

November, 2015

## HOWARD A. LEVINE

Distinguished Professor of Liberal Arts and Sciences 1999

Full Member of Graduate Faculty: 1979

Born: January 15, 1942 in St. Paul, Minnesota

Phone: 515-294-8142 (Office); 515-233-4884 (Home)

Fax: 515-294-5454

E-Mail: halevine@iastate.edu

### Education

B.A.	University of Minnesota, Duluth	1964	Chemistry, Mathematics
M.A.	Cornell University	1967	Mathematics
Ph.D.	Cornell University	1969	Mathematics

### Honors and Awards

Outstanding Freshman Chemistry Award (Am. Chem. Soc.) 1960-61

Outstanding Freshman Mathematics Award 1960-61

Bachelor of Science Degree awarded Summa Cum Laude 1964

National Science Foundation Graduate Fellowship 1964 -1968

Sigma Xi Scientific Honorary Society 1983 -

Phi Kappa Phi Honorary Society 1985 -

Iowa State University Honors Program Teaching Recognition Award, 1998

Iowa State University Distinguished Professor of Liberal Arts and Sciences 1999 -

Listed in ISI Web of Knowledge among 250 most highly cited mathematicians from 2000-2010 (<http://highlycited.com/>)

Member, University of Minnesota, Duluth College of Science and Engineering Academy of Sciences, 2006 -

Elected a Fellow of the American Association for the Advancement of Science (AAAS), 2015 -  
"For outstanding contributions to partial differential equations in singularity formation, modeling angiogenesis, novel dynamical systems approach to exponential enrichment, and invigorating applied mathematics at ISU" (2015 AAAS Citation)

### Editorial Duties

Advisory (Associate) Editor, Mathematical Methods in the Applied Sciences(1990 -2001 ) (John Wiley and B. G. Teubner copublishers), then Managing Editor, (1/1/2002-12/31/2002)

Associate Editor, Journal of Mathematical Analysis and Applications (1995 - 2008)(Academic Press )

Associate Editor, Applicable Analysis (2002 - 2008)(Taylor & Francis (formerly Gordon and Breach) )

Associate Editor, Mathematical Biosciences and Engineering (2002 -)(AMIS)

Associate editor, Communications in Applied Analysis (1994 -)

Member, editorial board, Cancer Informatics(2005 -) Libertas Academica Ltd

### Professional Experience

Eidgenossische Technische Hochschule (Zurich), Akademischer Mitarbeiter

Sept. 1968 - Aug. 1969  
 University of Minnesota, Assistant Professor, 1969-73 (on leave 1971-73)  
 Battelle Inst. (Geneva), Research Fellow, July-Dec. 1971; July-Dec. 1972  
 Univ. of Dundee (Scotland), Symposium Participant, North British Symposium on Differential Equations, Jan.-June 1972  
 SUNY, Binghamton, Visiting Assistant Professor, Jan.-June 1973  
 Univ. of Rhode Island, Assistant Professor, 1973-75  
 Associate Professor, 1975-78  
 Iowa State University,  
 Associate Professor, 1978-80  
 Professor, 1980-99  
 Distinguished Professor, 1999 -  
 Departmental Executive Officer (Chairman), 1989-1992  
 Phased Retirement , September, 2005 to May, 2010.

### Faculty Improvement Leave (Sabbatical) Activities

1. (1/1/83-5/31/83)  
 Math. Sci. Res. Inst. (NSF-Berkeley) Member 1/1/83 - 3/31/83  
 Istituto Analisi Globali (CNR-Univ. of Florence, Italy) 4/1/83 - 5/31/83  
 (Travel and living expenses paid by both institutes)
2. (1/1/95-5/15/95) but see note below.  
 University of Dundee, Dundee, Scotland 6/12/94-7/13/94 and 7/26/94-8/26/94  
 IMA (University of Minnesota) 10/3/94-12/16/94 and 2/7/95-4/7/95.  
 Automoma University of Madrid, 1/5/95-1/19/95  
 University of Paris South, 1/20/95-1/26/95  
 Comenius University (Slovakia) 4/12/95-5/11/95  
 University of Cologne 5/12/95-5/18/95/newline  
 Note: In addition to the FIL award, I received a teaching buy-out and subsistence award from the Institute for Mathematics and Its Applications at Minnesota in the amount of \$15,000 and spent a second semester at IMA. Moreover, I received a supplemental grant of \$5000 from the National Science Foundation for the foreign travel for this leave. All the foreign host institutions listed above paid my local expenses and intra European travel expenses. I also received a supplemental international travel grant from the Science Research Council of Great Britain for my visit to Dundee.
3. (1/1/98-5/15/98)  
 Faculty Improvement Leave for Study in A second Discipline. I used this time to study with Alric Rothmayer (ISU) by helping him with a text he was writing on fluid dynamics and to visit Brian Sleeman (Leeds) to learn about angiogenesis in tumor growth. We put together a successful NSF application. The travel to and from Leeds was supported by our NATO grant.
4. (8/20/01-12/21/01)  
 Faculty Professional Development Assignment (Faculty Improvement Leave). I spent the semester as a participant in the mathematical biology program: From Individual to Collective Behavior at the Isaac Newton Institute of the University of Cambridge. I received stipend in lieu of local expenses for two months by the INI.  
 Note: In addition to the INI award, I was awarded an additional grant from the Engineering and Physical Science Research Council of Great Britain (Brian Sleeman was the P. I.) which provided travel and additional living expenses for two months.)
5. (8/20/01-12/21/01) Co-organized a workshop on angiogenesis at the Institute for Pure and Ap-

plied Mathematics, UCLA. Program on Cells and Materials: At the Interface between Mathematics, Biology and Engineering Workshop III: Angiogenesis, NeoVascularization and Morphogenesis, May 8 - 12, 2006 (Functioned as the chief local organizer.)

### Professional Societies

American Mathematical Society  
 Society for Mathematical Biology  
 Society of Industrial and Applied Mathematics  
 (President, Iowa Section, 1980 - 81)  
 Visiting Lectures Program 1982 - 1985 (This program was turned over to the MAA in 1986)  
 Mathematical Association of America Visiting Lecturer (1986 - present)

### Research Interests

Partial differential equations and their applications.

### Teaching

Year	Semester	Courses Taught	
1978-79	Fall	M120 Calculus	M322 Elem. Part. Diff. Eq.
	Winter	M121 Calculus	M406 Numerical Analysis
	Spring	M407 Numerical Analysis	
1979-80	Fall	M521B Meth. Appl. Math.	M690P Part. Diff. Equations
	Winter	M522B Meth. Appl. Math.	M690P Part. Diff. Equations
	Spring	M523B Meth. Appl. Math.	M690P Part. Diff. Equations
1980-81	Fall	M121 Calculus	M521B Meth. Appl. Math.
	Winter	M122 Calculus	M522B Meth. Appl. Math.
	Spring	M523B Meth. Appl. Math.	
1981-82	Fall	M426 Meth. Appl. Math.	M526 Meth. Appl. Math.
	Spring	M527 Meth. Appl. Math.	SHRI
	Summer	M165 Calculus	M471 Num. Lin. Alg.
1982-83	Fall	M166 Calculus	M471 Num. Lin. Alg.
	Spring	(Faculty Improvement Leave)	
	Summer	M507 Num. Soln. of Ord. Diff. Equations	
1983-84	Fall	M165 Calculus	M585 Part. Diff. Equations
	Spring	M265 Calculus	M586 Part. Diff. Equations
1984-85	Fall	M514 Real Analysis	(Grant Funded Research)
	Spring	M515 Real Analysis	SHRI
1985-86	Fall	M165 Calculus	M521 Meth. Appl. Math.
	Spring	(Grant Funded Research)	SHRI

1986-87	Fall Spring	M481 Num. Sol. Dif. Eq. (Grant Funded Research)	M521 Meth. Appl. Math. SHRI
1987-88	Fall Spring	M585 Part. Diff. Eq. M586 Part. Diff. Eq.	SHRI M166 Calculus
1988-89	Fall Spring	M507 Num. Soln. of ODE's M508 Num. Soln. of PDE's	M165 Calculus DEO Search Comm. Chr.
1992-93	Fall Spring	M266 Ord. Diff. Equns M473 Comp. Methods	M395 Compl. Var. for EE's M395 Compl. Var. forEE's
1993-94	Fall Spring	M151 Business Calc. (Lg. Lect.) M267 Ord. Diff. Equns.	M585 Partial Diff. Equns. M586 Partial Diff.
1994-95	Fall Spring	Faculty Improvement Leave Institute for Mathematics and its Applications teaching buyout	
1995-96	Fall Spring	M166H Honors Calculus II. M166 Calculus II.	M515 Real Analysis I M516 Real Analysis II
1996-97	Fall Spring	M265H Honors Calculus III. M166H Honors Calculus II.	M557 Ordinary Differential Equations I M558 Ordinary Differential Equations II
1997-98	Fall Spring	M265H Honors Calculus III. Provost FIL	M465 Advanced Calculus (Study in a Second Discipline)
1998-99	Fall Spring	M166H Honors Calculus II. M520X Meth. of Appl. Math.	M519X Meth. of Appl. Math. Departmental release time
1999-00	Fall Spring	M165 Calculus I (Lg. Lect.). M166 Calculus II (Lg. Lect.).	M385 Intro to Partial Differential Equations. Departmental release time
2000-01	Fall Spring	M165H Honors Calculus I. M166H Honors Calculus II.	M385 Intro to Partial Differential Equations. Departmental release time
2001-02	Fall Spring	Faculty Improvement Leave M266 Ordinary Differential Equations	Math Methods buyout
2002-03	Fall Spring	M265H Honors Calculus III M516 Real Analysis	M515 Real Analysis
2003-04	Fall Spring	On leave Mathematical Biosciences Inst (OSU) (teaching buyout) Math 511, Complex Analysis	
2004-05	Fall Spring	Math 519 Methods of Applied Mathematics Math 520 Methods of Applied Mathematics	
2005-06	Fall	Math 515 Real Analysis & Phased Retirement	

	Spring	on leave at Institute for Pure and Applied Mathematic, UCLA
2006-07	Fall	Math 690P Topics in Mathematical Biology
	Spring	Math 690P Topics in Mathematical Biology (continued)& Phased Retirement
2007-08	Fall	Math 557 Ordinary Differential Equations
	Spring	Phased Retirement
2008-09	Fall	Math 515 Real Analysis
	Spring	Phased Retirement
2009-10	Fall	Math 501 Introduction to Real Analysis
	Spring	Phased Retirement

### Master's Committee or Creative Component Supervisor

- K. Padalino (URI - MA with thesis)  
 Major Professor (1975-78)  
 Thesis: *Numerical Computation of Blow up Times*  
 First employment: Naval Underwater Systems Center, New London, Conn.
- Ronald Hass (Chem. Eng.) (1980-83)
- Kim Hye-Rim (Physics) (1980-81)
- Viken N. Kondakji (Chem. E.) (1982)
- R. V. Gogri (Chem. E.) (1982)
- Hsu, Ching-Hua Ivy (EE) (1983-85)
- Thomas Evers (Math) (1984-85)(MA-1985)  
 Chairman - Major Professor  
 Thesis: *A numerical search for ground state solutions of a modified capillary equation* (in *Nonlinear Diffusion Equations and Their Equilibrium States, Volume II*, Springer Verlag 1988).  
 First employment: Texas Instruments Corp., Dallas, TX
- Houn Ja Lee (Math) (1985-87) Chairman - Major Professor
- John Axtell (Math) (1986-87) (MS-1987)  
 Chairman - Major Professor  
 Creative Component: *A numerical study of the derivatives of solutions of the wave equation with a singular forcing term at quenching* (in *Numerical Methods for Partial Differential Equations 1* (1989) 53-76).  
 First employment: Cessna Aircraft Corp.. Wichita, Kansas
- T. Revathi (Math) (1986-87)
- K. Sriskandarajah (Math) (1986-87)  
 (Aero E.) (1988-89)
- S. Athreya (Math) (1989-91)  
 Chairman - Major Professor  
 Creative Component: *Numerical studies of some nonlinear boundary value problems*
- Tuncay Candan (Math) (1998-99)  
 Chairman - Major Professor  
 Creative Component: *Inequalities between Dirichlet and Neumann eigenvalues-Some examples*
- N. Trangri (Math) (1998-99)  
 Chairman - co Major Professor  
 Creative Component:

- R. Grier (Math) (1998-99)  
 Chairman - Major Professor (with J. Peterson)  
 Creative Component: *An introduction to chemotaxis in D. Discodium*
- A. Tucker (Math) (2000-03)  
 Chairman - co Major Professor with M. Nilsen-Hamilton (BBMB)

### Post Doctoral/Other Fellows

- Joanna Renclawowicz, PhD, University of Warsaw, Warsaw Poland, supported by a NATO post doctoral fellowship, 8/2002 - 6/2003.  
 Valentina Burmistrova, MS, supported by a Fulbright Fellowship, 8/2002 - 6/2003.

