paris, Report 070, 1976.

PROCEEDINGS

TECHNICAL REPORTS