

**RALPH E. SHOWALTER**  
**BIOGRAPHICAL DATA**

***Education***

Ph.D.	University of Illinois	1968
M.A.M.	North Carolina State University	1965
B.S.	North Carolina State University	1964

***Professional Experience***

2003—	Professor, Oregon State University
2004-07	Chair, Department of Mathematics
12/94	Visiting Research Professor, Purdue University
1-5/93	Visiting Professor, ICAM, VPI & State University
7/90, 6/91	Visiting Professor, Institut für Mathematik, Universität Augsburg
1982-83	Visiting Professor, Brown University
1978-2003	Professor, The University of Texas at Austin
1972-78	Associate Professor, University of Texas at Austin
1968-72	Assistant Professor, University of Texas at Austin
1965	Consultant, Corning Electronics

***Professional Societies***

Society for Industrial and Applied Mathematics  
(SIAM Activity Groups on *Geosciences* and *Analysis of Partial Differential Equations*)  
American Mathematical Society (1967-2012)

**Awards**

1995—	Jane and Roland Blumberg Centennial Professor in Mathematics,
1992-1994	Joe B. and Louise Cook Professorship in Mathematics,
1992-1993	University Research Institute Faculty Research Assgn.
1982-1983	University Research Institute Faculty Research Assgn.
1965-1968	National Science Foundation Fellowship

**PROFESSIONAL SERVICE**

Editorial Board Applicable Analysis, Advances in Mathematical Sciences and Applications, Communications in Applied Analysis, Electronic Journal of Differential Equations, Electronic Journal of Mathematical and Physical Sciences, International Journal of Differential Equations and Applications, International Journal of Mathematics and Mathematical Sciences, International Journal of Pure and Applied Mathematics, International Journal of Mathematical Analysis, Mathematical Methods in the Applied Sciences

Referee for Advances in Mathematical Sciences and Applications, Applicable Analysis, Applied Mathematics and Computation, Applied Mathematics Letters, Archive for Rational Mechanics and Analysis, Boundary Value Problems, Canadian Journal of Mathematics, Communications in Applied Analysis, Communications in Partial Differential Equations, Computational Geosciences, Czechoslovak Mathematical Journal, Differential and Integral Equations, Electronic Journal of Differential Equations, European Journal of Applied Mathematics, Geophysical Journal International, Houston Journal of Mathematics, IEEE Transactions, Circuits and

Systems, Illinois Journal of Mathematics, Indiana University Mathematics Journal, Israel Journal of Mathematics, Journal of Applied Mathematics, Journal of Applied Mechanics (ASME), Journal of Differential Equations, Journal of Evolution Equations, Journal of the Indian Mathematical Society, Journal of Mathematical Analysis and Applications, Journal of Mathematical Physics, Journal of Nonlinear Analysis, Journal of Theoretical Biology, Mathematical Methods in the Applied Sciences, Mathematische Nachrichten, Numerical Functional Analysis and Optimization, Pacific Journal of Mathematics, Proceedings of the American Mathematical Society, Proceedings of the Royal Society of Edinburgh, Quarterly Journal of Applied Mathematics, SIAM Journal on Mathematical Analysis, SIAM Journal on Numerical Analysis, SIAM Journal on Control and Optimization, Transactions of the American Mathematical Society, Zeitschrift für Analysis und Anwendungen, Zeitschrift für Angewandte Mathematik und Mechanik,

Reviewer for Mathematical Reviews, SIAM Review, National Science Foundation, U.S. Army Research Office, Department of Energy, Natural Sciences and Engineering Research Council of Canada

### ***Additional Professional Service***

Member of Water Resources Graduate Program, OSU

Member of Review Panels, National Science Foundation

Organizer of *Northwest Consortium for Multiscale Mathematics and Applications*

Member of Scientific Committee, Conference on Differential and Integral Equations (DIEQ'99), Chelyabinsk, June 22-26, 1999.

Member of Scientific Committee, "Differential and Integral Equations, Mathematical Models" Chelyabinsk, February 4-11, 2002.

Panelist, Forward Looking Session, SIAM December 10-12, 2007.

Chair, External Review Committee, Colorado State University Department of Mathematics, 2009.

co-editor, Special Issue of *Applicable Analysis, Analysis and Approximation of Microstructure Models*, 2011.

Member of Scientific Committee, Laurier Centennial Conference: Applied Mathematics, Modeling and Computational Science - 2011, Waterloo, Ontario, Canada, July 25-29, 2011.

External Member of Dissertation Committee, Florian Maris, Worcester Polytechnic Institute, May, 2012

External Member of Doctorate Committee, Sören Dobberschütz, Universität Bremen, August, 2012.

Program Committee, "Degenerate Semigroups and Propagators of Sovolev Type Equations", International Symposium, Chelyabinsk, November 10-14, 2014.

External Member of Doctorate Committee, Martin Höpker, Universität Bremen, August, 2016.

### ***Conferences Organized***

1976 American Mathematical Society Special Session on PDE, Urbana, Illinois, March.

1977 (with J.T. Oden) National Science Foundation Workshop on Applications of Functional Analysis in Mechanics.

1978 Texas PDE Conference. (<http://www.math.txstate.edu/seminars-conf/txde.html>)

1979 Texas PDE Conference.

1980 Texas PDE Conference.

1981 Texas PDE Conference.

1982 Texas PDE Conference.

1987 Texas-Oklahoma Section SIAM meeting (Austin)

Texas PDE Conference.

- 1993 Special Session on “Distributed Systems for Flow in Aggregated Media” at the Conference on Differential Equations, Ohio University.
- 1994 Texas PDE Conference.
- 2000 Texas PDE Conference, Austin, TX.
- 2003 Minisymposium on ‘Deformable Porous Media’, I, II, III, SIAM Conference on Mathematical and Computational Issues in the Geosciences, Austin, March 17 - 20, 2003.
- 2004 (with Enrique Thomann and Roy Haggerty) SIAM Annual meeting, Portland, July 12 - 16. Special Session: Minisymposium on “Anomalous Diffusion in Porous Media”
- 2004 (with A. Miranville, Hong-ming Yin) American Institute of Mathematical Sciences’ Fifth International Conference on Dynamical Systems and Differential Equations, California State Polytechnic University, Pomona, June 16 - 19: Mathematical Models and Methods in Phase Transitions
- 2005 (with A. Panchenko and Hong-ming Yin) American Mathematical Society, Eugene, November 12 - 13: Special Session on PDE and Applications.
- 2006 DOE Workshop on Multiscale Models of Materials: Mathematics and Computation, Tacoma, WA, May 25 - 30.
- 2007 (with Lynn Bennethum) SIAM Conference on Mathematical and Computational Issues in the Geosciences, Sante Fe, March 19 - 22, Special Session: Minisymposium on ‘Flow and Deformation Processes in Porous Media’, I, II
- 2007 (with M. Pezysnska and S-Y. Yi) DoE and NSF sponsored Workshop, Corvallis, June 25-29, ‘Modeling, Analysis and Simulation of Multiscale Nonlinear Systems’ in cooperation with Society of Industrial and Applied Mathematics Activity Group on Geosciences.
- 2007 (with WSU, PNNL) DoE-sponsored Summer School in Multiscale Mathematics and HPC, Corvallis, OR, June 29 - July 3, 2007.
- 2008 (with Pacific Northwest National Lab) DoE-sponsored Summer School ‘Multiscale Mathematics and HP Computing’, Richland, WA, August 4 - 6, 2008.
- 2011 (with A. Muntean and M. Ptashnyk) SIAM Conference on Geosciences, Long Beach, March 24, Minisymposium on ‘Microstructure Models-Analysis and Approximation Estimates’.
- 2013 (with M. Murad and X.F. Xu) Fifth Biot Conference on Poromechanics, Vienna University of Technology, July 10 - 12, Minisymposium on ‘Multiscale and stochastic modeling in poromechanics’.
- 2018 (with Steve Bleier and Mau Nam Nguyen) co-organizeer of 2018 Spring Sectional Meeting of American Mathematical Society, Portland.

