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Professor of Mathematics

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**EDUCATION**

**Ph.D. in Applied Mathematics**, North Carolina State University, under the supervision of Prof. C.V. Pao, 1988.

**B. S. in Mathematics**, Huazhong University of Science and Technology, P. R. China, 1982.

**ACADEMIC APPOINTMENTS**

**Purdue University Calumet**, Department of Mathematics, Computer Science and Statistics

- Professor, 2001-present.
- Associate Professor, 1995-2001.
- Assistant Professor, 1993-1995.
- Visiting Assistant Professor, 1990-1993.

**RESEARCH INTERESTS**

**Partial differential equations**, including nonlinear parabolic and elliptic types, weakly or strongly coupled systems of semilinear, quasilinear, and/or degenerate types, hyperbolic type first order equations, especially those that are related to the conservation laws, Hamilton-Jacobi-Bellman equations

**Nonlinear analysis**, fixed point theory, bifurcation theory, and infinite-dimensional dynamical systems

**Mathematical models**, including reaction-diffusion models, Lotka-Volterra population models, blood flow models for human circulation systems, Einstein-Young/Mill's equations, sociological and political economy models

**Numerical methods for partial differential equations**, especially coupled nonlinear parabolic and elliptic equations, Navier-Stokes equations, and first order hyperbolic partial differential equations

**My current interests** are focused on mathematical analysis and numerical computation of (1) coupled systems of degenerate parabolic equations, (2) quasilinear hyperbolic equations that models blood flow in circulatory systems, and (3) sociological and political economy models

**PROFESSIONAL ACTIVITIES**

- Associate editor for *Journal of Applied Analysis and Computation*
- Reviewer for *Mathematical Reviews*
- Serve as an editor for the "Proceedings of the 10th AIMS Conference on Dynamical Systems" in 2014.
- Edited with C.V. Pao the special edition "Degenerate and Singular Parabolic and Elliptic Equations" of the International Journal of Dynamical Systems and Differential Equations, volume 4, no ½, 2012.
- Organized a session "Reaction Diffusion, Wave Propagation, and Mathematical Biology" with C.V. Pao and Wei Feng at the Fifth World Congress of Nonlinear Analysts (WCNA-2008) in Orlando Florida, July 2-9, 2008.
- Served as a consultant from 2002 to 2008 for VasSol, Inc., a medical technology company that develops computer softwares for simulating blood ow in the vascular environment. Contributions include established a mathematical just\_i\_cation of the underlying blood ow models, used in the company's technology, NOVA (Non-invasive Optimal Vessel Analysis), analyzed the numerical algorithm, and made comparison of this technology with an existing patented technology in the company's patent filing process.
- Participated in a research in the area of mathematical education conducted by Chris Rasmussen, which re-conceptualized and redeveloped a undergraduate differential equation course in an inquiry based approach. The research was a multi-year project funded by NSF. It resulted in a new design of the course

based on current theories of mathematical education. Contributions include serving as a professional expert on the project team on designing of the teaching materials and pilot testing the new course.

- Served in the Global Organizing Committee for the Third World Congress of Nonlinear Analysts in Catania, Italy, 2000, and organized a session “Nonlinear Evolution Equations and Applications in Biology” with Lu, Xin at the conference, July 19-26, 2000.