### Ph.D. Committee or Thesis Supervisor

- Gabia Lin (Math) (1978-81)  
 Luz Maria de Alba-Guerra (Math) (1980-84)  
 Alexander Ng (Physics) (1979-84)  
 Dwight Denny (Physics) (1982-84)  
 Teong Tan (Eng. Mech.) (1982-85)  
 Robert Sanderson (Chem. E.) (1982-86)  
 Chih-Ching Hsu (Chem. E.) (1982-84)  
 Steven Heron (Chem.) (1983-1988)  
 Richard A. Smith (Math.) (1984-85) (Ph.D.-1985)  
 Chairman/Major Professor  
 Dissertation: *Theoretical and numerical studies of some ill-posed problems in partial differential equations* (three papers).  
 First employment: Exxon Production Research Corp., Houston, TX
- S. Park (Math.) (1985-89) (Ph.D.-1989)  
 Chairman - Major Professor  
 Dissertation: *The phenomenon of quenching in the presence of convection.* (one paper)  
 Returned to continue employment at Keimyung University in Korea.
- Rvojia Lee (EE) (1986-88)  
 Jeffrey Anderson (Math) (1985-89) (Ph.D.-1989)  
 Chairman - Major Professor  
 Dissertation: *Qualitative studies of a convective porous medium equation with a nonlinear forcing term at the boundary* (two papers).  
 First employment: Ball State University, Muncie, IN
- Deng Keng (Math) (1986-90) (Ph.D. -1990)  
 Chairman - Major Professor  
 Dissertation: *The asymptotic behavior of solutions of some nonlinear initial-boundary value problems of parabolic type.* (three papers)  
 First employment: Southwest Louisiana State U., Lafayette, LA
- Bruce Reichard (Mech. E.) (1987-91)  
 K. Jayawardena (Math) (1988-92 )  
 T. Maheswaran (Math) (1988- 92)  
 F. Hummer (Math) (1990-92 )  
 Y. Uda (Math) (1989-93 ) (Ph.D. - 1993)  
 Chairman - Major Professor  
 Dissertation: *Some Fujita type results for systems of weakly coupled equations,*
- Serdal Pamuk (Math) (1997-2000) (Ph.D. -2000)  
 Chairman - Major Professor  
 Dissertation: *A mathematical model for tumor angiogenesis*  
 First employment: Kocaeli University, Kocaeli, Turkey
- Mathew Halverson (Math) 2005-2008

- Chairman - Major Professor  
 Dissertation: *Blow up and Collapse in Chemotaxis - How Much Diffusion is Enough?*  
 First employment: Wartburg College
- Cory Howk (Math) (2006-2009)  
 Chairman - co-Major Professor (with M.W. Smiley)  
 Dissertation: *A Mathematical Model for Selective Differentiation of Neural Progenitor Cells on Micropatterned Polymer Substrates*  
 First employment: University of Iowa post doctoral Fellow; Now East Carolina State University  
 First employment: Post Doctoral Fellow, University of Iowa Medical School (2010-2012)
- Yeonjung Seo (Math) (2007-2011)  
 Chairman - co-Major Professor (with M. Nilsen-Hamilton, Biochemistry)  
 Dissertation: *A Mathematical Analysis of Multiple Target SELEX*

### Curriculum Development/Honors Program/NSF-REU involvement

- Initiated course "Fluid Dynamics for Oceanographers" at URI 1974-75, repeated 1976-77.  
 Reactivated 690P, Partial Differential Equations, ISU, Fall 1979-Spring 1980. (Now Math 585-586).  
 Quadrupled enrollment in 521-523B from three students in 1979-80 to thirteen students in 1980-81. (Now Math 526-527.)  
 Initiated Math 426 "Math Methods for Physical Scientists" (with K. Heimes, S. Willson). A service course for the physics department.  
 Mentored two students in the Honors mentoring program, Spring, 2002.  
 Introduced an experimental mathematical physiology course with R. Ackerman, Spring, 2002.  
 Mentored David Pinkston, Honors project in angiogenesis, 2004-05  
 Mentored students in NSF REU program, Summers 2004, 2005, 2006.































### Publications




























#### A. Refereed research articles, survey papers and conference proceedings.




















1. Levine, H. A., *Convexity and Differential Inequalities in Hilbert Space*, Ph.D. Dissertation. Cornell University, Ithaca, New York (1969).
2. —, *Logarithmic convexity and the Cauchy problem for some abstract second order differential inequalities*, J.D.E. **8** (1970), 34-55.
3. —, *Logarithmic convexity, first order differential inequalities and some applications*, Trans. Am. Math. Soc. **152** (1970), 299-320.
4. —, *On a theorem of Knops and Payne in dynamical linear thermo-elasticity*, Arch. Rat. Mech. Anal. **38** (1970), 290-307.
5. —, *On the uniqueness of bounded solutions to  $u'(t) = A(t)u(t)$  and  $u''(t) = A(t)u(t)$  in Hilbert space*, SIAM J. on Analysis **4** (1973), 250-259.
6. —, *Some uniqueness and growth theorems in the Cauchy problems for  $Pu_{tt} + Mu_t + Nu = 0$  in Hilbert space*, Math Z. **126** (1972), 345-360.
7. —, *Some nonexistence and instability theorems for solutions of formally parabolic equations of the form  $Pu_t = -Au + F(u)$* , Arch. Rat. Mech. Anal. **51** (1973), 371-386.
8. —, *Instability and nonexistence of global solutions of nonlinear wave equations of the form  $Pu_{tt} = -Au + F(u)$* , Trans. Am. Math. Soc. **192** (1974), 1-21.
9. —, *Some additional remarks on the nonexistence of global solutions of nonlinear wave equations*, SIAM J. on Analysis. **5** (1974), 138-146.
10. (with Harriss, K., J. C. Nichol), *Behavior of diffuse electrolyte boundaries in an external electric field*, J. Phys. Chem. **77** (1973), 2989-2994.

11. Levine, H. A., *A note on a nonexistence theorem for nonlinear wave equations*, SIAM J. on Analysis **5** (1974), 644-648.
12. Levine, H. A., *A nonexistence theorem for a nonlinear Euler-Poisson-Darboux equation*, J. Math. Anal. Appl. **48** (1974), 646-651.
13. (with L. E. Payne), *A nonexistence theorem for the heat equation with a nonlinear boundary condition and for the porous medium equation, backward in time*, J. Diff. Equations **16** (1974), 319-334.
14. Levine, H. A., *On the uniqueness and growth of weak solutions of certain linear differential equations in Hilbert space*, J. Diff. Equations **17** (1975), 73-81.
15. (with L. E. Payne), *Some nonexistence theorems for initial boundary value problems with nonlinear boundary conditions*, Proc. A.M.S. **46** (1974), 277-284.
16. (with A. C. Murray), *Asymptotic behavior and lower bounds for semi-linear wave equations in Hilbert space*, SIAM J. on Analysis **6** (1976), 846-859.
17. (with Knops, R. J., L. E. Payne), *Nonexistence, instability and growth theorems for solutions of a class of abstract nonlinear equations with applications to nonlinear elastodynamics*, Arch. Rat. Mech. Anal. **5** (1974), 52-72.
18. Levine, H. A., *Some new uniqueness and continuous dependence results for equations of indeterminate type: The weighted energy method*, J. Diff. Equations **19** (1975), 330-343.
19. Levine, H. A., *On the nonexistence of global weak solutions of some properly and improperly posed problems of mathematical physics: The method of unbounded Fourier coefficients*, Mathematische Annalen **214** (1975), 205-220.
20. (with L. E. Payne), *Nonexistence of global solutions of general second order nonlinear elliptic equations*, SIAM J. Math. Anal. **7** (1976), 337-343.
21. Levine, H. A., *Nonexistence of global solutions of nonlinear wave equations*, Proceedings of N.S.F. Regional Conference on Improperly Posed Problems in Partial Differential Equations. Albuquerque, N.M., May 20-24, 1974. "Improperly posed boundary value problems," Res. Notes Math., vol. 1, Pitman, London, 1975.
22. (with L. E. Payne), *Nonexistence of global weak solutions for classes of nonlinear wave and parabolic equations*, J. Math. Anal. Appl. **5** (1976), 329-334.
23. Levine, H. A., *Growth of solutions of a generalized nonlinear Euler-Poisson-Darboux equation*, Arch. Rat. Mech. Anal. **61** (1976), 77-89.
24. Levine, H. A., *On the instability of nonlinear vibrations of free-free beams*, Zeit. Ang. Math. Phys. **26** (1975), 843-846.
25. (with D. R. Dunninger), *Some new uniqueness theorems for some nonstandard boundary value problems*, J. Diff. Equations **22** (1976), 368-375.
26. (with D. R. Dunninger), *Uniqueness criteria for solutions of singular boundary value problems*, Trans. Am. Math. Soc. **222** (1976), 368-375.
27. (with L. E. Payne), *On the nonexistence of global solutions of some abstract Cauchy problems of standard and nonstandard types*, Rend. Di. Mathematica (Picone Ann. Vol.) **8** (1975), 413-438.
28. (with L. E. Payne), *Growth estimates and lower bounds for solutions of equations of nonlinear elasticity with indefinite strain energy*, J. of Elasticity **5** (1975), 273-285.
29. Levine, H. A., *An equipartition of energy theorem for weak solutions of evolutionary equations in Hilbert Spaces: The Lagrange Identity Method*, J. Diff. Equations **24** (1977), 197-210.
30. (with J. T. Montgomery), *A note on the quenching and decay of solutions of some nonlinear parabolic equations*, SIAM J. Math. Anal. (1980), 842-847.
31. (with Payne, L. E., G. B. Kosrovshahi), *On the positive spectrum of Schrödinger type operators with long range potentials*, Trans. Am. Math. Soc. **253** (1979), 211-228.
32. Levine, H. A., *An estimate for the best constant in a Sobolev inequality*, Annali de Math. Pura et Applicada **74** (1980), 181-197.
33. (with P. Chang), *The quenching of solutions of some nonlinear hyperbolic equations*, SIAM J. Math. Anal. **12** (1981), 842-847.
34. (with L. E. Burkhart), *A mathematical model for the flow of surfactants on the interface of forming droplets*, Chem. Eng. Communications **21** (1983), 191-220.
35. Levine, H. A., *The quenching of solutions of linear parabolic and hyperbolic equations with nonlinear boundary conditions*, SIAM J. Math. Anal. **14** (1983), 1139-1153.



36. (with G. M. Lieberman), *Quenching of solutions of parabolic equations with nonlinear boundary conditions*, J. Reine Ang. Math. **345** (1984), 24-38. 
37. (with P. E. Sacks), *Some existence and nonexistence theorems for solutions of degenerate parabolic equations*, J. D. E. **52** (1984), 135-161. 
38. (with M. W. Smiley), *Abstract wave equations with a singular forcing term*, J. Math. Anal. Appl. **103** (1984), 409-427. 
39. Levine, H. A., *Continuous data dependence, regularization and a three lines theorem for the heat equation with data in a space like direction*, Annali di Mat. Pura et Applicada **84** (1983), 267-286. 
40. (with M. H. Protter), *The breakdown of solutions of quasi-linear first order systems of partial differential equations*, Arch. Rat. Mech. Anal. **95** (1986), 253-267. 
41. (with B. D. Sleeman), *A note on the nonexistence of global solutions of initial-boundary value problems for the Boussinesque equation  $u_{tt} = 3u_{xxxx} + u_{xx} - 12(u^2)_{xx}$* , J. Math. Anal. Appl. **107** (1985), 206-210. 
42. (with M. H. Protter), *Unrestricted lower bounds for eigenvalues for classes of elliptic equations and systems of equations with applications to problems in elasticity*, Math. Meth. Appl. Sci. **7** (1985), 210-222. 
43. (with S. Vessella), *Stabilization and regularization for solutions of an ill posed problem for the wave equation*, Math. Meth. Appl. Sci. **7** (1985), 202-209. 
44. (with S. Vessella), *Estimates and regularization for solutions of some ill posed problems of elliptic and parabolic type*, Rendiconti Del Circolo Matimatico Di Palermo **34** (1985), 141-160. 
45. (with H. F. Weinberger), *Inequalities between Dirichlet and Neumann eigenvalues*, Arch. Rat. Mech. Anal. **94** (1986), 193-208. 
46. (with L. E. Payne), *On an ill posed Cauchy problem for the wave equation*, (preprint) 
47. (with R. A. Smith), *A potential well theory for the wave equation with a nonlinear boundary condition*, J. Reine Ang. Math. **374** (1986), 1-23. 
48. (with R. A. Smith), *A potential well theory for the heat equation with a nonlinear boundary condition*, Math. Meth. Appl. Sci. **9** (1987), 127-136. 
49. Levine, H. A., *Minimal periods for solutions of semi-linear wave equations in exterior domains and for solutions of the equations of nonlinear elasticity*, J. Math. Anal. Appl. **135** (1988), 297-308. 
-  50. ———, *Stability, instability and nonexistence for solutions of an initial-boundary value problem for Burgers' equation*, SIAM J. Math. Anal. **19** (1988), 312-336. 
51. (with T. S. Chen, P. Sacks), *Stability analysis of a convective reaction diffusion equations*, Nonlinear Analysis, TMA **12** (1988), 1349-1370. 
52. (with S. Auerbach), *The charge balance equation*, J. Plasma Phys. Physica D, ( press).
53. (with C. Bandle), *On the existence and nonexistence of global solutions of reaction-diffusion equations in sectorial domains*, Trans. Am. Math. Soc. **316** (1989), 595-662. 
54. (with R. Quintanilla), *Some remarks on St. Venant's Principle*, Math. Meth. Appl. Sci. **11** (1989), 71-79. 
-  55. (with L. E. Payne, P. E. Sacks, and B. Straughan), *Analysis of a convective reaction-diffusion equation (II)*, SIAM J. Math. Anal. **20** (1989), 133-147. 
56. Levine, H. A., *Quenching, non-quenching and beyond quenching for solutions of some parabolic equations*, Annali di Math. Pura et Applic. **155** (1989), 243-290. 
57. (with Keng Deng), *On the blow up at  $u_t$  at quenching*, Proc. AMS **106** (1989), 1049- 5.
58. (with Keng Deng, Man Kam Kwong), *The influence of nonlocal nonlinearities on the long-time behavior of solutions of Burgers' equation*, Quarterly of Applied Math. **50** (1992), 173-200. 
59. (with P. Meier), *The value of the critical exponent for reaction-diffusion equations in cones*, Arch. Rat. Mech. Anal. **109** (1990), 73-80. 
60. (with P. Meier), *A blow up result for the critical exponent in cones*, Israel. J. Math. **67** (1989), 1-7. 
61. (with C. Bandle), *Fujita type results for convective-like reaction-diffusion equations in exterior domains*, Zeit. Ang. Math. Phys. **40** (1989), 665-676. 
62. Levine, H. A., *The role of critical exponents in blow up theorems*, SIAM Reviews **32** (1990), 262-288. 
63. (with G. M. Lieberman, P. Meier), *On critical exponents for some quasi-linear parabolic equations*, Math. Meth. Appl. Sci. **12** (1990), 429-438. 