## UNIVERSITY SERVICE

### *University Committees*

- 1983-84 University Research Institute Awards Committee
- 1984-85 University Research Institute Awards Committee
- 1985-86 University Research Institute Awards Committee
- 1987-88 Dissertation Awards Committee
- 1991-92 CAMLS  
Chair, Computational and Applied Mathematics  
Graduate Program Planning
- 1992-93 Chair, Graduate Studies Committe,

- 1993-94 Computational and Applied Mathematics  
Chair, Graduate Studies Committee,  
Computational and Applied Mathematics  
Search Committee for CAM Chair
- 1995-97 Computational and Applied Mathematics Program  
Acting Subcommittee of the Graduate Studies Committee  
Fellowships Committee
- 1995-96 Texas Institute for Computational and Applied Mathematics  
Assistant Director and Member of Advisory Board  
Search Committee for TICAM Chair
- 1996-97 Texas Institute for Computational and Applied Mathematics  
Member of Advisory Board  
Search Committee for TICAM Chair
- Oregon State University**
- Spring 2008 Arts and Sciences Strategic Planning Committee
- 2013-14 Memorial Resolution for Clifford Gardner (1924-2013), The University of Texas

**College Committees**

- 1973-75 Undergraduate Curriculum Committee
- 1987-88 Review of Tenure Appointments
- 1988-89 Tenure and Promotion Committee
- 1989-90 Tenure and Promotion Committee
- 2002-03 Chair, Promotion and Tenure Triad
- Oregon State University**
- 2003-04 COS Advisory Committee
- 2004-05 COS Tenure and Promotion Committee
- 2006-07 COS Tenure and Promotion Committee
- 2010-2011 Promotion and Tenure Committee
- 2011-2012 Promotion and Tenure Committee
- 2012-2013 COS Space Committee
- Promotion and Tenure Committee
- Fall 2013 Promotion and Tenure Committee (special)

**Department Committees**

- 1969-70 Chair, Undergraduate Curriculum Committee
- 1970-71 Chair, Undergraduate Curriculum Committee
- 1971-72 Chair, Undergraduate Curriculum Committee
- 1972-73 Chair, Undergraduate Curriculum Committee
- 1976-77 Chair, Recruiting Committee  
Tenure and Promotion Committee
- 1977-78 Chair, Recruiting Committee  
Tenure and Promotion Committee
- 1980-81 Promotion Triad  
Chair, Applied Math Prelim
- 1984-85 Subcommittee on Chairs  
Undergraduate Advising

1985-86	Subcommittee on Chairs Undergraduate Advising
1986-87	Subcommittee on Chairs Undergraduate Advising Analysis Preliminary Exam
1987-88	Raise Recommendations Committee B. A. Degree Committee Undergraduate Advising Subcommittee on Chairs Recruiting Committee
1988-89	Review Committee Subcommittee on Chairs Undergraduate Advising
1989-90	Subcommittee on Chairs Undergraduate Advising Raise Recommendations Chair, Graduate Studies Committee
1990-91	Subcommittee on Chairs Undergraduate Advising Raise Recommendations Chair, Graduate Studies Committee
1991-92	Subcommittee on Chairs Undergraduate Advising Chair, Graduate Studies Committee Chair, Textbook Selection, 427K
1992-93	Subcommittee on Chairs Undergraduate Advising Chair, Promotion Triad (Vishik)
1993-94	Subcommittee on Chairs Committee on Applied Mathematics
1994-97	Subcommittee on Chairs Committee on Applied Mathematics GSC: Applied Math. Prelim. Committee
1997-98	Committee on Applied Mathematics Undergraduate Course Development Undergraduate Preparation for Graduate Mathematics
1999-2000	Chair, Review Committee Post Tenure Review Committee Applicable Analysis Recruiting Committee
2000-2001	Faculty Review Post Tenure Review Committee Chair, Applied Math Prelim Chair, Promotion triad (Arbogast)
2001-2002	Assistant Prof Recruiting Committee Chairs Recruiting Committee

Chair, Post Tenure Review Committee  
 Long Range Planning - Leader  
 Applied Math Prelim  
 2002-2003 Chair, Instructor Recruiting Committee  
 Chairs Recruiting Committee  
 Applied Math Prelim  
**Oregon State University**  
 2003-04 Website Committee  
 Teaching Committee  
 2004-2007 CHAIR of Department of Mathematics  
 2004-05 Website Committee  
 Space Committee  
 2005-06 Space Committee  
 2007-2009 Advisory Committee  
 2007-2008 Chair, Hiring Plan Committee  
 Budget Committee  
 2008-09 Chair, Qualifying Exam Committee  
 Budget Committee  
 2009-2010 Graduate Committee (Fall)  
 Chair, Qualifying Exam Committee  
 2010-2011 Qualifying Exam Committee  
 Chair, Analysis Search Committee  
 Applied Math Committee  
 co-Chair, Dept. Chair Search Committee  
 2011-2012 Qualifying Exam Committee  
 Math Education Search Committee  
 2012-2013 Qualifying Exam Committee  
 Undergraduate Committee  
 Chair, Faculty & PostDoc Review Committee  
 2013-2014 Chair, Qualifying Exam Committee  
 Chair, Qualifying Exam Task Force  
 Faculty & PostDoc Review Committee  
 Search Committee for Department Head  
 2014-2015 Chair, Qualifying Exam Committee  
 Search Committee for Department Head  
 2015-2016 Advisory Committee  
 Chair, Qualifying Exam Committee (Fall)

#### **Activities in Student Affairs**

1968-78 Faculty Advisor for U.T. Men's Gymnastics Club  
 1969-70 Undergraduate Advisor for Mathematics Majors  
 1979-82 Graduate Advisor

**Courses Taught**

<i>Course</i>	<i>Title</i>
305G	Elementary Functions and Coordinate Geometry
408D	Calculus
311	Linear Algebra and Matrix Theory
427K	Advanced Calculus for Applications I
427L	Advanced Calculus for Applications II
361	Theory of Functions of a Complex Variable
665	Introduction to Analysis
370K	Ordinary Differential Equations
676	Methods of Applied Mathematics
383D	Complex Analysis
391C	Fourier Analysis and Differential Equations
391C	Topological Vector Spaces and Distributions
391C	Nonlinear Partial Differential Equations
393C	Conference Course in Applied Mathematics
393C	Hilbert Space Methods for Partial Differential Equations
393C	Optimal Control of Distributed Systems
393C	Numerical Analysis: Finite Element Methods
393C	Elliptic Boundary Value Problems and Variational Inequalities
391C	Convex Analysis
393C	Evolution Equations and Variational Inequalities
393C	Introduction to Partial Differential Equations
393C	Semilinear Partial Differential Equations
383D	Methods of Applied Mathematics, II
	<b>Oregon State University</b>
MTH 254	Vector Calculus
MTH 256	Applied Differential Equations
MTH 256H	Applied Differential Equations (Honors College)
MTH 306	Matrix and Power Series Methods
MTH 306H	Matrix and Power Series Methods (Honors College)
MTH 341	Linear Algebra, I
MTH 480	Dynamical Systems
MTH 511-513	Real Analysis
MTH 581-582	Mathematical Methods for Engineers & Scientists
MTH 607	Partial Differential Equations Seminar
MTH 607	Intro Research at OSU
MTH 607	Computational & Applied Mathematics Seminar
MTH 614	Functional Analysis
MTH 619	Topics in Analysis (Functional Analysis, II)
MTH 621-623	Differential & Integral Equations
MTH 627-628	Advanced Topics in Partial Differential Equations

**GRADUATE STUDENT SUPERVISION*****Ph.D. Degrees Supervised***

Robert L. Dawes, May 1977, A degenerate evolution equation for fluid flow in multi-porous media  
 Martin M. Rooney, December 1977, Numerical analysis of nonlinear wave equations  
 E. DiBenedetto, August 1979, Implicit degenerate evolution equations  
 Kenneth L. Kuttler, December 1980, Degenerate evolution inequalities.  
 J. Rulla, September, 1985, A Stefan Problem with prescribed convection, (awarded Best Dissertation Award by Graduate School).  
 M. P. Bosse, August, 1987, Homogenization of the layered medium equation.  
 S. Oppenheimer, December, 1987, Dynamics of gas absorption.  
 N. Walkington, May, 1988, Resolution of a diffusion problem arising in the flow of fluids.  
 Kingsheng Xu, August, 1988, The continuous dependence of solutions to a Cauchy problem  
 Gordon Clark, August 1992, Micro-structure modeling of fluid flow in layered media.  
 John Cook, August 1992, Diffusion models with microstructure and secondary flux.  
 Lindsay Packer, August 1992, The regularized layered medium equation.  
 Thomas Little, August 1993, Semilinear parabolic equations with Preisach Hysteresis.  
 Brook Hagood, August, 1994, Semilinear degenerate parabolic systems and distributed capacitance models.  
 Laura Lochhead, December, 1996, A coupled system of semilinear parabolic equations with hysteresis.  
 Hee Chul Pak, December, 1999, Two Distributed Capacitance Models.  
 Bahareh Momken, December, 2000, Fluid flow and Deformation in Composite Porous Media.  
 Darrin Visarraga, December, 2001, Heat Transport Models with Distributed Microstructure.  
 Fernando Morales, June, 2011, The Multiscale Analysis of Saturated Flow in Porous Media with an Adjacent Thin Channel  
 Dwight Holland, current.