## PUBLICATIONS

1. “Markovian strategies with continuous and impulse controls for a differential game model of revolution,” to appear in *Journal of Mathematical Sociology*.
2. “Markovian strategies for piecewise deterministic differential games with continuous and impulse controls,” to appear in *Journal of Dynamics and Games*, 6, no. 4, 2019.
3. “Wavefront solutions of quasilinear reaction-diffusion systems with mixed quasi-monotonicity,” with Feng Wei and Xin Lu, *Applicable Analysis*, 98, no. 5, 934-968, 2019.
4. “Wavefront solutions of degenerate quasilinear reaction-diffusion systems with mixed quasi-monotonicity,” *Nonlinear Anal.* 182, 75-96, 2019.
5. “Dynamics of degenerate quasilinear reaction diffusion systems with nonnegative initial functions,” with C. V. Pao, *J. Differential Equations*, 263, no. 11, 7709-7752, 2017.
6. “On traveling wave solutions in general reaction-diffusion systems with time delays,” with Feng Wei and Xin Lu, *J. Math. Anal. Appl.* 448, no. 1, 376–400, 2017.
7. “A dynamical system model of a changing society” with J. Ruan, *Dynamic systems and applications*, Vol. 7, 203-210, *Dynamic, Atlanta, GA*, 2016.
8. “On existence of wavefront solutions in mixed monotone reaction-diffusion systems,” with Feng Wei and Xin Lu, *Discrete Contin. Dyn. Syst. Ser. B* 21, no. 3, 815–836, 2016.
9. “Existence and dynamics of quasilinear parabolic systems with time delays,” with C.V. Pao, *J. Differential Equations* 258, no. 9, 3248-3285, 2015.
10. “Quasilinear parabolic and elliptic systems with mixed quasimonotone functions,” with C.V. Pao, *J. Differential Equations* 255, no. 7, 1515–1553, 2013.
11. “Viscosity Solutions of a Class of Degenerate Quasilinear Parabolic Equations with Dirichlet Boundary Condition,” with C.V. Pao, *Nonlinear Analysis Series A: Theory, Methods & Applications*, 75, no. 7, 3292-3312, 2012.
12. “A hyperbolic system of conservation laws for fluid flows through compliant axisymmetric vessels,” with G.Q. Chen, *Acta Math. Sci. Ser. B Engl. Ed.* 30, no. 2, 391–427, 2010.
13. “Positive solutions of quasilinear parabolic systems with Dirichlet boundary condition,” with C.V. Pao, *J. Differential Equations* 248, no. 5, 1175–1211, 2010.
14. “Asymptotic behavior of solutions for a system of quasilinear reaction-diffusion equations,” with C. V. Pao, *Advances in nonlinear analysis: theory methods and applications*, 99–107, Math. Probl. Eng. Aerosp. Sci., 3, *Camb. Sci. Publ., Cambridge*, 2009.
15. “Dynamics of a quasilinear reaction diffusion equation with singular reaction functions” with C.V. Pao, *Can. Appl. Math. Q.* 16, no. 1, 95–108, 2008.
16. “Initial-boundary-value problem of hyperbolic equations for blood flow in a vessel,” with M.E. Clark, M. Zhao and A. Curcio, *Nonlinear Analysis: Real World Applications*, Vol. 9, pp. 2068-2085, 2008.
17. “A coupled system of ODEs and quasilinear hyperbolic PDEs arising in a multiscale blood flow model,” *J. Math. Anal. Appl.*, Vol. 343, pp. 778-798, 2008.
18. “Using theorems-as-tools: a case study of the uniqueness theorem in differential equations,” with Chris Rasmussen, to appear in *Making the Connection: Research and Teaching in Undergraduate Mathematics*, Carlson, M. & Rasmussen, C. Eds, 2008.
19. “Positive solutions of quasilinear parabolic systems with nonlinear boundary conditions,” with C.V. Pao, *J. Math. Anal. Appl.*, Vol. 333, pp. 472-499, 2007.
20. “Global Solution to a Hyperbolic Problem Arising in the Modeling of Blood Flow in Circulatory Systems,” with M.E. Clark, M. Zhao and A. Curcio, *J. Math. Anal. Appl.*, Vol. 331, pp. 1068-1092, 2007.
21. “A hyperbolic system modeling blood flow in a circulation network” *Dynamics of Continuous, Discrete and Impulsive Systems Series A: Mathematical Analysis* 13B, suppl., pp. 457—470, 2006.