64. (with A. P. Rothmayer), *The viscous flow through a flexible tube*, Theoret. Comp. Fl. Dynamics **1991**, no. 2, 193-210. 
65. Levine, H. A., *A Fujita type global existence-global nonexistence theorem for a system of reaction-diffusion equations*, Zeit. Ang. Math. Phys. **42** (1991), 408-430. 
66. (with B. Kawohl, W. Velte), *On the eigenvalues of a clamped plate under compression and related questions*, SIAM J. Math. Anal **24** (1993), 327-340. 
67. (with M. Escobedo), *Explosion et existence globale pour un systeme faiblement couple' d'equations de reaction diffusion*, C. R, Acad. Sci. Paris **314** (1992), 735-740. 
68. (with B. Kawohl, M. Fila), *Quenching problems for quasi-linear equations*, Comm. in PDE **17** (1992). 
69. (with M. Fila, J. L. Vasquez), *Stabilization of solutions of weakly singular quenching problems*, Proc. AMS **119** (1993), 555-559. 
70. (with V. Galaktionov), *Critical exponents for quasi-linear and semi-linear parabolic equations with a semi-linear boundary condition*, Israel J. Mathematics **94** (1996), 125-146. 
71. (with M. Fila), *Quenching on the boundary*, TMA Nonlinear Analysis **21** (1993), 795-802. 
72. (with W. Qi), *The critical exponent for degenerate parabolic systems*, ZAMP **44** (1993), 249-265. 
73. (with C. Bandle), *Fujita type phenomena for reaction-diffusion equations with convection term*, J. Diff. Int. Eqns. **7** (1994), 1169-1193. 
74. (with M. Escobedo), *Critical exponents for a weakly coupled system of reaction-diffusion equations*, Arch. Rat. Mech. Anal. **129** (1995), 47-100. 
75. (with M. Fila, Y. Uda), *A Fujita type global existence - global nonexistence theorem for a system of reaction diffusion equations with differing diffusivities*, Math. Meth. Appl. Sciences **17** (1994), 807-835. 
76. (with K. Deng, M. Fila), *Critical exponents for a system of linear parabolic equations with a semi-linear boundary condition*, Acta Math. Univ. Comeniae **63** (1994), 169-192. 
77. (with J. Serrin), *Global nonexistence theorems for quasilinear evolution equations with dissipation* **137** (1997), 341-361, Arch. Rat. Mech. Anal. 
78. (with B. D. Sleeman), *A system of reaction diffusion equations arising in the theory of reinforced random walks*, SIAM J. Appl. Math. **57** (1997), 683-730. 
79. (with Fila, M.), *On critical exponents for a semi-linear parabolic system coupled in an equation and a boundary condition*, J. Math. Anal. Appl. **394** (1996), 494-521. 
80. (with V. Galaktionov), *Fujita type blow up theorems for some nonlocal parabolic equations and systems*, Nonlinear Analysis **34** (1998), 1005-1027. 
81. (with Park, S. R., J. Serrin M.), *Global existence and nonexistence theorems for quasilinear evolution equations of formally parabolic type*, J. Diff. Equations **142** (1998), 212-229. 
82. (with S. R. Park, J. Serrin), *Global Existence and Global Nonexistence of Solutions of the Cauchy Problem for a Nonlinearly Damped Wave Equation*, J. Math. Anal. Appl., **228** (1998), 181-205. 
83. (with Fila, M.), *On the boundedness of global solutions of semilinear parabolic equations in Banach Spaces*, J. Mat. Anal. Appl. **216** (1997), 654-666. 
84. (with Y. Ebihara, S. Kawashima), *On solutions to  $u_{tt} - |x|^\alpha \Delta u = f(u)$  ( $\alpha > 0$ )*, Funkcial. Ekvac. **38** (1995), 539-544. 
85. (with Deng, K.), *The role of critical exponents in blow up theorems: The sequel*, J. Math. Anal. Applications, **243** (2000), 85-126. 
86. (with B. D. Sleeman, Nilsen-Hamilton, M.), *Mathematical Modeling of the initiation of capillary formation initiating angiogenesis*, J. Math. Biol. **42(3)** (2001), 195-238. 
87. (with G. Todorova), *Blow up of solutions of the Cauchy problem for a wave equation with nonlinear damping and source terms and large initial energy*, Proc. AMS **129** (2000), 793-805. 
88. (with Zhang, Q. S.), *The critical Fujita number for a semilinear heat equation in exterior domains with homogeneous Neumann boundary values*, Proc. Roy. Soc. Edinburgh **130A** (2000), 591-602. 
89. (with B. D. Sleeman, Nilsen-Hamilton, M.), *A mathematical model for the roles of pericytes and macrophages in the initiation of angiogenesis: I. The role of protease inhibitors in preventing angiogenesis.*, Mathematical Biosciences **168** (2000), 77-115. 
90. (with Q. Zhang, Bandle, C.), *A Fujita theorem for forced semilinear parabolic equations and systems*, JMAA **251(2)** (2000), 624-648. 

91. (with B. D. Sleeman), *Partial differential equations of chemotaxis and angiogenesis*, Math. Meth. Appl. Sci. **24** (2001), 404-426. 
92. (with S. Pamuk, B. D. Sleeman, Nilsen-Hamilton, M.), *Mathematical modelling of capillary formation and development in tumor angiogenesis: Penetration into the stroma*, Bull. Math. Biol. **63** (2001), 801-863. 
93. (with A. Tucker, M. Nilsen-Hamilton), *A mathematical model for the role of cell signal transduction in the initiation and inhibition of angiogenesis*, Growth Factors **20** (2002), 155-176.. 
94. (with S. Pamuk, B. D. Sleeman, M. Nilsen-Hamilton), *Mathematical modelling of tumor angiogenesis and the action of angiostatin as a protease inhibitor*, J. Theoret. Med. **4(2)** (2002), 133-145. 
-  95. (with M. W. Smiley, A. Tucker, M. Nilsen-Hamilton ), *A mathematical model for the formation of avascular tumors based on the role of the p53 tumor suppressor gene*, Cancer Informatics **2** (2006), 163-188.
96. (with T. Hillen), *Blow up and pattern formation in hyperbolic models for chemotaxis*, ZAMP **54** (2003), 839-868. 
-  97. (with J. Rencławowicz), *Singularity formation in chemotaxis - A conjecture of Nagai*, (SIAM J. Appl. Math., ) **65(1)** (2004), 336-362. 
-  98. (with M. Halverson, J. Rencławowicz), *Erratum: Singularity formation in chemotaxis - A conjecture of Nagai*, SIAM J. Applied Math. **65(1)** (2004), 336-362. 
99. (with K. Boushaba, M. Nilsen-Hamilton), *A mathematical model for the regulation of metastatic tumor dormancy based on enzyme kinetics (Bull. Math. Biol.,)* **68** (2006), 1495-1526. 
100. (with M. Nilsen-Hamilton ), *A mathematical analysis of SELEX*, Journal of Computational Biology and Chemistry **31** (2007), 11-35. 
101. (with K. Boushaba, M. Nilsen-Hamilton), *A mathematical feasibility argument for the use of aptamers in chemotherapy and imaging*, Math. Biosciences **31** (2007), 11-35. 
102. (with M McGee, S. Serna), *Diffusion and reaction in the cell glycocalyx and the extracellular matrix*, J. Math. Biol. **60** (2010), 1-26. 
103. (with T. Shen, Y. J. Seo, M. Nilsen-Hamilton), *A mathematical analysis of multiple-target SELEX*, Bull. Math. Biology **72 (7)** (2010), 1623-1665. 
104. (with Y. J. Seo, M. Nilsen-Hamilton), *A discrete dynamical system arising in molecular biology*, Discrete and Continuous Dynamical Systems **17(6)** (2012), 2091-2151. 
105. (with C. L. Howk, M. W. Smiley, S. K. Mallapragada, M. Nilsen-Hamilton, Jisun Ohd, D. S. Sakaguchi), *A mathematical model for selective differentiation of neural progenitor cells on micropatterned polymer substrates*, Math. Biosciences **238** (2012), 65-79. 
106. (with Y. J. Seo, M. Nilsen-Hamilton), *A computational study of alternate SELEX*, Bull. Math. Biology **76** (2014), 1455-1521. 
107. (with Y. J. Seo), *Discrete Dynamical Systems in Multiple Target and Alternate SELEX*, SIAM J. Discrete and Continuous Dynamical Systems **14(2)** (2015), 1048-1101. 

## B. Conference proceedings (at organizers invitation) and other papers or chapters in books.

1. Levine, H. A., *Logarithmic convexity and the Cauchy problem for  $P(t)u_{tt} + M(t)u_t + N(t)u = 0$  in Hilbert space*, Heriot-Watt University, Edinburgh, Scotland, Springer Notes (1973), no. 316, 102-160.
2. ———, *Remarks on the growth and nonexistence of solutions of nonlinear wave equations*, Lecture notes on Partial Differential Equations, Rutgers University, 1974, pp. 59-70.
3. ———, *Uniqueness and growth theorems for the equations of dynamical linear elasticity*, Proc. Int. Symp. Ill-Posed Problems (M. Z. Nashed, ed.), (This volume never appeared because of conflicts between the editor and the publisher).
4. ———, *On the positive spectrum of Schrödinger operators with long range potentials*, Proc. Int. Conf. Spectral Theory (I. W. Knowles, J. T. Lewis, eds.), North Holland, 1981.
5. ———, *The phenomenon of quenching: A survey*, Proc. VIth Int. Conf. on Trends in Theory and Practice of Nonlinear Analysis, North Holland, N. Y., 1985.
6. (with R. A. Smith), *A potential well theory for the wave equation with a nonlinear boundary condition*, Proc. Int. Conf. on Theory and Applications of Diff. Equations, Pan Am University, Edinburg, TX,

May 20-23, 1985.