***Membership on Ph.D. Committees***

D. H. Eller (Electrical Engineering - Aggarwal), 1969  
 R. P. Rhoten (Electrical Engineering - Aggarwal), 1969  
 R. P. O'Donnell (Electrical Engineering - Aggarwal), 1971  
 W. P. Davis (Mathematics - Wall)  
 W. E. Hunt (Mathematics - Edmondsen)  
 H. Inabe (Aerospace Engineering - Tapley), 1972  
 E. Houston (Mathematics - McAdam), 1973  
 R. Ewing (Mathematics - Cannon), 1974  
 J. Gibson (Engineering Mechanics - Clark), 1975  
 R. Roure (Engineering Mechanics - Oden), 1975  
 L. Hayes (Mathematics - Young), 1977  
 J. Montemayor (Electrical Engineering - Womack)  
 C. T. Reddy (Engineering Mechanics - Oden), 1977  
 N. Kikuchi (Engineering Mechanics - Oden), 1977  
 S. Mochizuki (Engineering Mechanics - Oden), 1977  
 Jesse Walker (Mathematics - Gilbert), 1980  
 M-G. Sheu (Engineering Mechanics - Oden), 1978  
 Y. K. Kwon (Accounting), 1978  
 G. Alduncin (Engineering Mechanics - Oden), 1978  
 Mark Seager (Mathematics - Cantor), 1984  
 J. Wu, 1984



T. Strouboulis (Engineering Mechanics - Oden), 1987  
Joao Martins (Engineering Mechanics - Oden), 1984  
John Morrison (Mathematics - Bichteler), 1985  
Wayne Joubert (Mathematics - Young), 1989  
J. M. Pearson (Mathematics - Beckner), 1989  
John O'Leary (Engineering Mechanics - Clark)  
J. K. Lee (Engineering Mechanics - Oden)  
Paul Erickson (Engineering Mechanics - Clark)  
Patrick Le Tallec (Engineering Mechanics - Oden), 1980  
Thomas Kirkland (Electrical Engineering), 1985  
Eduardo Pires (Engineering Mechanics - Oden)  
Luis Campos (Engineering Mechanics - Oden)  
S.-R. Wu (Engineering Mechanics - Oden)  
Joao Martins (Engineering Mechanics - Oden)  
Y.-J. Song (Engineering Mechanics - Oden)  
Ricardo Kabrusly (Engineering Mechanics - Oden)  
Johan Rade (Mathematics - Uhlenbeck), 1991  
Reza Abbasian (Engineering Mechanics - Oden)  
Nanda Gopal (Electrical Engineering)  
Gary Berg (Mathematics-Odell), June, 1997  
C-Y Lee (Engineering Mechanics - Oden), 1993  
Si-Jian Lin (Mathematics-Bichteler)  
Ioannis Gasparis (Mathematics-Rosenthal), December, 1995  
J. R. Cho (Engineering Mechanics-Oden), December 1995  
Y-H Chang (Electrical and Computer Engineering - Wise)  
Robert Judd (Mathematics-Odell) August, 1997  
Meelae Kim (Mathematics-Beckner), 1996  
Nahwoo Hahm (Mathematics-Cheney), December, 1996  
Tau Xu (CAM-Carey)  
Tarek Zohdi (CAM-Oden), June, 1997  
Klaus Gerdes (CAM-Demkowicz), December, 1996  
Hongqiu Chen (Mathematics-Bona), August, 1998  
Yuan, Juan-Ming (Mathematics - Bona)  
Jiaosheng Jiang (Mathematics - Rosenthal)  
Seoweon Jin (Mathematics - Beckner)  
Katherine Socha (Mathematics - Bona)  
Manas Deb (CAM - Oden)  
Young Park (Mathematics - Beckner)  
Henrik Kalisch (Mathematics - Bona)  
Monica Torres (Mathematics - Caffarelli)  
Dana Brunson (Mathematics - Arbogast)  
Albert Romkes (CAM - Oden)  
Ovidiu Savin (Mathematics - Caffarelli)  
Brian Carnes (CAM - Carey)  
Mario Gomez (Mathematics - Arbogast)  
J. Ramirez (Mathematics - Thomann), 2007  
M. Michalsen-Sapp (Civil Enging - Istok), 2005  
C. Plengsaard (Mechanical Enging - Peterson),  
C. Garibotti (Mathematics - Peszynska),

R. Kykyneshi (Mech Enging - Tate), 2007  
 H. Kim (Mathematics - Thomann), 2011  
 B. Iyob (Geosciences - Wolf), 2009  
 G. Saini (Env Enging - Wood), (current)  
 N. Webb (Mathematics - Bogley), 2011  
 K. Hickman (Mathematics - Finch), 2010  
 V. Klein (Mathematics - Peszynska), 2011  
 A. Monfared (MIME - Atre), 2011  
 Z. Gelbaum (Mathematics - Parks), 2013  
 Y.S. Chen (Civil Enging - Yeh), 2013  
 J. Barrett (Mathematics - Dray), 2014  
 P. Medina (Mathematics - Peszynska), 2014  
 P. Wongsason (Mathematics - Finch), 2014  
 R. Challa (Civil Enging - Yim), 2014  
 Shan Zhou (Economics - Rolf Färe) (current)  
 B. Sherson (Mathematics - Finch), 2015  
 M. Islam (Civil Enging - ), (current)  
 Adriana Debora Piemonti (Civil Enging - Babbar-Sevens), 2015  
 Hussain Al-Hammali(Mathematics - Faridani), 2016  
 Azhar Alhammali (Mathematics - Peszynska), (current)  
 Jhjh-Jyun Zeng (Mathematics - Dascaluc), (current)

***Master's Degrees Supervised***

John R. McNeely, August 1969  
 Lonnie Brauner, Jr., June 1970  
 Yii-Ming Chen, June 1970  
 Steven R. Brooks, 1975  
 Kevin Holley, 1981  
 Cam Snyder, 1984  
 Carl Baribault, 1989  
 Christina Grieg, 1993  
 R-Sya Chen, 1995  
 Tim Povich, 2002.  
 Bernard Clark Musselman, August 2005  
 Fernando Morales, March, 2007  
 Dwight Holland, 2015

***Membership on Master's Committees***

J. B. Micklethwait, 1970  
 T. A. Miller, 1973  
 R. Ewing, 1972  
 Joy Diamond, 1978  
 Myrick Crampton, 1987  
 Myron Davis, 1991  
 Nara Thacher, 1992  
 Anupan Netyanun (Mathematics - Solmon), 2004  
 K. Champley (Mathematics - Faridani), 2004  
 J. Ramirez (Mathematics - Thomann), 2004  
 S. Biederman (Mathematics - Peszynska),  
 R. Hass (Mathematics - Faridani), June, 2005

C. Garibotti (Mathematics - Peszynska), March 2007  
 C. Woodall (Mathematics - Peszynska), September 2008  
 J. Wilson (Wood Science Engng), September 2008  
 B. Scherson (Mathematics - Finch), 2011  
 Kelley Ruehl (MSME), June, 2011  
 J. Umhoefer (Mathematics - Peszynska), March 2016

### RESEARCH IN PROGRESS

Singular or degenerate nonlinear evolution equations and systems of variational inequalities; related partial differential equations & systems. Initial-boundary-value problems of coupled mechanics and diffusion in heterogeneous media, design and analysis of multiscale models, transport and flow in deformable porous media.

