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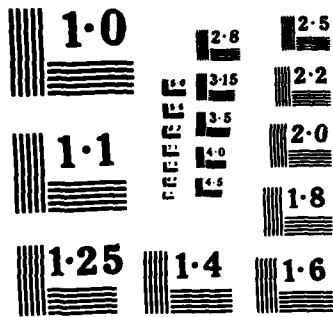
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FINAL REPORT ON AIR FORCE RESEARCH GRANT

During the period of this grant I wrote eleven research papers, edited one, major research symposium and supervised to completion the Ph.D.'s of two graduate students. My research was conducted on three main themes: First, explicit solution of a variety of nonlinear partial differential equations their integrability and the stability properties of such problems. In this area I wrote four major articles and found what I believe are major new approaches to this basic problem. I found a method to extend work in a finite degrees of freedom to infinite numbers in several space variables. This idea is reported on in papers [8], [10], and [11]. In addition, I extended my general notion of local analysis to more complicated stable singularity types (namely cusps) as reported in paper [7].

The second project that I studied involved new bifurcation phenomens as reported in papers [3], [12], and [9]. In paper [3] I showed how to introduce bifurcation in semiconductor device design quantitatively. In paper [9] I discuss bifurcation phenomena as they occur in classical mechanical systems describing periodic motions. In this way new computation methods discover new classes of periodic motions not previously known. Finally, in [12] I was able to carry out research on a new bifurcation phenomenon, nonlinear desingularization for type 2 superconductors. This work makes quantitative ideas which had previously been purely descriptive.

My third project describes constructive methods for im-

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plementing the calculus of variations for concrete physical problems. Papers [2], [5], and [6] are devoted to this topic and describe a whole new constructive point of view in calculating solutions for the relevant problem.

In addition to all this I organized and published a conference promoting new connections between mathematics and science and high technology in a nonlinear context based on the ideas of J.C. Maxwell. This was the first conference of its type and drew an enthusiastic reception that is having important ramifications in current research.

I supervised two Ph.D students to their Ph.D. degree with Dr. P. Costa currently working at MIT-Lincoln Labs and Dr. Yi Chen currently an assistant professor of math at Indiana University.

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2 Ph'D thesis

1. P. Casta
2. Y. Chen

Publications for AFOSR

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- (2) Berger, M.S., "Vortex Phenomena", Volume Studies in Global Analysis, Teubner Publishers, pp 34-42, 1983.
- (3) Berger, M.S., "Some Nonlinear Analytic Aspects of VLSI Semiconductor Device Modelling", IEEE Transactions on Electron Devices, Volume 30, pp. 1181-3, 1983.
- (4) Berger, M.S., "The Confinement Problem in Nonlinear Gauge Theories", The Maxwell Sesquicentennial Volume, pp. 179-184, 1984. North-Holland Publishers.
- (5) Berger, M.S., "New Ideas in the Calculus of Variations in the Large", College de France Seminar in Nonlinear Differential Equations, Volume VI, Pitman Advanced Publishing Program, pp. 106-127, 1984.
- (6) Berger, M.S., "Variational Principles for Equilibrium Figures of Fluids Without Symmetry Assumptions", Asterisque, pp. 125-135, 1985.
- (7) Berger, M.S., "Folds and Cusps in Banach Spaces, with Applications to Nonlinear Partial Differential Equations I", with P.T. Church and J. Timourian, Indiana University Mathematical Journal, Volume 34, pp. 1-19, 1985.
- (8) Berger, M.S., "Integrability of Nonlinear Differential Equations via Functional Analysis", to appear in Proc. of Symposium AMS on nonlinear differential equations, 1985.
- (9) Berger, M.S., "Global Aspects of Periodic Solutions for Nonlinear Conservative Systems", (to appear in Lecture Notes in Physics, Springer Verlag Volume Nonlinear Dynamical Systems), 1985.
- (10) Berger, M.S., "The Diagonalization of Nonlinear Differential Operators", to appear in Proc. of the Symposium AMS-SIAM on Nonlinear P.D.E. of Applied Math, 1986.
- (11) Berger, M.S., "Bifurcation and the Integration of Nonlinear Ordinary and Partial Differential Equations", (Chaos and Nonlinear Dynamics Symposium to be Published by World Scientific), 1986.
- (12) Berger, M.S., "Nonlinear Desingularization for Symmetric Vortices in the Ginsberg-Landau Equations", with Y.Y. Chen, submitted to Comm. Math Physics.

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