7. Levine, H. A., *Some boundary value problems for the wave equation*, Proc. Int. Symp. on Inverse and Ill posed Problems, St. Wolfgang, Austria, Academic Press, 1987.
8. (with K. A. Ames, and L. E. Payne), *Improved continuous dependence results for a class of evolutionary equations*, Proc. Int. Symp. on Inverse and Ill-Posed Problems, St. Wolfgang, Austria, Academic Press, 1987.
9. Levine, H. A., *Numerical searches for ground state solutions of a modified capillary equation for solutions of the charge balance equation*, Proceedings of Microprogram on Nonlinear Diffusion held at Mathematical Sciences Research Institute of the NSF at U.C. Berkeley, August 1986, Nonlinear Diffusion Equations and their Equilibrium States(II), Springer Verlag, New York, 1988.
10. \_\_\_\_\_, *Some remarks on inequalities between Dirichlet and Neumann Eigenvalues*, Proc. Conf. on Maximum Principles and Eigenvalue Problems, Univ. of Texas, Knoxville, Tennessee, June 15-19, 1987, Pitman Research Notes, vol. 175, 1988.
11. \_\_\_\_\_, *The long time behavior of reaction-diffusion equations in unbounded domains: A survey.*, Proc. 10th Dundee Conference on Ordinary and Partial Differential Equations, July 1-10, 1988, Pitman Research Notes, vol. 216 yr 1989, pp. 97-118.
12. \_\_\_\_\_, *Advances in quenching*, Proc. Int. Conf. Reaction-Diffusion Equations and their Equilibrium States 3, Gregynog, Wales, August 20 -August 30, 1989, Progress in Nonlinear Differential Equations, Birkhuser, 1992, pp. 319-346.
13. \_\_\_\_\_, *Fujita type theorems for weakly coupled systems of parabolic equations*, Proc. 1st European Conference on Elliptic and Parabolic Problems, Pont-a' Mousson, France, June 17-21, 1991, Progress in Partial Differential Equations: Elliptic and Parabolic Problems, Pitman Res. Notes #266, Longman Scientific (Wiley), N.Y., 1992.
14. \_\_\_\_\_, *Quenching and beyond: A survey of recent results*, Proc. Int. Conf. on Nonlinear Mathematical Problems in Science and Industry, Iwaki, Japan, November 14, 1992, GAKUTO International Series Mathematical Sciences and Applications, Volume II, Tokyo, Japan, 1993, pp. 501-512.
15. \_\_\_\_\_, *A global existence-global nonexistence conjecture of Fujita type for a system of degenerate semi-linear parabolic equations*, Symp. on Singularities and Differential Equations, Banach Center for Mathematics, October 17-27, 1993, Singularities and Differential Equations, Banach Center Publications, Institute of Mathematics, Polish Academy of Sciences, Warszawa, Poland, 1996.
16. (with B. D. Sleeman), *Systems of reaction-diffusion equations modelling chemotaxis*, Proc. 12th Dundee Conference on Ordinary and Partial Differential Equations, July, 1996, Pitman Research Notes in Mathematics, vol. 370, Longman Publishing Co., 1997, pp. 130-150.
17. (with P. Pucci, and J. Serrin), *Some Remarks on global nonexistence for nonautonomous abstract evolution equations*, Conference in honor of Victor Shapiro, Contemporary Mathematics, vol. 208, American Mathematical Society, 1997, pp. 253-263.
18. (with M. Ashbough), *Inequalities for the Dirichlet and Neumann eigenvalues of the Laplacian domains on spheres*, Annual Meeting on Partial Differential Equations, Saint-Jean de-Monts, France, June 2-6, 1997, Equations Aux Derivees Partielles, CNRS Research Group # 1151..
19. (with G. Todorova), *Blow up of solutions of the Cauchy problem for a wave equation with nonlinear damping and source terms and large initial energy*, Recent Trends and Advances in PDEs and Numerical PDEs, a conference held in honor of Olga Ladyzhenskaya, (This paper was supposed to appear under a conference proceedings of the same title. However the organizers and the publishers could not come to a mutually agreeable arrangement.).
20. (with Sleeman, B.D.), *Systems of reaction-diffusion equations modeling angiogenesis and chemotaxis*, Proceedings of Equadiff 99 (B. Fiedler, K. Groger and J. Sprekels, eds.) **2** (1999), World Scientific, 1107-1114.
21. ( with M. W. Smiley and M Nilsen-Hamilton), *Numerical simulation of capillary formation during the onset of tumor angiogenesis*, Proceedings of the Fourth International Conference on Dynamical Systems and Diffusion Equations, Dynamical Systems and Differential Equations (A Supplemental Volume to the journal Discrete and Continuous Dynamical Systems) (W.Feng, S. Hu, X. Lu, eds.), 2003, pp. 817-826.

**C. Chapters in Books**

1. (With B. D. Sleeman), Modelling Tumour Induced Angiogenesis, Chapter 6, in: Cancer Modelling and Simulation, L. Preziosi, eds., Chapman and Hall/CRC Press, pp. 147-183 (2003).
2. (With M. Nilsen-Hamilton), Angiogenesis-A Biochemical/Mathematical Perspective, Chapter 2., in Tutorials in mathematical biosciences: Cell cycle, proliferation, and cancer (Vol. 3). A. Friedman, ed., Springer-Verlag, Berlin, Heidelberg, New York (2006).

**D. Book Reviews**

1. "Nonlinear Diffusion" (Fitzgibbon and Walker, eds.) Pitman 1977, Mathematics of Computation **32**(1978), 1323-1324.
2. "Solutions of Ill-Posed Problems", Tikhonov and Arisinen, Wiley (1977), Bull. Am. Math. Soc. (new series), **1**(1979), pp. 521-523.
3. "Partial Differential Equations; An Introduction to a General Theory of Linear Boundary Value Problems", A. Dezin, Springer-Verlag (1977), SIAM Review **30**(1988), 672-673.
4. "Operator Inequalities", Schröder, Academic Press (1980), Mathematics of Computation **37**(1981), 600-601.
5. "The Energy Method, Stability, and Nonlinear Convection", Straughan, Springer Applied Mathematical Sciences Series 1992, Bull Am. Math. Soc. (New Series) **27**(1992), pp.320-322.
6. "Blow-up in Quasilinear Parabolic Equations," Samarskii, Galaktionov, Kurdyumov and Mikhailov, De Gruyter Expositions in Mathematics, **19** (1995), SIAM Review **38**(1997), 692-694.
7. "Free Energy and Self Interacting Particles", Suzuki, Birkhauser, Progress in Nonlinear Differential Equations and Their Applications, (2005), Bull. Am. Math. Soc. (New Series) **44**(1)(2007), 139-145.

**C. Miscellaneous Publications**

1. Letter to the Editor: Subject of the letter was an earlier article by Steven Zucker: "Teaching at the University Level," which appeared in the August, 1996 Notices. Notices of the American Mathematical Society, November 1996.
2. "Tribute to Lawrence E. Payne", Notices of the American Mathematical Society, May 2012, (With P. Schaefer, S. Levin.)
3. "Obituary for Lawrence E. Payne", Society of Industrial and Applied Mathematics News, May 2012, (With C. Bandle, F. Santosa and H. F. Weinberger.)
4. "Remembering James Serrin", Notices of the American Mathematical Society, June/July 2013, (With H. F. Weinberger, coeditor.)

**Research Grants****A. Research Grants and Summer Research Activities**

1. As Coinvestigator
  - (a) NSF (GP7041X) 1970, 1971, 1972, University of Minnesota (H. F. Weinberger, PI) (six summer months).
  - (b) NSF (GP33031X), 1973, Cornell University (L. E. Payne, PI) (one month)
  - (c) ONR (N0001482K0051), 1983, Cornell University (L. E. Payne, PI) (one month)
  - (d) NIH-NIGMS (National Institute of General Medical Sciences) with Mallapragada (Chem-E), Nilsen-Hamilton (BBMB) PI, Smiley, Sakaguchi (Zoo-Gen), "Coupled Biological and Mathematical Models of Neuronal Pattern Formation investigating the biology of stem cell

development", \$1.6M 7-04 to 6-08.

- (e) NIH Small Business Grant with Nilsen-Hamilton and George Krause, PI (Chemistry) , \$100,000 11/15/04-05 extended to "Aptamers for Imaging and Therapy", 9/1/06-8/31/10, Total funding including indirects: \$ 312,103, Purpose: To develop aptamers that promote drug efficacy, and aid in imaging.
2. As Principal Investigator
- (a) NSF(GP42777) 6/74 - 11/77, University of Rhode Island
  - (b) NSF(MCS 78-02729) 7/78 - 12/79, University of Rhode Island  
(Amount of award under (a), (b), \$26,026) (eight summer months)
  - (c) (i) AFOSR (84-0252) 8/30/84 - 9/30/87, Iowa State University,  
(Amount of award, \$242,130)  
Coinvestigator: Paul Sacks  
Other investigators: Tsu Fen Chen, Sat Nam Singh Khalsa,  
Michael Smiley, Roger Alexander  
Research Assistants: Richard Smith, Thomas Evers,  
Jeffrey Anderson, John Axtell, Keng Deng, S. Park.
  - (ii) AFOSR (88-0031) 10/1/87 - 4/15/89 (\$53,293)  
Coinvestigators: Paul Sacks and Roger Alexander.
  - (d) NSF (split funding with AFOSR) (DMS-8822788) 6/1/89 - 8/1/91, (\$ 55,000).
  - (e) NSF (DMS-9102210) 9/15/91 – 9/15/93 Extended to 9/1/95 and supplemented by \$ 5,000.  
(Total Award \$ 53,800 )
  - (f) NATO (CRG.951209) (11/22/95-11/22/97) Travel grant (with B. D. Sleeman, (\$ 6263. Ex-  
tended to 11/22/99 and supplemented by \$5098. (Total Award \$ 11,361.)
  - (g) PI NSF (DMS-98-03992) 9/98-8/01, A grant to study and model malignant tumor growth.  
(Total Award, \$ 140,000

## B. Other Summer Employment and Consultant Work

1. Mathematician, Naval Underwater Systems Center, Algorithmic Design Branch, New London, Connecticut. 5/13/77 - 8/31/78
2. Ames Laboratory, Chemical Engineering Division, Ames, Iowa. 6/1/80 - 7/31/80, Summer employee 6/1/81 - 7/31/81.
3. Lawrence Livermore National Laboratory, Magnetic Fusion Energy, Theory and Computations Group, Livermore, California. Summer employee 5/30/84 - 8/3/84, consultant 10/1/84 - 10/31/86.
4. University of Basel, Basel, Switzerland, visitor (6/1/87 - 6/30/87).
5. Univ. Heidelberg, Sonderforschungsbereich fur Mat., visitor 6/12/90 - 7/18/90.
6. Max Plank Institut fuer Matematik in der Naturwissenschaft, University of Leibzig, visitor 6/15/02 - 7/1/02.

## Professional Service

1. Refereeing

I typically referee 2-3 NSF proposals and 10-20 journal submissions for 5-10 different journals per year.

2. Associate Editorships listed on page 1 of this vita.
3. Reviewer for faculty at other institutions
  - University of South Carolina
  - University of Tennessee
  - University of Glasgow
  - University of Cincinnati
  - University of Northern Illinois
  - University of Nebraska (2)
  - National Tsing Hua University, Hsinghu, Taiwan
  - University of Alabama, Huntsville (2)
  - University of Southwestern Louisiana
  - University of Notre Dame
  - Tulane University
  - University of Kuwait
  - University of Bath, England, UK
  - Universidad del Pais Vasco, Bilbao, Spain
  - Comenius University, Bratislava, Slovakia
  - Koc University, Istanbul, Turkey
  - University of Alberta
  - Clair College, Cambridge University
  - Georgia Tech University
  - University of California, Davis, CA
4. Conference Organizing Committees
  1. Workshop on Partial Differential Equations in honor of L. E. Payne  
Held at Cornell University, October 5-7, 1990. Supported by the Mathematical Sciences Institute of the United States Army.
  2. Workshop on Similarity Solutions of Differential Equations, April 14-16, 1991. Supported by Institute for Mathematics and its Applications and the National Science Foundation.

**Invited Lectures (\* Denotes honorarium or travel expenses received)**

**1971**

- (\*) A. University of Florence (Italy). "On the Uniqueness of Bounded Solutions to some Evolutionary Equations", October 15, 1971.
- B. Battelle Advanced Studies Center, Geneva, Switzerland.
  1. "On Uniqueness in the Cauchy Problem for  $Pu_{tt} + Mu_t + Nu = 0$  in Hilbert Space", August 12, 1971.
  2. "Mathematical Aspects of a Problem in Free Electrophoresis", September 15, 1971.
  3. "Uniqueness of Bounded Solutions of  $u' = A(t)u$  and  $u'' = A(t)u$  in Hilbert Space", November 10, 1971.
- C. University of Minnesota. "Convexity, Concavity and the Porous Medium Equation", January 26, 1971.
- (\*) D. Forschungsinstitut für Mathematik, E.T.H., Zurich, Switzerland. "On the Growth of Solutions of Evolutionary Equations", December 13, 1971.

**1972**

- A. University of Dundee, Scotland
  1. "Convexity, Uniqueness and Stability for some Non-Well Posed Problems in Partial Differential Equations: An Abstract Approach." (Five lectures)
  2. "Some Mathematical Aspects of a Problem in Free Electrophoresis", April 27, 1972.



3. "Instability of Solutions of Nonlinear Hyperbolic Equations", May 3, 1972.
  4. "An Instability Theorem for Nonlinear Parabolic Equations", May 24, 1972.
  5. "An Instability Theorem for the Heat Equation with a Nonlinear Boundary Condition for the Porous Medium Equation, Backward in Time", December 11, 1972.
- (\*) B. University of Edinburgh, Scotland. "Uniqueness of Bounded Solutions to  $u'(t) = A(t)u$  and  $u''(t) = A(t)u$  in Hilbert space", February 7, 1972.
- (\*) C. University of Oxford, Oxford, England. "Instability of Solutions of Nonlinear Wave Equations," March 3, 1972.
- (\*) D. Heriot Watt University, Edinburgh, Scotland.
1. Symposium on Logarithmic Convexity, "Logarithmic Convexity and Abstract Evolutionary Equations", March 24, 1972.
  2. "An Instability Theory for the Heat Equation with a Nonlinear Boundary Condition and for the Porous Medium Equation, Backward in Time", December 2, 1972.
- E. Battelle Advanced Studies Center, Geneva, Switzerland.
1. "A Nonexistence Theorem for a Class of Mildly Nonlinear Parabolic Equations", August 16, 1972.
  2. "Nonexistence and Growth Theorems for Mildly Nonlinear Wave Equations of the Form  $Pu_{tt} = -A(t)u + F(u)$ ", August 23, 1972.
  3. "Lower Bounds for Solutions of Hyperbolic Equations: The Method of Protter and Murray", October 17, 1972.
- (\*) F. Forschungsinstitute for Mathematik, E.T.H., Zurich, Switzerland.
1. "Nonexistence and Instability Theorems in Nonlinear Problems", July 23, 1972.
  2. "Nonexistence and Instability Theorems for Nonlinear Wave Equations", July 31, 1972.
  3. "A Nonexistence Theorem for  $u_t = u_{xx}$  with a Nonlinear Boundary Condition and for  $u_t = (u^m)_{xx}$  Backward in Time", August 7, 1972.
- (\*) G. Ecole de Physique Theorique, University of Geneva, Switzerland. "Some Instability Theorems for Nonlinear Wave Equations", October 20, 1972.
- (\*) H. Ecole Polytechnique Federale, Lausanne, Switzerland. "Instability and Nonexistence of Global Solutions to Nonlinear Wave Equations of the Form  $Pu_{tt} = -Au + F(u)$ ", October 26, 1972.
- (\*) I. University of Strathclyde, Glasgow, Scotland. "Some new Instability and Nonexistence Theorems for Nonlinear Wave Equations", December 13, 1972.