### RESEARCH SUPPORT

1972-73	National Science Foundation
1975-77	National Science Foundation, MPS 75-07870, \$15,600
1977-79	National Science Foundation, MCS 75-07870, \$20,200
1980-82	National Science Foundation, MCS 80-02687, \$25,496
1985-88	National Science Foundation, DMS 85-10660, \$22,600
1988-90	Texas Advanced Research Program, #1886, \$46,303
1990-91	Deutsche Forschungsgemeinschaft
1988-91	National Science Foundation, DMS 88-012664, \$80,200
1988-91	Department of the Navy (with G. Carey, ASE/EM, N00014-89-J-1002), \$168,676
1991-92	National Science Foundation, DMS-9103984, \$17,567
1992-93	DOE Computational Science Graduate Science Fellowship Proposal
1992-94	National Science Foundation, DMS-9121743, \$107,988
1993	University Research Institute Faculty Research Assignment
1995-00	National Science Foundation, DMS-9500920, \$104,053
2002-2004	Texas Advanced Research Program, \$50,000 Design and Analysis of Mathematical Models for Deformable Porous Media.
	<b>Oregon State University</b>
2005 - 2008	Department of Energy, \$2.6 M, PNNL, WSU, OSU Northwest Consortium for Multiscale Mathematics and Applications, Educational Strategies and Critical Problems in Thermo-mechanics of Materials (co-PI).
2007 - 2008	National Science Foundation, \$27,634, OSU Modeling, Analysis, and Simulation of Multiscale Nonlinear systems: Workshop at OSU, (PI: Malgorzata Peszynska, co-PIs: Ralph Showalter, Son-Young Yi) Award Number 0707562
2005 - 2010	Department of Energy, \$647,000, OSU Modeling, Analysis, and Simulation of Multiscale Preferential Flow, (PI: Ralph E. Showalter, co-PI: Malgorzata Peszynska).

### Lectures Presented

Pseudo-parabolic partial differential equations, Conference on Qualitative Theory of Nonlinear Differential and Integral Equations, University of Wisconsin, August 12-23, 1968.  
 Partial differential equations of Sobolev-Galpern type, Seventy-Fifth Annual Meeting, American Mathematical Society, New Orleans, Louisiana, 1969.

- Well-posed problems for a partial differential equation of order  $2m + 1$ , 653rd Meeting, American Mathematical Society, New York, 1970.
- An abstract evolution equation with application to partial differential equations, colloquium lecture, University of South Carolina, April 23, 1970.
- $L^2$ -theory of elliptic boundary value problems, colloquium lecture, University of Texas at El Paso, May 8, 1970.
- An abstract evolution equation with application to partial differential equations, colloquium lecture, University of Texas at El Paso, May 8, 1970.
- Perturbation of generators of contraction semigroups, invited lecture, Second Annual October Meeting, University of Southwestern Louisiana, October 15-17, 1971.
- Accretive operators and related topics, colloquium lecture, Georgetown University, Washington, D.C., November 5, 1971.
- Quasi-reversibility of first and second order parabolic evolution equations, National Science Foundation Conference on Improperly Posed Problems in Partial Differential Equations, University of New Mexico, May 1974.
- Regularization of partial differential equations, colloquium lecture, Texas A&M University, October 10, 1974.
- Invited address, Special Session on Singular Cauchy Problems, 81st Annual Meeting, American Mathematical Society, Washington, D.C., 1975.
- Integration of second-order evolution equations, colloquium lecture, University of Delaware, January 27, 1975.
- Energy estimates for perturbations of evolution equations, invited address, 12th Annual Meeting of Society of Engineering Science, October 20-22, 1975.
- Asymptotic behavior of a planetary circulation model, invited address, Seventh Annual University of Southwestern Louisiana Mathematics Conference, Lafayette, Louisiana, October 22-24, 1976.
- Model equations for nonlinear dispersive systems, Symposium on Nonlinear Equations in Abstract Spaces, University of Texas at Arlington, June 8-10, 1977.
- Special Session on Ill Posed Problems, 84th Annual Meeting, American Mathematical Society, Atlanta, Georgia, 1978.
- An abstract Green's formula and applications, colloquium lecture, Georgetown University, Washington, D.C., April 4, 1978.
- An abstract Green's formula and applications, colloquium lecture, University of Delaware, Newark, Delaware, April 6, 1978.
- A Green's formula for weak solutions of variational problems, International Conference on Applied Nonlinear Analysis, University of Texas at Arlington, April 20-22, 1978.
- Nonlinear evolution equations with singular or degenerate coefficients, invited lecture, National Science Foundation Conference on Nonlinear Functional Analysis and Partial Differential Equations, Colorado State University, August 21-25, 1978.
- Stefan problems for two-temperature heat conduction, Texas Seminar on Differential Equations and Applications, Austin, March 10-11, 1979.
- Quasi-reversibility of parabolic evolution systems, invited lecture, International Symposium on Ill-Posed Problems, Newark, Delaware, October 2-6, 1979.
- Diffusion in nonhomogeneous media, Tenth Annual University of Southwestern Louisiana Mathematics Conference, Lafayette, Louisiana, October 26-27, 1979.
- Diffusion in heterogeneous media, colloquium lecture, Argonne National Laboratory, December 6, 1979.
- Colloquium lecture, Indiana University, December 8, 1980.
- Colloquium lecture, University of Illinois, December 11, 1980.

- Invited speaker, International Conference on Dynamical Systems, Gainesville, Florida, February 1981.
- International Conference on Spectral Theory of Differential Operators, March 1981, declined.
- Invited speaker, International Workshop on Semigroups and Applications to Numerical Analysis, Norman, Oklahoma, May 1981.
- Contributed talk, SIAM Summer Meeting, Albany, New York, June 1981.
- Two one-hour talks by invitation, International Workshops on Nonlinear Functional Analysis and Applications, Berlin, September 1981.
- Colloquium, Brown University, December 1981.
- Colloquium, Virginia Polytechnic, December 1981.
- Colloquium, North Carolina State University, December 1981.
- Colloquium, University of Connecticut, September 29, 1982.
- USL Meeting, October 1982 – declined.
- Partial Differential Equations Seminar, Brown University, October 22, 1982.
- Partial Differential Equations Seminar, Brown University, November 5, 1982.
- Colloquium, University of Massachusetts, November 8, 1982.
- Invited lecture, American Mathematical Society Meeting 798, Special Session on Nonlinear Partial Differential Equations, Baton Rouge, Louisiana, November 12-13, 1982.
- Partial Differential Equations Seminar, Brown University, May 18, 1983.
- Colloquium, University of Delaware, April 6, 1983.
- Colloquium, Georgetown University, April 8, 1983.
- Invited lecture, Conference on Physical Mathematics and Nonlinear Partial Differential Equations, Morgantown, W. Virginia, July 6-9, 1983.
- Invited participant with support (declined), American Mathematical Society Summer Research Institute on Nonlinear Functional Analysis and Applications, Berkeley, California, 1983.
- The parametric oscillator equation, invited lecture, American Mathematical Society Meeting #809, Special Session on Ill-Posed Problems, Lexington, Kentucky, January 25-28, 1984.
- A hyper-parabolic equation, Texas Seminar on Partial Differential Equations, San Marcos, Texas, March 3, 1984.
- Colloquium, Southwest Texas State University, San Marcos, Texas, March 23, 1984.
- Cauchy problem for hyper-parabolic partial differential equations, invited speaker, International Conference on Nonlinear Partial Differential Equations, University of Texas, Arlington, Texas, June 1984.
- Ten lectures on variational theory and approximation of boundary value problems, principal lecturer, Numerical Analysis Summer Program, sponsored by Science and Engineering Research Council of the United Kingdom, The University of Lancaster, July 15 to August 3, 1984.
- Colloquium, Iowa State University, Ames, Iowa, October 2, 1984.
- Nonlinear distributed RC networks, Texas Seminar on PDE, University of Houston, April 27, 1985.
- Semi-state model of a distributed RC network, International Conference on Theory and Applications of Differential Equations, invited one hour talk, Pan American University, Edinburg, May 20-23, 1985.
- Invited speaker, Seminar on Differential Equations in Banach Space, July, 1985, Bologna, Italy (declined).
- Colloquium, Northwestern University, Evanston, Illinois, October 31, 1985.
- Fissured medium equation and systems, invited speaker (45 minutes), SIAM meeting, Tulsa, Oklahoma, February 21-22, 1986.
- Invited speaker, International Conference on Differential Equations and Mathematical Physics, Birmingham, March 3-8, 1986 (declined).