22. “A quasilinear hyperbolic system that models blood flow in a network,” with M.E. Clark, M. Zhao and A. Curcio, in *Focus on Mathematical Physics Research*, pp. 203-230, ed. by Charles V. Benton, published by Nova Science Publishers, Inc., New York, 2004.
23. “Blood flow in a network,” with M.E. Clark, M. Zhao and A. Curcio, *Nonlinear Analysis: Real World Applications*, Vol. 5, pp. 463-485, 2004.
24. “A hyperbolic system of equations of blood flow in an arterial network,” with M.E. Clark, M. Zhao and A. Curcio, *SIAM J. Appl. Math.*, Vol. 64, pp. 637-667, 2003.
25. “The state space of perturbative quantum field theory in curved spacetimes,” with S. Hollands, *Ann. Henri Poincare*, Vol. 3, pp. 635-657, 2002.
26. “Existence of infinitely-many black holes in  $SU(3)$  Einstein-Yang-Mills theory,” Proceedings of the Third World Congress of Nonlinear Analysts, Part 9 (Catania, 2000). *Nonlinear Anal.* Vol. 47, pp. 6109—6119, 2001.
27. “Hairy black hole solutions to  $SU(3)$  Einstein-Yang-Mills equations,” *Comm. Math. Phys.* Vol. 224, pp. 373—397, 2001.
28. “A competing reaction-diffusion system with small cross-diffusions,” *Canadian Applied Mathematics Quarterly*, Vol. 7, pp. 69-91, 1999.
29. “Monotone iteration method for nonlinear degenerate parabolic equations,” *Nonlinear Analysis, Theory, Methods and Applications*, Vol. 34, pp. 37-63, 1998.
30. “Local average Liapunov functions and persistence in population dynamics,” *SIAM Journal on Mathematical Analysis*, Vol. 29, pp. 134-154, 1998.
31. “Persistence in population dynamics via local average Liapunov functions,” *Nonlinear Analysis*, Vol. 30, Proceedings for the Second World Congress of Nonlinear Analysis, pp. 3399-3407, 1997.
32. “Positive steady-state solutions of a competing reaction-diffusion system with large cross-diffusion coefficients,” *Journal of Mathematical Analysis and Applications*, Vol. 197, pp. 558-578, 1996.
33. “Multiple steady-state solutions of nonlinear parabolic system in convex invariant set,” *Nonlinear Analysis, Theory, Methods and Applications*, Vol. 26, pp. 1643-1654, 1996.
34. “A reaction-diffusion system arising in population genetics,” *Quarterly of Applied Mathematics*, Vol. 54, pp. 133-152, 1996.
35. “Coexistence, permanence and stability in a three species competition model,” with Feng, W., *Acta Mathematicae Applicatae Sinica*, Vol. 12, pp. 443-446, 1996.
36. “Convergence to constant states in a population genetic model with diffusion,” *Nonlinear Analysis, Theory, Methods and Applications*, Vol. 25, pp. 1159-1179, 1995.
37. “One-parameter family of invariant sets for non-weakly coupled nonlinear parabolic systems,” *Journal of Mathematical Analysis and Applications*, Vol. 189, pp. 763-780, 1995.
38. “Positive steady-state solutions of a competing reaction-diffusion system,” with C.V. Pao, *Journal of Differential Equations*, Vol. 117, pp. 411-427, 1995.
39. “On the fixed point index and multiple steady-state solutions of reaction-diffusion systems,” with Wei Feng, *Differential and Integral Equations*, Vol. 8, pp. 371-391, 1995.
40. “Asymptotic behavior and positive steady-state solutions of a reaction-diffusion model with autocatalysis and saturation law,” *Nonlinear Analysis, Theory, Methods and Applications*, Vol. 21, pp. 439-456, 1993.
41. “Asymptotic behavior and positive solutions of a chemical reaction diffusion system,” with C.V. Pao, *Journal of Mathematical Analysis and Applications*, Vol. 169, pp. 157-178, 1992.
42. “Bounded solutions for reaction-diffusion systems with nonlinear boundary conditions,” *Nonlinear Analysis, Theory, Methods and Applications*, Vol. 14, pp. 1051-1077, 1990.