Also invited to attend CBMS Regional Conference on Partial Differential Equations, May 22-26, 1973. (declined) (Texas Tech.).

### 1973

- A. University of Minnesota, Minneapolis, Minnesota. "Some Instability Theorems for Solutions of Nonlinear Wave Equations of the Form  $Pu_{tt} = -Au + F(u)$ ", January 4, 1973.
- (\*) B. Cornell University, Ithaca, N.Y. "Instability and Nonexistence of Global Solutions to Nonlinear Wave Equations", February 1, 1973.
- C. State University of New York at Binghamton, N.Y.
1. "A Nonexistence Theorem for the Heat Equation with a Nonlinear Boundary Condition and for the Porous Medium Equation, Backward in Time", February 9, 1973.
  2. "On the Growth of Solutions of Nonlinear Wave Equations in Hilbert Space", March 16, 1973.
  3. "Uniqueness Theorems in Partial Differential Equations", May 5, 1973.
- (\*) D. University of Rhode Island, Kingston, Rhode Island. "Some new Non-existence and Growth Theorems for Nonlinear Wave Equations", March 14, 1973.
- (\*) E. Cornell University, Ithaca, New York. Seminar on Improperly Posed Problems.
1. "Uniqueness and Stability Theorems for Improperly Posed Problems: Logarithmic Convexity", February 21, 28, 1973.
  2. "Uniqueness and Stability Theorems for Improperly Posed Problems: Weighted Energy Arguments", March 8, 15, 1973.
  3. "On the Asymptotic Behavior of Solutions to Nagumo's Equation", May 3, 1973.



- (\*) F. University of Maryland, Baltimore County, Baltimore, Maryland. "Some Remarks on the Global Behavior of Solutions of some Semi-Linear Parabolic Equations", March 23, 1973.
- (\*) G. State University of New York at Albany, N.Y. "Some Remarks on the Behavior of Solutions of Nonlinear Wave Equations", April 6, 1973.
- (\*) H. Battelle Institute, Columbus, Ohio. "Some Mathematical Aspects of a Problem in Free Electrophoresis", March 28, 1973.
- (\*) I. Rutgers, The State University of New Jersey, New Brunswick, New Jersey. "Remarks on the Growth and Nonexistence of Solutions of Nonlinear Wave Equations", August 20, 1973.
- (\*) J. Battelle Institute, Advanced Studies Center, Geneva, Switzerland. "A Variational Inequality leading to a Nonlinear Eigenvalue Problem", August 20, 1973.
- K. University of Rhode Island, Kingston, R.I. "Some Mathematical Aspects of a Problem in Free Electrophoresis", October 5, 1973.

**1974**

- A. University of Rhode Island, Kingston, R.I. "On a Certain Sobolev Inequality", January 25, 1974.
- (\*) B. University of New Mexico, Albuquerque, New Mexico. "Nonexistence of Weak Solutions of Nonlinear Wave Equations", Conference on Improperly Posed Problems in Partial Differential Equations, May 20-24, 1974.
- (\*) C. Battelle Institute, Advanced Studies Center, Geneva, Switzerland. "Some Remarks on the Nonexistence of Global Solutions of Some Nonlinear Elliptic and Wave Equations", July 1974.
- (\*) D. Mathematisches Institut, Universitat Koln, Cologne, Germany. "Some Remarks on the Nonexistence of Global Solutions of Wave Equations", June 28, 1974.
- E. University of Rhode Island, Kingston, R.I. "Growth Properties of Solutions of the Cauchy Problem for a Nonlinear Euler-Poisson-Darboux Equation", October 4, 1974.
- (\*) F. Michigan State University, East Lansing, Michigan. "On the Growth of Solutions of a Nonlinear Euler-Poisson-Darboux Equation", October 24, 1974.
- (\*) G. Texas Tech University, Lubbock, Texas. "Some Uniqueness and Non-uniqueness Theorems for Some Classes of Improperly Posed Problems of Mathematical Physics", December 5, 1974.
- (\*) H. University of Texas, Arlington, Texas. "Nonexistence of Global Solutions to a Class of Nonlinear Second Order Elliptic Equations", December 6, 1974.

**1975**

- A. American Mathematical Society, Special Session on Singular Problems: "On the Growth of Solutions of a Nonlinear Euler-Poisson-Darboux Equation", Washington, D.C., January 24, 1975.
- (\*) B. University of Delaware, Newark, Delaware. "Nonexistence of Solutions of Nonlinear Wave Equations in and out of Hilbert Space", January 21, 1975.
- (\*) C. University of Kentucky, Lexington, Kentucky. "Some New Necessary Conditions for Global Existence of Solutions of Nonlinear Wave Equations", February 14, 1975.
- (\*) D. Brown University, Providence, Rhode Island. "Nonexistence of Weak Solutions for some Nonlinear Initial Value Problems", April 7, 1975.
- (\*) E. Georgia Institute of Technology, Atlanta, Georgia. "New Growth and Uniqueness Theorems for some Classes of Improperly Posed Problems in Partial Differential Equations", April 11, 1975.
- F. University of Rhode Island, Kingston, Rhode Island. "On a Sobolev Inequality: Triumph and Tragedy", October 17, 1975.

**1976**

- (\*) A. Brown University, Providence, Rhode Island. "An Equipartition of Energy Theorem for Weak Solutions of Evolutionary Equations in Hilbert Space", March 4, 1976.
- B. American Mathematical Society. Special Session on Sobolev Equations: "An Equipartition of Energy and Uniqueness Theorem for Weak Solutions of Second Order Evolutionary Equations in Hilbert Space", Urbana, Illinois, March 20, 1976.
- C. University of Rhode Island, Kingston, Rhode Island. "An Equipartition of Energy Theorem", September 24, 1976.

**1977**

- A. American Mathematical Society. "Saddle Points, and Instability in Nonlinear Partial Differential Equations, some examples and Open Questions." New York, New York, April 15, 1977.
- B. University of Rhode Island. "A Theorem of Ball" (semi-group seminar), April 27, 30, May 3, 1977.
- C. University of South Carolina. "Ill-posed Problems in Partial Differential Equations: Some Examples", Columbia, S.C., May 10, 1977.

**1978**

- (\* A. University of Montreal (three lectures). "Ill-posed Problems in an Abstract Setting." Montreal, Canada, March 6, 7, 8, 1978.
- (\* B. Iowa State University. "Existence and Nonexistence Theorems in Partial Differential Equations: Some Examples and Open Questions", Ames, Iowa, May 9, 1978.
- C. Iowa State University. "Best Constant in a Sobolev Inequality", Ames, Iowa, October 24, 1978.
- (\* D. NASA/Langley Research Center, Joint Institute for Flight Sciences. "Existence and Nonexistence for Wave Equations with Nonlinear Forcing Terms", Hampton, VA., October, 27, 1978.  
(Also invited to speak at Symposium on Nonlinear Analysis and Math Physics organized by J. E. Marsden) (July 10-11, 1978) (declined).

**1979**

- (\* A. University of Minnesota. "An estimate for the best constant in a Sobolev inequality Involving Three Integral Norms", Minneapolis, MN, February 28, 1979.
- (\* B. University of California. "An estimate for the best constant in a Sobolev inequality", Berkeley, CA, April 17, 1979.
- (\* C. International Symposium on Ill-posed Problems, University of Delaware. "Uniqueness Theorems for Partial Differential Equations", Newark, Delaware, October 3, 1979.

**1981**

- (Invited to Lecture at AMS special session on qualitative theory of differential equations) (San Francisco)(declined).
- (\* A. University of Alabama, International Conference on Spectral Theory of Differential Operators. "On the Positive Spectrum of Schrödinger Type Operators with Long Range Potentials." Birmingham, Ala., March 26-28, 1981.
  - B. Iowa State University, (Department of Chemical Engineering). "Analysis of Surface Flows on Drop Interfaces", Ames, Iowa, January 29, 1981.
  - C. Iowa State University (Mathematics Colloquium). "A Mathematical Model for Surface Flow on the Interface of Forming Droplets." Ames, IA, February 17, 1981.
  - (\* D. Virginia Polytechnic University. "On the quenching of Solutions of Semi-linear Parabolic and Hyperbolic Equations." Blacksburg, VA, March 26, 1981.
  - (\* E. University of Texas. "On the Quenching of Solutions of Semi-Linear Parabolic and Hyperbolic Equations." Austin, Texas, March 30, 1981.
  - (\* F. University of Iowa. "Nonexistence of Global Solutions of Evolutionary Equations with Nonlinearities having a Finite Pole." Iowa City, IA, April 9, 1981.
  - G. Coe College. "A Model for the Flow of Surfactants on the Interface of Forming Droplets" (Iowa Section of SIAM Meeting), Cedar Rapids, IA, April 24, 1981.
  - H. American Mathematical Society Special Session on Inverse or Non Well Posed Problems in Partial Differential Equations. "On the Quenching of Solutions of Parabolic Equations with Nonlinear Boundary Conditions", Austin, Texas, November 6, 7, 1981.

**1982**

- A. Iowa State University. "Quenching of Solutions of Semi-Linear Parabolic and Hyperbolic Equations." Ames, Iowa, January 19, 1982.
- B. Society of Engineering Science, 19th Annual Meeting. "An Analysis of Surfactant Induced Motion

on the Interface of a Forming Droplet." Rolla, Missouri, October, 27-29, 1982.

### **1983**

- (\*) A. University of California. "Quenching of Solutions of Nonlinear Partial Differential Equations." Berkeley, California, February 1983.
- (\*) B. Mankato State University. "What is a Well-Posed Problem? Examples and Counter Examples" and "An Illustration of the Use of the Computer to Guess a Theorem in Partial Differential Equations." Mankato, Minnesota, April 6, 1983. (SIAM Lectureship Program).
- (\*) C. University of Dundee. "Quenching of Solutions of Nonlinear Partial Differential Equations." Dundee, Scotland, April 12, 1983.
- (\*) D. Heriot-Watt University. "The Formulation of Cellular Flow in the Interface of Forming Droplets." Edinburgh, Scotland, April 13, 1983.
- (\*) E. University of Glasgow. "New Inequalities and Lower Bounds for Eigenvalues of the Laplacian." Glasgow, Scotland, April 15, 1983.
- (\*) F. University of Florence. "Quenching of Solutions of Nonlinear Partial Differential Equations." Florence, Italy, April 29, 1983.
- (\*) G. University of Florence. "New inequalities and lower bounds for eigenvalues of the Laplacian." Florence, Italy, May 13, 1983.
- (\*) H. University of Karlsruhe. "Quenching of Solutions of Nonlinear Partial Differential Equations." Karlsruhe, Germany. May 17, 1983.
- (\*) I. Swiss Federal Polytechnic Univ. (ETH) "Quenching of Solution of Nonlinear Partial Differential Equations." Zurich, Switzerland, May 18, 1983.
- (\*) J. University of Milan. "New Inequalities and Lower Bounds for Eigenvalues of the Laplacian." Milan, Italy. May 31, 1983.
- (\*) K. Iowa State University. "New Inequalities and Lower Bounds for Eigenvalues of the Laplacian." Ames, Iowa. August 31, 1983.

### **1984**

- (\*) A. American Mathematical Society, Special Session on Ill posed Problems. "Estimates and Regularization for Solution of some ill-posed Problems." Louisville, KY., January 25, 1984.
- (\*) B. Georgia Institute of Technology. "New Lower Bounds for Eigenvalues of Plates and Membranes." Atlanta, Georgia, March 28, 1984.
- (\*) C. University of Tennessee. "New Lower Bounds for Eigenvalues of Plates and Membranes." Knoxville, Tennessee, March 29, 1984.
- (\*) D. Vanderbilt University, "New Lower Bounds for Eigenvalues of Plates and Membranes." Nashville, Tennessee, March 30, 1984.
- (\*) E. VIth International Conference in Trends in the Theory and Practice of Nonlinear Analysis; "The Phenomenon of Quenching: A Survey." Arlington, Texas, June 18-24, 1984.
- (\*) F. American Mathematical Society, Special Session on Nonlinear Problems. "An Ordinary Differential Equation Arising in Mirror Fusion Theory." Minneapolis, Minnesota, November 3, 1984.