- Stefan problem with memory, invited talk (20 minutes), AMS meeting, Denton, Texas, October 31, 1986.
- The hyperbolic Stefan problem, invited speaker, NSF Workshop on Nonlinear PDE, Provo, March 3-7, 1987.
- Colloquium, North Carolina State University, April, 1987.
- The hyperbolic Stefan problem, International Colloquium on Free Boundary Problems, Bavaria, Germany, June 11-20, 1987.
- Colloquium, Mississippi State University, Mississippi, November 19-20, 1987.
- International Conference on Differential Equations, invited talk (1 hour), Columbus, Ohio, March 21-25, 1988.
- Invited talk (90 minutes), Workshop on Nonlinear Analysis, University of Oklahoma, Norman, Oklahoma, March 28-April 1, 1988.
- Dynamics of gas adsorption, Arizona State University, April 14, 1988.
- A pseudo-conservation law, Texas Seminar on PDE, Texas A&M University, April 16, 1988.
- Colloquium, Texas A&M University, February 3, 1989.
- Colloquium, Utah State University, March 2, 1989.
- Invited Speaker, Second Dublin Differential Equations Meeting, Dublin, May 22-25, 1989 (declined).
- Survey Lecture, MicroStructure Models of Diffusion, International Conference on Mathematical Modeling for Porous Media, Bavaria, West Germany, May 15-20, 1989.
- Invited Speaker, International Conference on Differential Equations: Theory and Applications in Stability and Control, Colorado Springs, June 7-10, 1989.
- Invited Speaker, Dynamical Systems, Control Theory and Applications, Dayton, June 14-17, 1989 (declined).
- Invited Talk in Special Session, SIAM Conference on Mathematical and Computational Issues in Geophysical Fluid and Solid Mechanics, Houston, September 25-28, 1989.
- Diffusion Models with Microstructure, AMS Special Session by invitation, Muncie, IN, October 27, 1989.
- Colloquium, University of Texas, El Paso, December 8, 1989.
- Diffusion in a fissured medium with microstructure, Fifth International Colloquium on Free-Boundary Problems, Montreal, June, 1990.
- Colloquium, Institute for Mathematics, University of Augsburg, FRG, July 30, 1990.
- AMS Special Session on Convex Analysis, by invitation, Denton, Texas, November 2, 1990.
- AMS Special Session on Differential Equations, by invitation, Denton, Texas, November 3, 1990.
- Colloquium, Vanderbilt University, November 15, 1990.
- Colloquium, Institute for Mathematics, University of Augsburg, Germany, June 27, 1991.
- Colloquium, Carnegie-Mellon University, September 13, 1991.
- Principal Speaker: SE-Atlantic Regional Conference on Differential Equations, Mississippi State Univ., October 25-26, 1991.
- Colloquium, UC San Diego, February 20, 1992.
- Texas PDE Conference, March 7-8, 1992.
- 1991-1992 Dean's Scholars' Freshman Lecture Series, March 12, 1992.
- Colloquium, University of Houston, March 13, 1992, 'Parabolic PDE and boundary hysteresis'.
- Mathematisches Forschungsinstitut Oberwolfach, Porous Media, June 21-27, 1992.
- Principal Speaker, PDE Day, University of Toronto, July 31, 1992.
- Invited Speaker (1 hour), Second International Colloquium on Numerical Analysis, Plovdiv, Bulgaria, August 13-17, 1992 (declined).
- Midwest-Southeast Atlantic Conference on DE, University of Kentucky, Elliptic-parabolic equations with hysteresis, November 13-15, 1992.
- Colloquium, Virginia Tech, February 26, 1993.

- Colloquium, Georgetown University, March 26, 1993.
- Secondary flux in partially fissured or layered media, SIAM Conference on Mathematics in Geosciences, Houston, April 19-21, 1993.
- Lecture Series - Zakopane, Poland, May 23-30, 1993.
1. Diffusion Models and Microstructure
  2. Distributed Microstructure Models of Porous Media
  3. The Super-Stefan Free Boundary Problem
  4. Parabolic PDE and Preisach Hysteresis
- Parabolic PDE and Hysteresis, Seminar Lecture - Cracow, Poland, May 31, 1993.
- The Super-Stefan Problem and Hysteresis, Expository Lecture, Conference on Differential Equations, Ohio University, August 3-7, 1993.
- (with T. Little) The Super Stefan Problem, Special Session, AMS Mtg 886, College Station, Texas, October 23, 1993.
- Colloquium, Vanderbilt University, November 11, 1993.
- Colloquium, Ball State University, December 2, 1993.
- Colloquium, University of Kentucky, December 3, 1993.
- Seminar, Purdue University, December 7, 1993.
- Colloquium, University of Arkansas, March 15, 1994.
- Colloquium, University of Oklahoma, March 16, 1994.
- University of Alberta: April 11-15, 1994, Applied Mathematics Institute Invited Lecture Series.
- University of Strathclyde, July 25-29, 1994, Conference on Evolution Equations, Plenary lecture 'Elliptic-Parabolic Equations with Hysteresis'.
- PDE Seminar, Purdue University, September 20, 1994, 'Elliptic-Parabolic Equations with Hysteresis'.
- Colloquium, Oakland University, January 10, 1995, 'Parabolic PDE and Preisach Hysteresis'.
- SIAM Conference on Mathematical and Computational Issues in Geosciences, February 8-10, 1995, San Antonio, Simulation of flow in partially fissured media.
- Symposium on Advances and Trends in Computational and Applied Mathematics, Austin, April 20-22, 1995, 'Parabolic systems of PDE with hysteresis'.
- Applied Math Seminar, Purdue University, April 28, 1995, 'Parabolic systems of PDE with hysteresis'.
- Special Session on Optimization and Nonlinear Analysis, Joint AMS -Israel Mathematical Union Meeting, Jerusalem, May 24-26, 1995 -declined.
- Free Boundary Problems, Zakopane, Poland, June 11-18, 1995, 'Implicit evolution equations and degenerate parabolic systems'.
- Free Boundary Problems, Zakopane, Poland, June 11-18, 1995, Expository Lecture: Introduction to the Stefan Problem.
- IFIP Conf. on Modelling and Optimization of Distributed Parameter Systems with applications to Engineering, Warsaw, July 17-21, 1995, 'Parabolic Systems with Hysteresis'.
- Conference on 'Models of Hysteresis', June 25-29, 1996, Trento, Nonlinear semigroups and plasticity models.
- Symposium on Computational Mechanics Advances in honor of Professor J. Tinsley Oden's 60th Birthday, January 13-15, 1997, Austin, Plasticity Models and Nonlinear Semigroups.
- Invited Participant to Workshop on Issues in Plasticity, January 17-18, 1997, Austin.
- Colloquium, Notre Dame, April 22, 1997.
- Principal Speaker (4 lectures), Third Colloquium on Differential Equations, May 17-22, 1997, Maracaibo, Venezuela: Flow in Porous Media.
- Plenary Speaker, New York Journal of Mathematics Conference, June 8 - 14, 1997, University at Albany, SUNY, Albany, NY: Partial Differential Equations with Hysteresis.