### **1985**

- (\*) A. University of Wyoming. "Lower Bounds for Eigenvalues of the Laplacian." Laramie, Wyoming, March 28, 1985.

### **1986**

- (\*) A. University of California, Berkeley. "Inequalities between Dirichlet and Neuman Eigenvalues." Berkeley, California, January 15, 1986.
- (\*) B. Cornell University. "Inequalities between Dirichlet and Neuman Eigenvalues." Ithaca, New York, February 10, 1986.
- (\*) C. University of Connecticut. "Inequalities between Dirichlet and Neuman Eigenvalues." Storrs, Conn., February 17, 1986.
- D. Iowa State University. "Inequalities between Dirichlet and Neuman Eigenvalues." Ames, Iowa, February 25, 1986.

- (\*) E. University of Texas, Arlington. "Inequalities between Dirichlet and Neuman Eigenvalues." Arlington, Texas, March 13, 1986.
- (\*) F. U.S.-Alpine Seminar on Inverse and Ill posed Problems. "Some Boundary Value Problems for the Wave Equation." St. Wolfgang, Austria, June 8-13, 1986.
- (\*) G. Microprogram on Nonlinear Diffusion Equations and their Equilibrium States. "Numerical Search for Ground State Solutions of a Modified Capillary Equation." M.S.R.I., Berkeley, California, August 25 - September 13, 1986.
- (\*) H. Maharishi International University. "What is a Well Posed Problem?" Fairfield, Iowa, October 1986.
- (\*) I. Grinnell College. "Minimal Periods for Solutions of Semi-Linear Wave Equations." (ISU-UI PDE Meeting), November 1986.

### **1987**

- (\*) A. Drexel University. "Inequalities for Eigenvalues of the Laplacian." Philadelphia, PA, January 22, 1987.
- (\*) B. University of Minnesota, Duluth. "Inequalities between Dirichlet and Neumann Eigenvalues and Polya's Conjecture." Duluth, Minnesota, January 27, 1987.
- (\*) C. University of Tennessee. "Minimal Periods for Solutions of Semi-linear Wave Equations in Exterior Domains and for Solutions of Equations of Nonlinear Elasticity." Invited talk at J. H. Barrett Memorial Lectures, Knoxville, Tennessee, April 23, 1987.
- (\*) D. University of Zurich. "Inequalities between Dirichlet and Neumann Eigenvalues." Zurich, Switzerland, May 22, 1987.
- (\*) E. University of Basel. "Burgers' Equation with a Nonlinear Boundary Condition." Basel, Switzerland, May 29, 1987.
- (\*) F. University of Tennessee. "Some Additional Remarks on Inequalities between Dirichlet and Neumann Eigenvalues." Hour talk at a conference Maximum Principles and Eigenvalues held at Knoxville, Tennessee, July 15-19, 1987.
- G. Iowa State University, "Some Recent Results and Open Questions for Parabolic and Hyperbolic Quenching Problems", Ames, Iowa, October 6, 1987.
- (\*) H. University of Alabama, Birmingham. "Some Recent Results and Open Questions for Parabolic and Hyperbolic Quenching Problems." Birmingham, Alabama, October 22, 1987.
- I. The Vanderbilt University. "The Long Time Behavior of Solutions of  $u_t = u + \delta u^p$  in Sectorial Domains. Joint Midwest-Southeast Conference on Differential Equations, Nashville, Tennessee, October 24, 1987.
- (\*) J. University of Nebraska, Lincoln "Inequalities between Dirichlet and Neumann Eigenvalues." Lincoln, Nebraska, November 10, 1987.

### **1988**

- (\*) A. University of Alabama, Birmingham. "The Long Time Behavior of Solutions of Burgers' Equation with a Nonlinear Boundary Condition." Birmingham, Alabama, February 19, 1988.
- (\*) B. University of Heidelberg. "The Critical Exponent for Reaction-Diffusion Equations in Unbounded Domains." Heidelberg, Germany, June 14, 1988.
- (\*) C. University of Dundee. Plenary lecture: "The Long Time behavior of Solutions of Reaction-Diffusion Equations in Unbounded Domains: A Survey." 10th Dundee Conference on the Theory of Ordinary and Partial Differential Equations, July 4-8, 1988.
- D. Iowa State University. "Critical Exponents for Reaction-Diffusion Equations." Ames, Iowa, August 30, 1988.
- E. Iowa State University. "Critical Exponents in Cones." 17th Midwest Differential Equations Conference, Ames, Iowa, October 29, 1988.

### **1989**

- (\*) A. Southwest Louisiana State University, "Advances in Quenching", Lafayette, Louisiana, April 21, 1989.

- (\*) B. Texas A & M, “Quenching, Non-quenching and Beyond Quenching”, College Station, Texas, May 2, 1989.
- (\*) C. Emory University, “The Role of Critical Exponents in Blow Up Theorems”, Atlanta, Georgia, May 4, 1989.
- (\*) D. Argonne National Laboratory, “The Role of Critical Exponents in Blow Up Theorems”, Argonne, Illinois, June 8, 1989.
- (\*) E. Gregynog Conference on Nonlinear Diffusion Equations and their Equilibrium States, “Advances in Quenching, A Survey of Recent Literature”, Gregynog, Wales, August 20-29, 1989.
- F. Iowa State University, “Critical Exponents in Blow Up Theorems; Revisited.” Ames, Iowa, October 31, 1989.

**1990**

- (\*) A. University of Alabama, Birmingham Conference International Conference Differential Equations and Mathematical Physics, “The Role of Critical Exponents in Blow Up Theorems”, Birmingham, Alabama, March 15-21, 1990 (Expenses offered and declined).
- (\*) B. University of Houston, “A Survey of the Role of Critical Exponents in Blow Up Theorems”, Houston, Texas, April 18, 1990.
- (\*) C. University of Heidelberg, “A Fujita Type Global Existence - Global Nonexistence Theorem for a System of Reaction - Diffusion Equations”, Heidelberg, Germany, June 21, 1990.
- (\*) D. Cornell University, “A Fujita Type Global Existence - Global Nonexistence Theorem for a System of Reaction-Diffusion Equations”, Workshop on Partial Differential Equations held in honor of L.E. Payne, Ithaca, New York, October 5-7, 1990.
- (\*) E. University of Northern Illinois, “A Fujita Type Global Existence-Global Nonexistence Result for a System of Reaction - Diffusion Equations”, DeKalb, Illinois, October 14, 1990.
- (\*) F. Argonne National Laboratory “A Fujita Type Global Existence-Global Nonexistence Result for a System of Reaction-Diffusion Equations”, Argonne, Illinois, October 19, 1990.
- G. Iowa State University, “Blow up Theorems for Nonlinear Heat Equations”, Opening lecture for the new Mathematical Physics Seminar Series, Physics Department (R. Leacock, organizer) Ames, Iowa, September 14, 1990.

**1991**

- (\*) A. Technische Universitat, Delft. “Inequalities between Dirichlet and Neumann Eigenvalues”, Functional Analysis Colloquium, Delft, Netherlands, June 12, 1991.
- (\*) B. First European Conference on Elliptic and Parabolic Problems, plenary lecture “Fujita Type Theorems for Systems of Weakly Coupled Parabolic Equations”, held at Pont-a-Mousson, France, June 17-21, 1991.
- (\*) C. Fourth Czechoslovak Summer School on Dynamical Systems, “Critical Blow Up Exponents for Single Equations and for Systems” (two lectures). Bratislava, Czechoslovakia, June 24-29, 1991.
- (\*) D. University of Heidelberg, “Inequalities between Dirichlet and Neuman Eigenvalues”, Heidelberg, Germany, July 4, 1991.
- (\*) F. University of Friburg, “A Survey of Fujita Type Results for Semi-Linear Equations”, Friburg, Germany, July 11, 1991.
- (\*) G. Universidad del Pais Vasco, “Some recent advances in quenching”, Bilbao, Spain, October 11, 1991.

**1992**

- A. Iowa State University, “Minding your p’s and q’s: A Fujita type blow up Theorem for a System of Weakly Coupled Parabolic Equations,” January 27, 1992.
- (\*) B. Universidad del Pais Vasco, “Exponentes criticos y resultados de explosion en ecuaciones de evolucion no lineales” (delivered in English), Bilbao, Spain, March 5, 1992
- C. Georgia Tech-UAB International Conference on Differential Equations and Mathematical Physics, “A Fujita type blow up theorem for a system of parabolic equations with differing diffusivities”, Atlanta, Georgia, March 22-28, 1992

- (\*) D. Tulane University, "The role of critical exponents in blow up theorems for systems of reaction-diffusion equations", New Orleans, LA. April 9, 1992.
- (\*) E. University of Southwest Louisiana, "Critical blow up exponents for reaction diffusion and Schrödinger equations", Lafayette, La., April 8, 1992.
- (\*) F. University of Nebraska, "Critical exponents for systems of equations", Lincoln, Nebraska, October 20, 1992.
- (\*) G. Workshop on Dynamical Systems Theory and its Applications, "A blow up theorem of Fujita type for a system of reaction-diffusion equations with differing diffusivities", held at Kyoto, Japan, November 2, 1992.
- (\*) H. University of Tokyo, "Fujita type blow up theorems in parabolic differential equations", Tokyo, Japan, November 5, 1992.
- (\*) I. Tokyo Metropolitan University, "A Fujita type global existence-global nonexistence theorem for a system of reaction-diffusion equations", Tokyo, Japan, November 6, 1992.
- (\*) K. International Conference on Nonlinear Problems in Industry, "Recent advances in the problem of quenching", Iwaki, Japan Plenary lecturer, November 9-14, 1992.

### **1993**

- A. Iowa State University, Graduate Student Colloquium, "What is a Well Posed Problem", Ames, Iowa, February 18, 1993.
- (\*) B. Seoul National University, "Fujita type blow up theorems for reaction diffusion equations in unbounded domains", Seoul, Korea, May 18, 1993.
- (\*) C. Youn Sei University, "Inequalities between Dirichlet and Neumann Eigenvalues," Seoul, Korea, May 19, 1993.
- (\*) D. Cheju National University, "Fujita type blow up theorems for reaction diffusion equations in unbounded domains", Cheju, Korea, May 20, 1993.
- (\*) E. Chonnam National University, "Advances in quenching", Kwanju, Korea, May 22, 1993.
- (\*) F. Korean Institute of Science and Technology, University, "Inequalities between Dirichlet and Neumann eigenvalues", Taejion, Korea, May 24, 1993.
- (\*) G. Susan National University, "Inequalities between Dirichlet and Neumann eigenvalues", Pusan, Korea, May 25, 1993.
- (\*) H. Pusan National University, "Fujita type blow up theorems for systems of reaction diffusion equations in  $R^N$ ", Pusan, Korea, May 25, 1993.
- (\*) I. Kyungpook, University, "Fujita type blow up theorems for systems of reaction diffusion equations in  $R^N$ ", Taegu, Korea, May 26, 1993.
- (\*) J. Keimyung University, "Advances in quenching", Taegu, Korea, May 27, 1993.
- K. Fields Institute for Research in Mathematical Sciences, "Some Fujita type blow up theorems for systems of reaction diffusion equations", Symposium on Comparison Methods and Stability Theory, University of Waterloo, Waterloo, Ontario, Canada, June 5, 1993.
- L. Dublin City University, "Fujita type blow up theoryems for systems of reaction diffusion equations with differing diffusivities", Third Dublin Differential Equations Meeting, Dublin, Ireland, September 12-16, 1993.
- (\*) M. Comenius University, "A Fujita type blow up theorem for a system of degenerate reaction diffusion equations", Bratislava, Slovakia, October 12, 1993.
- (\*) N. Stephan Banach Mathematical Center, "An introduction to Fujita type blow up theorems for systems of reaction diffusion equations", Symposium on singularities and differential equations, Workshop on Geometric and Analytic Methods in Partial Differential Equations, October 16, 1993.

### **1994**

- A. Special Session on Nonlinear Partial Differential Equations, " A Fujita type global-existence global nonexistence theorem for a system of degenerate reaction-diffusion equations, American Mathematical Society National Meeting, Cincinnati, Ohio, January 15, 1994
- B. Iowa State University, "Modeling of diffusion processes",  $\pi\mu\varepsilon$  lecture, March 6, 1994.
- C. Special Session on Critical Phenomena in Nonlinear Partial Differential Equations " Critical

exponents for quasi-linear and semi-linear parabolic equations” American Mathematics Society Regional Meeting, Manhattan, Kansas March 24, 1994.

- D. Iowa State University, Graduate Student Colloquium, ” An introduction to deterministic transport processes”, Ames, Iowa April 20, 1994.
- (\* E. University of Dundee, ”A survey of new critical exponent results for semi-linear parabolic equations and systems”, Dundee, Scotland, September 15, 1994.
- (\* F. University of Bristol, ” A survey of new critical exponent results for semi-linear parabolic equations and systems””, Bristol, England, September 21, 1994.
- (\* G. University of Minnesota, Institute for Mathematics and its Applications, ” An introduction to the theory of critical blow up exponents”, Minneapolis, Minnesota, November 29, 1994
- (\* H. University of Minnesota, Special topics in PDE seminar, ”Some remarks on the effect of nonlinearities on solutions of time dependent equations ,” November 30, December 2, 1994.

### 1995

- (\* A. Universidad del Pais Vasco, ”A system of reaction-diffusion equations arising in chemotaxis,” Bilbao, Spain, January 16, 1995
- (\* B. Universidad Autonoma de Madrid, ”A system of reaction-diffusion equations arising in chemotaxis,” January 20, 1995
- (\* C. Universite de Paris-Sud et Centre National de la Recherche Scientifique, ”Some recent results for Fujita type critical blow up exponents,” Paris, France, January 26, 1995
- (\* D. École Normale Supérieure, ”A system of reaction-diffusion equations arising in chemotaxis,” January 24, 1995
- E. Special Session on Improperly Posed Problems, ”An ill posed problem arising in chemotaxis”, American Mathematical Society Regional Meeting, Orlando, Florida , March 17-19, 1995.
- (\* F. Comenius University, Applied Mathematics Colloquium, ”Blow-up, collapse and aggregation for a system of partial differential equations arising in chemotaxis,” Bratislava, Slovakia, April 24, 1995.
- (\* G. Comenius University, Applied Mathematics Colloquium, ”The influence of damping on blow-up for solutions of semi-linear wave equations,” Bratislava, Slovakia, May 5, 1995.
- (\* H. Universitat zu Köln, ”Blow-up, collapse and aggregation for a system of partial differential equations arising in the theory of reinforced random walks,” May 12, 1995.
- (\* I. Middle East Technical University, ”Can Damping inhibit Blow-up?” Workshop on Nonlinear Problems in Mathematical Physics II, Ankara, Turkey September 14, 1995.
- (\* J. Middle East Technical University, ”Fujita type Blow-up theorems since 1991” Workshop on Nonlinear Problems in Mathematical Physics II, Ankara, Turkey, September 16, 1995.
- K. Iowa State University, ”Can Damping inhibit Blow-up?” Ames, Iowa, October 11, 18, 1995.
- (\* L. University of Notre Dame, ”Can Damping inhibit Blow-up?” Notre Dame, Indiana, December 5, 1995.

### 1996

- A. Special Session on Nonlinear Partial Differential Equations, ”Can Damping inhibit Blow-up?”, American Mathematics Society Regional Meeting, Iowa City, Iowa, March 25, 1996..
- (\* B. Heriot-Watt University, ”Aggregation, Blow up and Decay in Chemotaxis”, Edinburgh, Scotland, May 16, 1996.
- (\* C. University of Glasgow ”Aggregation, Blow up and Decay in Chemotaxis”, Glasgow, Scotland, May 17, 1996.
- D. University of Leeds, ”Can Damping inhibit Blow-up?”, Leeds, England, May 29, 1996.
- (\* E. University of Portsmouth, ”Aggregation, Blow up and Decay in Chemotaxis”, Portsmouth, England, June 13, 1996.
- (\* F. University of Iowa, ”Aggregation, Blow up and Decay in Chemotaxis,” Colloquium Lecture, Iowa City, Iowa, October 3, 1996.
- G. Iowa State University, ”Aggregation, Blow up and Decay in Chemotaxis (I)”, PDE Seminar, Ames, Iowa, October 16, 1996.

- H. Special Session on Partial Differential Equations and Mathematical Physics “Buckling Eigenvalues for a Clamped Plate and other problems, ” American Mathematical Society Regional Meeting, Columbia, Missouri, November 2, 1996
- I. Iowa State University, “Aggregation, Blow up and Decay in Chemotaxis (II)”, Mathematical Biology Seminar, November 6, 1996.

**1997**

- A. Iowa State University, “An Introduction to Chemotaxis”, Graduate Student Colloquium, Ames, Iowa, January 22, 1997.
- B National Academy of Sciences of Ukraine, Institute of Applied Mathematics, International Conference on Nonlinear PDE, Plenary speaker, August, 26, 1997 (I. Skrypnik, Organizer).. I declined this invitation but I did submit an abstract.
- C Iowa State University, “The motion of a particle on a curved surface under the influence of gravity “. Pi Mu Epsilon talk, Ames, Iowa, November 7, 1997.

**1998**

- (\* A. Univeritat zu Köln, “The influence of damping on blow up for the Cauchy problem for a semi-linear wave equation.” Cologne, Germany, January 21, 1998
- (\* B. Mathematisches Forschungsinstitut, Oberwolfach, “A system of reaction-diffusion equations arising in the theory of reinforced random walks’, Conference on Geometric Questions in Partial Differential Equations, Lorenzenof, Germany, January 25-31, 1998.
- C. Iowa State University, “Blow up of solutions of the Cauchy problem for a wave equation with nonlinear damping and source terms and large initial energy”, Recent Trends and Advances in PDEs and Numerical PDEs, a conference held in honor of Olga Ladyzhenskaya, Ames, Iowa, August 2-5, 1998.
- (\* D. University of Minnesota, Institute for Mathematics and its Applications, “A mathematical model for the onset of angiogenesis in tumor growth”, IMA program on Mathematical Biology, Workshop #2, Pattern Formation and Morphogenesis: Model Systems, Minneapolis, Minnesota, September 14-18, 1998.
- (\* E. University of Minnesota, Institute for Mathematics and its Applications, “ A mathematical model for angiogenesis in tumor growth .” Cancer Minisymposium, IMA program on Mathematical Biology, Minneapolis, Minnesota, November 15-19, 1998.
- F. Iowa State University, “A mathematical model for the onset of angiogenesis in tumor growth”, Physiology Council Minisymposium, Iowa State University, December 4, 5, 1998.
- (\* G. Kyoto University, “A mathematical model for angiogenesis in tumor growth”, Workshop on Blow-up, Breakdown, and Related Topics in Nonlinear PDE” in honor of the 70<sup>th</sup> birthday of Hiroshi Fujita, Kyoto, Japan, December 8-11, 1998.

**1999**

- (\* A. University of Nebraska, “A mathematical model for vasuclarization in malignant tumor growth”, Workshop on Mathematical Methods in the Geosciences and Related Areas, Lincoln, Nebraska, March 15-19, 1999.
- (\* B. University of Basel, “ Global existence and global nonexistence theorems for semilinear wave equations with nonlinear damping terms”, Basel, Switzerland, April 8, 1999.
- (\* C. University of Basel, “ An introduction to the mathematical modeling of angiogenesis in tumor growth”, Basel, Switzerland, April 9, 1999.
- D. Iowa State University , “ An introduction to modeling tumor growth”, GSC Colloquium, April 28, 1999.
- E. University of Leeds, “A mathematical model for vasuclarization in malignant tumor growth”, Leeds, England, July 6, 1999.
- (\* F. University of Sheffield, “A mathematical model for vasuclarization in malignant tumor growth”, North British Symposium on Differential Equations Invited Lecturer, Sheffield, England, July 13, 1999.



- (\*) G. Manchester Institute of Science and Technology, “A mathematical model for vasuclarization in malignant tumor growth”, North British Symposium on Differential Equations Invited Lecturer, Manchester, England, July 14, 1999.

## **2000**

- A. Iowa State University “ New critical blow up exponents of Fujita type”, Ames, Iowa, February, 2000.
- B. AMS Special Session, “A conjecture involving single point and double point blow up in chemo-taxis”, March, 2000 (I was unable to give this talk because of weather related travel difficulties.)
- (\*) C. University of Memphis, “ Global existence and global nonexistence theorems for semilinear wave equations with nonlinear damping terms”, Memphis Lectures, March 16-19, 2000.
- (\*) D. University of Memphis, “An introduction to chemotaxis, aggregation, blow up, and collapse”, Memphis Lectures, March 16-19, 2000.
- (\*) E. University of Memphis, “A mathematical model for vasuclarization in malignant tumor growth”, Memphis Lectures, March 16-19, 2000.
- (\*) F. Center for Wiskunde und Informatik, “A mathematical model for vasuclarization in malignant tumor growth”, Amsterdam, Netherlands, June 23, 2000.
- (\*) G. University of Strathclyde “ New critical blow up exponents of Fujita type”, North British Symposium on Differential Equations Invited Lecturer, Glasgow, Scotland, UK, June 27, 2000.
- (\*) H. University of Dundee “An introduction to chemotaxis, aggregation, blow up, and collapse”, North British Symposium on Differential Equations Invited Lecturer, Dundee, Scotland, UK, June 28, 2000.
- I. University of Leeds “ New critical blow up exponents of Fujita type”, Leeds, England, July 3, 2000.
- J. SIAM Pacific Rim Conference on Dynamical Systems, “A mathematical model for vasuclarization in malignant tumor growth”, Maui, Hawaii, August 10, 2000.
- K. University of Wisconsin, Green Bay, “A mathematical model for vasuclarization in malignant tumor growth”, Green Bay, Wisconsin, November 7, 2000.
- (\*) L. Mathematisches Forschungsinstitut, Oberwolfach, “Mathematical modelling of capillary formation and development in tumor angiogenesis: From the onset of tumor necrosis to the beginning of tumor vascularization”, RIP Workshop on Mathematical Problems in Modelling and Control, Lorenzenof, Germany, November 26 - December 2, 2000.

## **2001**

- (\*) A. Feza Gürsey Institute, Research Semester on Qualitative Theory of Non-linear Partial Differential Equations, Tübitak-Bogazici University, Istanbul, Turkey. Three lectures:
  1. “A survey of Fujita type blow up results since 1995”, March 12, 2001.
  2. “Global existence and global nonexistence theorems for semilinear wave equations with non-linear damping terms”, March 13, 2001.
  3. “An introduction to chemotaxis, aggregation, blow up, and collapse”, March 14, 2001.
- (\*) B. Vanderbilt University, “A mathematical model for vasuclarization in malignant tumor growth”, Colloquium lecture, Nashville, Tennessee, March 28, 2001.
- C. Iowa State University, “A system of equations arising in cell signaling,” Navier Stokes Weekend at ISU, Ames, Iowa, April 7, 2001.
- (\*) D. Winona State University, ”A mathematical model for tumor angiogenesis” Colloquium lecture, Winona, Minnesota, April 17, 2001.
- (\*) E. Wuhan University, “A biochemical approach to tumor angiogenesis”, Plenary Speaker, International Conference on Partial Differential Equations and Mathematical Biology, Wuhan, China, May 7, 2001.
- (\*) F. Wuhan University, “The mathematical underpinings of aggregation, blow-up an collapse”, International Conference on Partial Differential Equations and Mathematical Biology, Wuhan, China, May 11, 2001.
- (\*) G. Beijing University, “ New critical exponents of Fujita type,” Beijing, China May 14, 2001.
- (\*) H. University of Durham, “ The mathematical underpinings of aggregation, blow-up an collapse,”

London Mathematical Society International Symposium on Combustion Theory, Durham, England, UK July 5-11, 2001.

- (\*) I. University of Minnesota, “The role of cell signaling and transduction in angiogenesis,” Symposium to Celebrate the 75<sup>th</sup> Birthday of James Serrin, Minneapolis, Minnesota, November 8-11, 2001.
- (\*) J. University of Bath, “A model for tumor angiogenesis: From the avascular state to the onset of vascularization” Bath, England, UK, November 24, 2001.
- (\*) K. University of Cambridge, “A biochemical approach to tumor angiogenesis” Dynamical Systems Seminar, Cambridge, England, UK November 28, 2001.
- (\*) L. University of Leeds, “The role of cell signaling and transduction in angiogenesis,” Euromech Colloquium 422 and a satellite workshop to the Isaac Newton Institute programme From Individual to Collective Behaviour in Biological Systems, December 2-5, 2001, Leeds, England.
- (\*) M. University of Strathclyde, “A biochemical approach to tumor angiogenesis” Glasgow, UK, December 17, 2001.

## **2002**

- (\*) A. Northwestern University, “A new mathematical model for tumor angiogenesis: From the onset of necrosis to tumor vascularization.” Evanston, Ill., January 7, 2002.
- (\*) B. Vanderbilt University, “A mathematical model for the role of cell signal transduction in the initiation and inhibition of angiogenesis”, Workshop on Mathematical Models in Cancer, Nashville, Tennessee, May 3-5, 2002.
- (\*) C. Max Plank Institute for the Natural Sciences, “A model for tumor angiogenesis based on stromal stem cell response to tumor secreted growth factor”, Leibzig, Germany, June 19, 2002.
- (\*) D. University of Tennessee, “A model for tumor angiogenesis based on stromal stem cell response to tumor secreted growth factor”, International Conference on Mathematics and Biology and 2002 Annual Meeting of the Society of Mathematical Biology, Knoxville, Tennessee, July 13-16, 2002.
- E. Iowa State University, GSC Colloquium, “A model for the movement of D. Discoideum: aggregation, blow up and collapse”, Ames, Iowa, October 16, 2002
- (\*) F. Department of Mathematics, University of Minnesota, Duluth, “A model for the movement of D. Discoideum: aggregation, blow up and collapse”, Duluth, Minnesota, October 31, 2002.
- (\*) G. Department of Chemistry, University of Minnesota, Duluth, “A biochemically based model for the onset of tumor angiogenesis”, Duluth, Minnesota, November 1, 2002.