- Colloquium, University of Southern California, Dec. 3, 1997. Elliptic-parabolic equations with hysteresis.
- TICAM Seminar, April 14, 1998. Diffusion in Deformable Media.
- Special Session, AMS Mtg #937, State College, PA, October 24-25, 1998. Biot Fissured Media.
- Colloquium, University of Texas at San Antonio, January 22, 1999. Elliptic-parabolic equations with hysteresis.
- Texas PDE, San Marcos, April 10, 1999. Diffusion in Poro-Elastic Media.
- Colloquium, Mississippi State University, April 17, 1999. A transport model with adsorption hysteresis.
- Special Session, Joint AMS # 944 -TexMex Meeting, May 19-22, 1999. Diffusion in Deformable Media.
- Colloquium, Warsaw, Interdisciplinary Centre for Mathematical and Computational Modeling, June, 1999. Diffusion in Deformable Media.
- Principal speaker, Conference on Differential and Integral Equations, June 22-26, 1999, Chelyabinsk, SU. (declined)
- Colloquium, Carnegie-Mellon University, November 5, 1999. Diffusion in Deformable Media.
- Invited Speaker in IMA Workshop on Resource Recovery, Feb. 9 -13, 2000, Minneapolis. Diffusion in Deformable Media.
- Plenary Speaker, Conference on Differential Equations & Computational Mathematics, April 1-2, 2000, Georgia Southern University. Diffusion in Deformable Media.
- Invited Speaker, Minisymposium on ‘Singular differential-operator equations: theory, stability, computing’ at IMACS, 2000, August 21-25, 2000, Lausanne. (declined: no travel funds)
- Invited Speaker, Minisymposium on Mathematical Modeling and Numerical Simulation of Sub-surface and Surface Flow Problems, SIAM Annual Meeting 2000, July 10 - 14, 2000, Puerto Rico.
- Invited Speaker, International Conference on Homogenization and Materials Science, September 15 - 17, 2000, University of Akron.
- Colloquium, Vanderbilt University, March 19, 2001. Diffusion in Deformable Media.
- Invited Speaker, Minisymposium on ‘Modeling, Analysis and Simulation of Hysteresis and Irreversible Phenomena in Porous Media’, Sixth SIAM Conference on Mathematical and Computational Issues in the Geosciences, June 11 - 14, 2001, Boulder, CO. Analysis of Flow in Porous Media with Hysteresis.
- Invited Speaker, Minisymposium on ‘Computational Modeling of Multi-Scale Processes in Deformable Porous Media’ Sixth SIAM Conference on Mathematical and Computational Issues in the Geosciences, June 11 - 14, 2001, Boulder, CO. Deformable Composite Porous Media.
- Texas PDE, San Antonio, February 2, 2002. Partially saturated flow in deformable media.
- Plenary Speaker, Progress in Partial Differential Equations and Applications, Pacific Northwest PDE seminar series, Washington State University, May 23 - 25, 2002.
- Invited Speaker, Second Biot Conference on Poromechanics, August 26 - 28, 2002, Grenoble.
- Colorado State University Lecture Series, Fort Collins, January 29 - 31, 2003.
- Minisymposium on ‘Deformable Porous Media’, SIAM Conference on Mathematical and Computational Issues in the Geosciences, Austin, March 17 - 20, 2003.
- Oregon State University, Colloquium, April 3, 2003.
- Invited Speaker, Conference on Control Theory for PDE, Georgetown University, Washington, May 30 - June 1, 2003
- Hydrophiles Seminar, OSU, March 10, 2004, “Underground Mathematics.”
- WPI, Worcester, Colloquium, April 27, 2004, “The interface of a poroelastic medium with viscous fluid or elastic solid.”
- UO & OSU Joint Colloquium, June 1, 2004, “PDE’s and Hysteresis.”



- Invited Speaker, American Institute of Mathematical Sciences, Conference on Differential Equations and dynamical systems, Pomona, June 16-19, 2004, "The interface of a poroelastic medium with viscous fluid or elastic solid."
- REU Lecture, OSU, July 7, 2004, "Hysteresis Models."
- Society of Industrial & Applied Mathematics Annual Meeting, Special Session, July 12-16, 2004, "A Transport Model with Adsorption-Delay."
- Invited Speaker, Dissipative Models in Phase Transitions, INdAM workshop, Cortona, Sept. 6-10, 2004, "Poroelastic filtration coupled to Stokes flow."
- Istituto di Matematica Applicata e Tecnologie Informatiche, Seminario di Matematica Applicata, Pavia, Sept. 14, 2004, "Diffusion in deforming porous media."
- Applied Mathematics & Computation Seminar - OSU, Oct.15, 2004, "Introduction to homogenization."
- Applied Mathematics & Computation Seminar - OSU, Jan. 14, 2005, "Homogenization in models of flow in fractured media."
- Physics Colloquium - OSU, January 31, 2005, "Hysteresis Models of Adsorption and Deformation."
- Applied Mathematics & Computation Seminar - OSU, Feb. 4, 2005, "Introduction to poroelasticity."
- Colloquium, Portland State University, February 18, 2005.
- Applied Mathematics & Computation Seminar - OSU, April 1, 2005, "The Random Walk Equation."
- Vanderbilt University: BioMath Study Group Seminar, Nashville, TN, April 13, 2005.
- Colloquium, University of Tennessee, Knoxville, TN, April 15, 2005.
- Biot Conference on Poromechanics, Norman, OK, May 24 - 27, 2005, "Poro-Plastic Filtration Coupled to Stokes Flow."
- Colloquium, University of Oklahoma, May 26, 2005.
- Society of Industrial & Applied Mathematics GeoSciences, Avignon, June 7 - 10, 2005, "Multiscale Diffusion Models with Secondary Flux."
- Applied Mathematics & Computation Seminar - OSU, Sep. 30, 2005, "Coupled Stokes and porous media flow."
- November 12 - 13, 2005 Eugene, OR, Amer. Math. Soc. Meeting # 1012, "Poroplastic filtration coupled to Stokes Flow"
- Applied Mathematics & Computation Seminar - OSU, May 5, 2006, "Hysteresis models of adsorption and deformation"
- Colloquium, May 9, 2006 Seattle, WA, University of Washington, "Poroelastic filtration coupled to Stokes Flow"
- Multiscale Modeling of Materials DOE Workshop, May 25 - 30, 2006 Tacoma, WA, "Homogenized Models of Flow in Heterogeneous Media".
- Applied Mathematics & Computation Seminar - OSU, Sep 29, 2006, "Brinkman versus Darcy flow in porous media: modeling and analysis"
- SIAM GeoSciences, Special Session, March 19 - 22, 2007, Sante Fe, "Brinkman-Darcy Models of Porous Media"
- Workshop on Modeling, Analysis and Simulation of Multiscale Nonlinear Systems, June 25 - 29, 2007, Corvallis, OR, "Nonlocal models of transport in multiscale porous media",
- Summer School in Multiscale Mathematics and HPC, June 29 - July 3, 2007, Corvallis, OR, "Multiscale Modeling of Preferential Flow"
- 9th US National Congress on Computational Mechanics July 23 - 26, 2007, San Francisco, CA, "Modeling preferential flow in subsurface"
- The Annual Murray/Ollivier Lecture, Mississippi State University, November 16, 2007
- SIAM Conference on Analysis of PDE, Minisymposium on Multiscale Phenomena in Material Sciences: "Darcy-Brinkman Models of Fast Channel Flow at an Interface"; Minisymposium