## **2003**

- (\*) A. University of Alberta, “Mathematical modeling of capillary formation and development in tumor angiogenesis”, Edmonton, Alberta, January 30, 2003.
- (\*) B. University of Alberta, ‘Singularity formation in parabolic models of chemotaxis’, Edmonton, Alberta, January 31, 2003.
- ( ) C. Iowa State University, “Singularity formation in parabolic models for chemotaxis”, Ames, Iowa, April 26, 2003
- (\*) D. The Ohio State University, Mathematical Biosciences Institute, “Mathematical modeling of capillary formation and development in tumor angiogenesis” Columbus, Ohio, September 9, 2003
- (\*) E. Northwestern University, “Singularity formation in parabolic models for chemotaxis” Department of Engineering Science and Applied Mathematics, October 20, 2003.
- (\*) F. The Ohio State University, Mathematical Biosciences Institute, “Avascular tumor formation: A mathematical model for the onset of avascular tumor growth in response to the loss of p53 function”, Workshop on Mathematical challenges arising in cancer models, Columbus, Ohio, November 17-19, 2003.
- (\*) F. The Ohio State University, “A blow up conjecture of Nagai in in chemotaxis - True or False?”, Columbus, Ohio, December 9, 2003.

## **2004**

- (\*) A. University of Tennessee, “A blow up conjecture of Nagai in in chemotaxis - True or False?”, Department of Mathematics PDE Seminar, Knoxville, Tenn., March 22, 2004.
- (\*) B. University of Texas, ‘Mathematical modeling of capillary formation and development in tumor angiogenesis’, Austin, Texas, March 25, 2004.

- (\* B. MD Anderson Cancer Center, “Mathematical modeling of capillary formation and development in tumor angiogenesis’, Departments of Plastic Surgery and Applied Mathematics”, Houston, Texas, March 26, 2004.

### **2005**

- (\* A. University of California, Irvine, Applied Mathematics Seminar, “A mathematical model for the regulation of tumor dormancy based on enzyme kinetics”, Irvine, CA, April 4, 2005
- (\* B. IAS/Park City Mathematics Institute (PCMI) Summer Session, “A mathematical model for the regulation of tumor dormancy based on enzyme kinetics”, Park City Utah, June 25-July 16, 2005

### **2006**

- (\* A. University of Notre Dame, Applied Mathematics Colloquium, ‘A mathematical analysis of SELEX’ South Bend, IN, April 7, 2006
- (\* B. AMS Special Session in Mathematical Biology ”, “A mathematical model for the regulation of tumor dormancy based on enzyme kinetics”, South Bend, Indiana, April 8-9, 2006
- (\* C. Cells and Materials Seminar Series Speaker, Institute for Pure and Applied Mathematics, UCLA, “A mathematical analysis of SELEX (Systematic Evolution of Ligands by Exponential Selection)”, Los Angeles, CA, April 17, 2006.
- (\* D. Cells and Materials Seminar Series Speaker, Institute for Pure and Applied Mathematics, UCLA), “A model for dormant tumor growth at a distance”, Los Angeles, CA, May 4, 2006.
- (\* E. Workshop III: Angiogenesis, NeoVascularization and Morphogenesis May 8 - 12, 2006, Institute for Pure and Applied Mathematics, UCLA, plenary speaker, “Angiogenesis-A biochemical/mathematical perspective”, Los Angeles, CA, May 8, 2006.
- F. Mathematical Biology Seminar, Iowa State University, “ A mathematical analysis of SELEX (Systematic Evolution of Ligands by Exponential Selection)”, Ames, Iowa, September 14, 2006
- G. BCB Faculty Seminar’, Iowa State University ‘A mathematical model for the regulation of tumor dormancy based on enzyme kinetics ’ Ames, Iowa, October 6, 2006
- H. Truman State University, Mathematics Department “A mathematical model for the regulation of tumor dormancy based on enzyme kinetics”, Kirksville, Mo., December 7, 2006

### **2007**

- (\* A. St. Thomas University, Mathematics Department, “A mathematical model for the regulation of tumor dormancy based on enzyme kinetics”, Saint Paul, Minnesota, February 9, 2007.
- (\* B. University of Michigan, Mathematics Department, “A mathematical model for the regulation of tumor dormancy based on enzyme kinetics”, Ann Arbor, MI., April 13, 2007
- (\* C. University of Michigan, Mathematics Department, “A mathematical analysis of SELEX (Systematic Evolution of Ligands by Exponential Selection)”, Ann Arbor, MI., April 14, 2007.
- (\* D. The Ohio State University, Mathematical Biosciences Institute, Post Doc research Seminar (1) “A mathematical model for the regulation of tumor dormancy based on enzyme kinetics”, Columbus, Ohio, May 31, 2007
- (\* E. The Ohio State University, Mathematical Biosciences Institute, Post Doc research Seminar (2), “A mathematical analysis of SELEX (Systematic Evolution of Ligands by Exponential Selection)”, Columbus, Ohio, May 31, 2007.
- (\* F. Osaka University, The 21st Century COE Program ”Towards a New Basic Science: Depth and Synthesis”, Plenary speaker, “A mathematical model for the regulation of tumor dormancy based on enzyme kinetics,” Osaka, Japan, September 10, 2007
- (\* G. The Ohio State University, Mathematical Biosciences Institute, “A mathematical feasibility argument for the use of aptamers in drug therapy and in imaging”, A conference in honor of Avner Friedman’s 75<sup>th</sup> birthday: Differential Equations and Mathematical Biology, Columbus, Ohio, November 15-18, 2007.

### **2008**

- (\* A. Marrakesh International Conference and Workshop on Mathematical Biology, “A mathematical model for the regulation of tumor dormancy based on enzyme kinetics,” Marrakesh, Morocco, January 6, 2008

- (\*) B. Marrakesh International Conference and Workshop on Mathematical Biology, "A mathematical feasibility argument for the use of aptamers in drug therapy and in imaging", Marrakesh, Morocco, January 6, 2008
- (\*) C. University of Minnesota, Institute for Mathematics and its Applications, "A Mathematical Analysis of single and multiple target SELEX", Minneapolis, Minnesota, May 14, 2008
- (\*) D. University of Alabama, Huntsville, Karen Ames Memorial Lectures in Applied Mathematics, "A mathematical feasibility argument for the use of aptamers in drug therapy and in imaging", Huntsville, Alabama, September 5, 2008
- F. Iowa State University, Computational and Applied Math Seminar, "Classical properties of solutions of some elliptic boundary value problems", Ames, Iowa September 15, 2008
- (\*) F. University of Minnesota, A Symposium In Honor of Hans F. Weinberger, "Spectral Properties, Regularity and Bounds for Solutions of Elliptic Boundary Value Problems", Minneapolis, Minnesota, October 4, 2008

## University service

### 1. Departmental

1. Screening Committee (1978-1981)
2. Graduate Committee (1981-82), (1983-86)
3. Colloquium Co-Chair (1982-86)
4. Organized P.D.E. Seminar (1979-85)
5. High Energy Physics Search Committee (1981-82)
6. Analysis Examination Committee (1983-85)
7. Applied Math Examination Committee (1987-88)
8. Numerical Analysis Examination Committee (1987-90)
9. PDE Search Committee Chair (1984-88)
10. Coordinating and Policy Committee (1987-89) (Chair, 1987-88)
11. Department Executive Officer Advisory Committee (1985-86), (1988-1989)
12. Individual Review Team for Associate Professors (1988-1989)
13. Coordinating and Policy Committee (1993-96) (Chair, 1993-94)
14. Applied Mathematics Search Committee (1995-96)
15. Individual Review Team for Associate Professors (1995-96)
16. Chair, Ad-hoc committee on research criteria and standards for faculty evaluation and promotion (Fall, 1996).
17. Individual Review Team member for Sunny Canic, (Fall, 1997)
18. Chair, Individual Review Team for Micheal Smiley, (Fall, 1997)
19. Coordinating and Policy Committee (1997-1998)
20. Represented the department at IMA chairman meeting, April, 1998.
21. Chair, Applied Mathematics Search Committee (1998-99)
22. Chair, Full Professor Review Committee (1998-99).
23. Mentor for Xiaoming Wang (1998-99)
24. Applied Math Examination Committee (1998-99, Chair, 1999-2000)
25. Chair, Honors and Awards Committee (1999-2000)
26. Chair, DEO Review Committee (1999-2000)
27. Member, Advisory Committee (1999-2000)
28. Replacement Member, Advisory Committee (Spring, 2002)
29. Chair, Honors and Awards Committee (2004-2007)
30. Member, Assistant Professor Review Committee (2007-08)
31. Member, Individual Review Team for K. Boushaba (Fall, 2008)

### 2. College

1. Honors and Awards (replaced K. Athreya, 1986-87)
2. Chair, DEO Search Committee (Spring, 1989)

3. Faculty Development Committee (2000-2003)
4. Chair, Computer Science DEO Search Committee, (2000-2001)
5. Chair, Internal DEO Search Committee for Mathematics, (2001)
6. Member, Distinguished Professor Nominating Committee (2002- 2003)

### 3. University

1. Physical Sciences Program Review Committee (1983-87)
2. Graduate Council (1984-86)
3. Graduate Cabinet (1985-87)
4. Vice President for Academic Affairs ad hoc Committee to review faculty grievance processes, (Dean Kelly, Chair), April 1985-April 1987.
5. Chair, DEO Search Committee for combined Aeronautical engineering/Engineering Science and Mechanics Departments. (1989-1990)

### 4. Other significant service not listed above

I initiated a long term program to build an active group in partial differential equations when I came to Iowa State University in 1978. The group has had as many as six faculty members although it currently has only five (Lieberman, Levine, Smiley, Sacks, Boushaba). All are actively engaged in research. The group has acquired an international reputation in this area as well as having attracted a considerable amount of outside funding for research. It formed the nexus for the successful formation of groups in numerical partial differential equations and in the control of partial differential equations.

Anne Steiner and I (during her tenure as DEO) convinced the University Administration that an institutional membership in the Institute for Mathematics and its Applications at the University of Minnesota would be in the long term best interests of the Mathematic Department and Iowa State University as a whole. We have been a participating institution since 1985. Since then, the University has received (in the form of grants, small and large, to our faculty) far more monies than it has spent on membership. At least one of our faculty members has had a post doctoral position at the IMA while several have obtained supplemental support for their Faculty Improvement Leaves from the IMA.

### 5. Department Executive Officer (July 1, 1989- June 30, 1992)

I have listed here some of the projects and activities that have taken up a good deal of my time beyond the ordinary duties of the DEO such as budget planning, ordinary personnel matters (promotion and tenure etc.).

1. (Fall 1989) Drafted a long range plan for the Department. Approved by the department (with modifications of a minor nature) by a vote of 33-3. Endorsed by the College.
2. Attended IMA Chairman's Meeting in Chicago (for K. Heimes) April, 1989 (IMA funded)
3. Attended Conference Board of Mathematical Sciences Chairman's Meeting, October, 1989 (Department and Provost's Office funded).
4. Attended IMA Chairman's Meeting in Chicago, April 22, 1990 (IMA funded)
5. Submitted a proposal for Graduate Assistance in Areas of National Need to the Department of Education, January, 1990. This proposal was not funded. There was 2.9M available and 147 proposals submitted. Only 19 were funded.
6. NSF Proposal submitted (Fall 1990) (also submitted to ONR, ARO) (A separate proposal was also sent to AFOSR.)
7. Added Carver 404 and Carver 196 to the Department's inventory of rooms (1990-91). Carver 404 is the J.L. Hinrichsen Faculty Common Room. Money for its refurbishing was donated by the Hinrichsen family. Carver 196 is the Mathematics Help Room. After several years of rather unsatisfactory solutions to the problem of the lack of a help room, we persuaded Facilities Planning and Management to dedicate a room in Carver for this purpose.
8. Increased office staff from 4 to 6 secretaries, one of whom monitors the reading room (1989-90).

9. Retained more departmentally generated funds in the department including obtaining complete departmental control over remedial math budget. We also control all grant buyout funds (Fall, 1989). Account converted to roll over type (Fall, 1991).
10. Reorganized front office for more efficient paper processing.
11. Increased the amount of computer equipment including the addition of 17 Project Vincent Workstations to the department's equipment base. (Later Vincent II brought this to 21 workstations.)
12. Added a full time professional computer hardware and software manager to the department's support staff (Fall, 1990).
13. Attended IMA Chairman's meeting April 21, 1991.
14. Added an Associate Chairman (Mike Smiley) to aid in more efficient scheduling. He also spent considerable time creating data bases for the Department.
15. Remodeled and redecorated faculty and departmental offices (1990-91).
16. The completion of the computerization of faculty offices was carried out.
17. (With Mathews) Submitted a proposal to the Department of Energy (through the Office of Minority Student Affairs) to fund to minority graduate fellowships in the MSM program. (1991-92).
18. Ad hoc committee to review the role and scope of teacher preparation classes in the LAS College (Appointed by the dean.) (1991-92).
19. GAANN proposal (Graduate Assistantships in Areas of National Need) prepared for submission to the U. S. Department of Education) (With E. Johnston). (Spring, 1992, Fall, 1992).
20. Reading Room report (with J. D. Smith) prepared for Parks Library (Spring, 1992). This report was prepared at the request of the Library in response to a suggestion from a University committee studying space that recommended the closing of remote reading rooms. The report was instrumental in preventing the closing of the room.