- on Analytical and Numerical Aspects of Fluid-Structure Interaction: “Multiscale Modeling of Preferential Flow”, December 10 - 12, 2007, Phoenix, AZ,
- Applied Mathematics & Computation Seminar - OSU, February 29, 2008, “A dam problem”
- Pacific Northwest National Lab, NW Consortium for Multiscale Mathematics Summer School, August 4 - 6, 2008, “Homogenization of Multiscale Problems”
- Applied Mathematics & Computation Seminar, October 3, 2008, “The Stefan Problem”
- Scaling Up for Modeling Transport and Flow in Porous Media Plenary Lecture, October 13 - 16, 2008, Croatia, “Flow with dynamic capillary pressure over multiple scales”
- Applied Mathematics & Computation Seminar, January 9, 2009, “The Super-Stefan Problem”
- Applied Mathematics & Computation Seminar, January 30, 2009, “Homogenization of Pseudo-parabolic systems”
- Institut Henri Poincaré: Nonlinear Evolution Equations, March 30 - April 1, 2009, Paris, “Homogenization of Pseudo-parabolic systems”
- SIAM GeoSciences, June 15 - 18, 2009, Leipzig. Minisymposium on Modeling Flow in Porous Media with Fractures: “Preferential flow in fissure systems”; Minisymposium on Multiple Coupled Processes for Porous Materials: “Preferential flow and geomechanics”.
- November 16, 2009 Munich, Seminar, Technische Universitaet Muenchen, “Multiscale Modeling of Preferential Flow”
- November 17, 2009 Munich, Seminar, Technische Universitaet Muenchen, “Deformation and Flow in Porous Media”
- December 7 - 9, 2009, Miami, SIAM Conference on Analysis of PDE, Minisymposium on Mathematical and Numerical Models for Coupled Multiphysics Problems: “Filtration Into Deforming Porous Media”
- February 24, 2010, Warsaw, Seminar, University of Warsaw, “A singular elliptic problem for channel flow”
- March 4, 2010, Warsaw, Colloquium, University of Warsaw, “Coupled Systems of Darcy and Stokes”
- April 21, 2010, Warsaw, Institute of Mathematics, Polish Academy of Sciences, Seminar, “Deformation and Flow in Porous Media”
- April 29, 2010, Montpellier, Colloquium, “Deformation and Flow in Porous Media”
- October 1, 2010, Applied Mathematics & Computation Seminar, “Variational Methods, I”
- October 22, 2010, Applied Mathematics & Computation Seminar, “Variational Methods, II”
- March 24, 2011, Long Beach, SIAM Conference on Geosciences, Minisymposium on Microstructure Models-Analysis and Approximation Estimates: “Homogenization of Pseudo-parabolic Systems”
- April 1, 2011, Applied Mathematics & Computation Seminar “Flow systems in Mixed Formulation”
- October 7, 2011, Applied Mathematics & Computation Seminar “Mixed Formulations of Coupled Systems of Mechanics and Diffusion”
- November 16, 2011, San Diego, SIAM Conference on Analysis of PDE, Minisymposium on Partial Differential Equations for Non-linear Processes in Porous Media: “Nonlinear Systems in Mixed Formulation”
- March 5, 2012, Analysis Seminar, “A Scalar Conservation Law with Hysteresis”
- July 9 - 13, 2012, Minneapolis, SIAM Annual Meeting, Minisymposium on Coupled and Hybrid Models and Multiple Scales in Mathematical Geosciences: “Analysis of CO<sub>2</sub>-water Models”
- October 5, 2012, Applied Mathematics & Computation Seminar “The General Porous Medium Equation”
- November 26, 2012, Analysis Seminar “The General Porous Medium Equation”
- April 5, 2013, Pittsburgh, Center for Nonlinear Analysis Seminar, Carnegie-Mellon University, “General Porous Medium Equation for Methane-Hydrates”

- April 5, 2013, Pittsburgh, Colloquium, University of Pittsburgh, “Variational problems & Mixed Formulations”
- May 9, 2013, Orlando, International Conference on Computational Analysis of Inverse Problems and Partial Differential Equations, University of Central Florida: “General Porous Medium Equation as a Multi-phase Methane-hydrate Model”
- June 17 - 20, 2013, Padova, SIAM Conference on Geosciences, Minisymposium on Complementarity Problems for Flow in a Porous Medium: “Analysis and Numerical Approximation of Methane Hydrates Model”
- November 10, 2014, Analysis Seminar “Semilinear PDEs and systems”
- January 9, 2015, Applied Mathematics & Computation Seminar “Mathematical modeling of mechanics and geomechanics. I”
- January 16, 2015, Applied Mathematics & Computation Seminar “Mathematical modeling of mechanics and geomechanics. II”
- April 4, 2015, Portland, Cascade RAIN, “Consolidation Models”
- April 21, 2015, Raleigh, Colloquium, North Carolina State University, “Evolution equations & Mixed Formulations”
- April 30, 2015, Norman, Colloquium, University of Oklahoma, “Variational problems & Mixed Formulations”
- May 22, 2015, Portland, Maseeh Colloquium, Portland State University, “Evolution equations and Mixed Formulations”
- June 29 - July 2, 2015, Stanford, SIAM Conference on Geosciences, “Methane Transport in the Hydrate Zone”
- December 7 - 10, 2015, Phoenix, SIAM Conference on Analysis of PDEs, “Porous Medium Equation with Heterogeneous Constraints and Advection”
- April 11 - 15, 2016, Cambridge, Invited Speaker, Isaac Newton Institute Programme, Melt in the Mantle, “Multiscale Systems for Flow and Transport”
- May 16 - 20, 2016, Nashville, invited 30 min presentation in focus session at International Conference on Evolution Equations, “Single-phase flow in thermo-poroelasticity”
- June 6 - 10, 2016, Cambridge, Invited Speaker, Isaac Newton Institute Programme, Melt in the Mantle, “Filtration Flow in Poro-Visco-Elastic Media”
- November 10, 2016, Bergen, Seminar, University of Bergen, “Compaction and Flow Models from Geosciences”
- November 29, 2016, Warsaw, Nonlinear Analysis Seminar, Interdisciplinary Centre for Mathematical and Computational Modeling, “Compaction and Flow Models from Geosciences”
- February 20, 2017, Analysis Seminar “Hysteresis, Adsorption and Consolidation”
- March 2, 2017, Atlanta, SIAM Conference on Computational Science & Engineering, Minisymposium on New Approaches to Complex Coupled Multiscale Systems, “Consolidation of a Sedimentary Basin”
- April 8, 2017, Vancouver, VC Cascade RAIN, “Consolidation of a Sedimentary Basin”
- April 22 - 23, 2017 Pullman, AMS Sectional Meeting, Special Session on Partial Differential Equations and Applications, “Visco-Elastic Consolidation”
- May 4, 2017, PNW SIAM Section Seminar,

## PUBLICATIONS

### *Books*

- (with R. W. Carroll) Singular and Degenerate Cauchy Problems, Academic Press, 1976.
- Hilbert Space Methods in Partial Differential Equations, Monographs & Studies in Mathematics, Pitman Publishing, 1977,

Electronic Monographs in Differential Equations (1994), <http://ejde.math.swt.edu//monotoc.html>,

and Dover Publications (2010).

Chapter in Book: Variational theory and approximation of boundary value problems, in Lecture Notes in Mathematics, #1129, Springer-Verlag, P. R. Turner (ed.), 1985, pp. 140-179.

Chapter in Book: Micro-structure models of porous Media, in 'Homogenization and Porous Media', Edited by Ulrich HORNUNG, Interdisciplinary Applied Mathematics Series, vol. 6, Springer, New York, 1996.

Monotone Operators in Banach Space and Nonlinear Partial Differential Equations, Mathematical Surveys and Monographs #49, American Mathematical Society, Providence, 1997.

### ***Edited works***

(with J. T. Oden) Workshop on Existence Theory in Nonlinear Elasticity, National Technical Information Service, 1977.

(with Alain Miranville and Hong-Ming Yin) Special Issue: 'Mathematical Problems in Phase Transitions', *Discrete and Continuous Dynamical Systems*, vol. 15, August, 2006, pp. 1017-1258.

(with M. Peszynska, A. Spagnuolo, N. Walkington) Special issue: 'Modeling, Analysis and Simulation of Multiscale Nonlinear Systems', *International Journal of Numerical Analysis and Modeling*, Vol. 5, Supp, 2008, pp. 1-170.

(with A. Muntean, M. Ptashnyk) Special Issue: 'Analysis and Approximation of Microstructure Models', *Applicable Analysis*, vol. 91, No. 6, June, 2012, pp. 1053-1054.

### ***Articles***

1. The solution of boundary-value problems in ordinary differential equations, *Simulation*, 5(1965), 374-380.
2. (with T. W. Ting) Pseudoparabolic partial differential equations, *Advances in Differential and Integral Equations, Studies in Applied Math.*, 5(1969).
3. Partial differential equations of Sobolev-Galpern type, *Pacific J. Math.*, 31(1969), 787-794.
4. (with T. W. Ting) Pseudo-parabolic partial differential equations, *SIAM J. Math. Analysis*, 1(1970), 1-26.
5. Local regularity of solutions of partial differential equations of Sobolev-Galpern type, *Pacific J. Math.*, 34(1970), 781-787.
6. Well-posed problems for partial differential equations of order  $2m + 1$ , *SIAM J. Math. Analysis*, 1(1970), 214-231.
7. (with T. W. Ting) Asymptotic behavior of solutions of pseudo-parabolic partial differential equations, *Ann. Mat. Pura Appl. (IV)*, 90(1971), 241-258.
8. Weak solutions of nonlinear evolution equations of Sobolev-Galpern type, *J. Differential Equations*, 11(1972), 252-265.
9. Existence and representation theorems for a semilinear Sobolev equation in Banach space, *SIAM J. Math. Analysis*, 3(1972), 527-543.
10. Global perturbation of generators of semigroups, *Proceedings of the Second Annual U.S.L. Mathematics Conference, University of Southwestern Louisiana, Lafayette, La., (1972)*.
11. Equations with operators forming a right angle, *Pacific J. Math.*, 45(1973), 357-362.
12. Degenerate evolution equations, *Indiana Univ. Math. J.*, 23(1974), 655-677.
13. Continuity of maximal monotone sets in Banach space, *Proc. Amer. Math. Soc.*, 42(1974), 543-546.

14. The final-value problem for evolution equations,  
Jour. Math. Anal. Appl., 47(1974), 563-572.
15. A nonlinear parabolic-Sobolev equation,  
Jour. Math. Anal. Appl., 50(1975), 183-190.
16. Nonlinear degenerate evolution equations and partial differential equations of mixed type,  
SIAM J. Math. Analysis, 6(1975), 25-42.
17. A-priori error estimates for approximation of parabolic boundary value problems,  
SIAM J. Numer. Anal., 12(1975), 456-463.
18. The Sobolev Equation, I,  
Applicable Analysis, 5(1975), 15-22.
19. The Sobolev Equation, II,  
Applicable Analysis, 5(1975), 81-99.
20. Energy estimates for perturbations of evolution equations, Proceedings of the Twelfth Annual Meeting of the Society for Engineering Science, (1975), 275-278.
21. Quasi-reversibility of first and second order parabolic evolution equations, Improperly Posed Boundary Value Problems, A. Carasso and A. P. Stone (eds.), Pitman Publishing, Carlton, (1975), 76-84.
22. Regularization and approximation of second order evolution equations,  
SIAM J. Math. Anal., 7(1976), 461-472.
23. Asymptotic behavior of a planetary circulation model, Proceedings of the Seventh Annual U.S.L. Mathematics Conference, University of Southwestern Louisiana, Lafayette, La., 1976, 23-36.
24. Perturbation of maximal accretive operators with right angle,  
Portugaliae Mathematica, 36(1977), 79-82.
25. Well-posed problems for some nonlinear dispersive waves,  
J. Math. Pures et Appliquees, 56(1977), 123-135.
26. A Sobolev equation for long waves in nonlinear dispersive systems,  
Applicable Analysis, 7(1978), 297-308.
27. (with J. Goldstein and C. Radin) Convergence rates of ergodic limits for semigroups and cosine functions,  
Semigroup Forum, 16(1978), 89-95.
28. Model equations for nonlinear dispersive systems, Nonlinear Equations in Abstract Spaces, V. Lakshmikantham (ed.), Academic Press, New York, (1978), 327-329.
29. Degenerate parabolic initial-boundary value problems,  
J. Diff. Eqs., 31(1979), 296-312.
30. Initial and final-value problems for degenerate parabolic evolution systems,  
Indiana Univ. Math. J., 28(1979), 883-893.
31. A Green's formula for weak solutions of variational problems, Applied Nonlinear Analysis, V. Lakshmikantham (ed.), Academic Press, NY, (1979), 381-387.
32. Diffusion in heterogeneous media, Texas Institute for Computational Mechanics Technical Report #79-15, and Proceedings of the Tenth Annual U.S.L. Mathematics Conference, University of Southwestern Louisiana, Lafayette, Louisiana, (1979), 54-63.
33. Quasi-reversibility of parabolic evolution systems, Proceedings of the International Symposium on Ill-Posed Problems, Newark, Delaware, Z. Nashed (ed.), (1979).
34. Singular nonlinear evolution equations,  
Rocky Mountain Math. J., 10(1980), 499-507.
35. (with E. DiBenedetto) Implicit degenerate evolution equations, Mathematical Research Center Technical Report #2099, Madison, Wisconsin, and  
SIAM J. Math. Anal., 12(1981), 731-751.

36. Two Stefan problems for a degenerate parabolic system, Proceedings of the Second International Conference on Dynamical Systems, L. Cesari and A.R. Bednarek, (eds.), Gainesville, Florida, (1981), 367-374.
37. (with E. DiBenedetto) Pseudo-parabolic variational inequality and Stefan problem, Math. Res. Center Tech. Report #2100, Madison, Wisconsin, and J. Nonlinear Analysis, 6(1982), 279-291.
38. Mathematical formulation of the Stefan problem, Internat. J. Engrg. Sci., 20(1982), 909-912.
39. Degenerate nonlinear parabolic systems and free-boundary problems, Applied Nonlinear Functional Analysis, R. Gorenflo and K-H. Hoffman (ed.), Verlag Peter Lang, Frankfurt-Berlin, (1983), 289-300.
40. (with E. DiBenedetto) A free-boundary problem for a degenerate parabolic system, Jour. Diff. Equations, 50(1983), 1-19.
41. The fissured medium equation, Lecture Notes in Pure and Applied Mathematics, Conference on Physical Mathematics and Nonlinear P.D.E., West Virginia University, Morgantown, Marcel-Deker, 1985, pp. 199-205.
42. A singular quasilinear diffusion equation in  $L^1$ , J. Math. Soc. Japan, 36(1984), 177-189.
43. Local regularity, boundary values and maximum principles for pseudoparabolic equations, Applicable Analysis, 16(1983), 235-241.
44. (with M. Böhm) Diffusion in fissured media, SIAM J. Math. Anal., 16(1985), 500-509.
45. Variational theory and approximation of boundary value problems, Lecture Notes in Mathematics, #1129, Springer-Verlag, P. R. Turner (ed.), 1985, pp. 140-179.
46. (with M. Böhm) A nonlinear pseudoparabolic diffusion equation, SIAM J. Math. Anal., 16(1985), 980-999.
47. Cauchy problem for hyper-parabolic partial differential equations, North Holland MATH studies, #110, Trends in the Theory and Practice of Non-Linear Analysis, V. Lakshmikantham (ed.), 1985, pp. 421-425.
48. (with C. Snyder) A distributed RC network model with dielectric loss, IEEE Transactions on Circuits and Systems, 33(1986), 707-710.
49. (with N. Walkington), A hyperbolic Stefan problem, Quarterly of Applied Math, 45(1987), 769-781.
50. (with J. Rulla) Diffusion with prescribed convection in fissured media, Differential and Integral Equations, 1(1988), 315-325.
51. (with X. Xu), Convergence of diffusion with concentrating capacity, Jour. Math. Anal. Appl., 137(1989), 132-147.
52. (with G. Carey and B. N. Jiang) A regularization-stabilization technique for nonlinear conservation equation computations, Numerical Methods PDE, 4(1988) 165-171.
53. Implicit evolution equations, Differential Equations and Applications Vol. II, Proceedings of the International Conference on Theory and Applications of Differential Equations, Columbus, Ohio, University Press, Athens, 1989, pp. 404-411.
54. (with N. Walkington) A diffusion system for fluid in fractured media, Differential and Integral Equations, 3 (1990), 219-236.
55. (with M.-P. Bosse) Homogenization of the layered medium equation, Applicable Analysis, 32(1989), 183-202.
56. (with X. Xu) An approximate scalar conservation law from dynamics of gas absorption, J. Differential Equations, 83(1990), 145-165.

57. (with U. Hornung) Diffusion models for fractured media, *Jour. Math. Anal. Appl.*, 147(1990), 69-80.
58. (with N. Walkington) Micro Structure Models of Diffusion in Fissured Media, *Jour. Math. Anal. Appl.*, 155(1991), 1-20.
59. (with N. Walkington) A hyperbolic Stefan problem, *Rocky Mtn. J. Math.* 21(1991), 787-797.
60. (with N. Walkington) Diffusion of fluid in a fissured medium with micro-structure, *SIAM J. Math. Anal.*, 22(1991), 1702-1722.
61. (with N. Walkington) A hyperbolic Stefan problem, in *Free boundary problems: theory and applications*, vol. II, eds. K.-H. Hoffmann and J. Sprekels, Pitman Res. Notes Math. Ser. 186 (London: Longman, 1990), 840-844.
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