VITA
ALBERT C. REYNOLDS

PROFESSIONAL POSITIONS

McMan Chair in Petroleum Engineering, The University of Tulsa, Tulsa, Oklahoma. 2003–present.

Professor of Petroleum Engineering and Mathematics, The University of Tulsa, Tulsa, Oklahoma. 1985–present.

Chairman, Department of Petroleum Engineering, The University of Tulsa, Tulsa, Oklahoma. 1990–1992

Director of TU Petroleum Reservoir Exploitation Projects, The University of Tulsa, Tulsa, Oklahoma. 1990–present.

Associate Graduate Dean and Associate Director of Research, The University of Tulsa, Tulsa, Oklahoma. 1986–1990.

Associate Professor of Petroleum Engineering and Mathematics, The University of Tulsa, Tulsa, Oklahoma. 1980–1985.

Associate Professor of Mathematics, The University of Tulsa, Tulsa, Oklahoma. 1976–1980.

Assistant Professor of Mathematics, The University of Tulsa, Tulsa, Oklahoma. 1970–1976.

EDUCATION

BA	Mathematics	University of New Hampshire, Durham, NH, 1964–1966
MS	Mathematics	Case Institute of Technology, Cleveland, OH, 1966–1968
PhD	Mathematics	Case Western Reserve University, Cleveland, OH, 1968–1970

PROFESSIONAL MEMBERSHIPS

Society of Petroleum Engineers.

European Association of Geoscientists and Engineers.

International Association of Mathematical Geology.

Society for Industrial and Applied Mathematics.

MAJOR HONORS

Phi Beta Kappa National Honor Society, 1966.

Phi Kappa Phi National Honor Society, 1966.

Society of Petroleum Engineers Distinguished Achievement Award for Petroleum Engineering Faculty, 1983.

Society of Petroleum Engineers Distinguished Member, 1999.

Society of Petroleum Engineers Reservoir Description and Dynamics Award, 2003.

McMan Chair in Petroleum Engineering, 2003

Society of Petroleum Engineers Formation Evaluation Award, 2005.

Society of Petroleum Engineers Outstanding Technical Editor, 2008.

BOOKS

R. Burden, D. Faires and A. Reynolds: *Numerical Analysis*, Prindle, Webber and Schmidt, Inc., Boston, Massachusetts (ix + 579 pages) 1978.

D. Oliver, A. Reynolds and N. Liu: *Inverse Theory for Petroleum Reservoir Characterization and History Matching,* (ix + 360 pages), Cambridge University Press, May 2008.

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Chaohui Chen and Gaoming Li and Albert C. Reynolds, "Robust Constrained Optimization of Short and Long-Term NPV for Closed-Loop Reservoir Management," paper SPE-141314, Proceedings of the SPE Reservoir Simulation Symposium, *SPE Journal*, Vol. 17, No. 3 (Sept. 2012), 849-864.

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Emerick A. A. and Reynolds, A. C.: "History Matching a Field Case Using the Ensemble Kalman Filter with Covariance Localization," *SPE Reservoir Evaluation & Engineering*, (August 2011), 443-452.

Li, Gaoming and Reynolds, A. C.: "Uncertainty Quantification of Reservoir Performance Predictions Using a Stochastic Optimization Algorithm," in *Computational Geosciences*, Vol. 15, No. 3 (June 2011) 451-462.

Han, Mei, Li, Gaoming and Reynolds, A. C.: "Application of EM Algorithms for Seismic Facies Classification," *Computational Geosciences*, Vol. 15, No. 3 (June 2011) 421-429.

Emerick, A. and Reynolds, A. C.: "Combining Sensitivities and Prior Information for Covariance Localization in the Ensemble Kalman Filter for Petroleum Reservoir Applications," *Computational Geosciences*, Vol. 15, No. 2 (March 2011) 251-269.

Tavakoli, R. and Reynolds, A. C.: "Monte Carlo Simulation of Permeability Fields and Reservoir Performance Predictions With SVD Parameterization in RML compared With EnKF," *Computational Geosciences*, Vol. 15, No. 1 (January, 2011) 99-116.

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Onur, M. and Reynolds, A. C.: SPE 20016 Supplement to SPE 15132, Interference Testing of a Two-Layer Commingled Reservoir, (December 1989) available from SPE Book Order Department.

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He, N. and Reynolds, A. C.: Estimation of Porosity in Thin-Layered Reservoirs by Seismic Inversion, (Extended Abstract) Proceedings of 1995 SEG Annual Meeting, Oct. 8-13, 1022-1024.

Chu, L., Reynolds, A. C. and Oliver, D. S.: Computation of Sensitivity Coefficients With Application to the Integration of Static and Well-Test Data, Proceedings of the Eclipse International Forum, Milano, Sept. 6-9, 1994.

Feitosa, G. S., Chu, L., Thompson, L. G., and Reynolds, A. C.: Determination of Reservoir Permeability Distribution From Pressure Buildup Data, paper SPE 26047, Proceedings of the 1993 SPE Annual Technical Conference and Exhibition, Houston, Texas, October 3-6, 1993.

Chu, L. and Reynolds, A. C.: Analysis of Pressure Data From Heterogeneous Reservoirs: Wellbore Storage and Skin Effects, paper SPE 26047, Proceedings of the 1994 Western Regional Meeting, Long Beach, CA March 23-25.

Roadifer, R. D. and Reynolds, A. C.: Estimation of the Pseudoskin Factor Caused by a Restricted-Entry Well Under Multiphase Flow Conditions, paper SPE 26052, Proceedings of the 1993 Western Regional Meeting, Anchorage, Alaska, May 26-28, 1993.

Xiao, J. J. and Reynolds, A. C.: A Pseudopressure-Pseudotime Transformation for the Analysis of Gas Well Closed Chamber Tests, paper SPE 25879, Proceedings of the 1993 SPE Rocky Mountain Regional/Low Permeability Meeting, Denver, CO, April 12-14, 1993.

Onur, M., Satman, A., and Reynolds, A. C.: New Type Curves for Analyzing the Transition Time Data From Naturally Fractured Reservoirs, paper SPE 25873, Proceedings of the 1993 SPE Rocky Mountain Regional/Low Permeability Meeting,

Denver, CO, April 12-14, 1993.

Thompson, L. G., Niu, J. G., and Reynolds, A. C.: Well Testing for Gas Condensate Reservoirs, paper SPE 25371, Proceedings of the 1993 SPE Asia Pacific Oil & Gas Conference and Exhibition, Singapore, Feb. 8-10, 1993.

Carvalho, R. S., Redner, R. A., Thompson, L. G., and Reynolds, A. C.: Robust Procedures for Parameter Estimation by Automated Type-Curve Matching, paper SPE 24732, Proceedings of 1992 SPE Annual Technical Conference and Exhibition, Washington, D.C., October 4-7, 1992.

Hatzignatiou, D. G. and Reynolds, A. C.: Estimation of Effective Permeabilities for Heterogeneous Reservoirs, paper SPE 24061, Proceedings of the 1992 SPE Western Regional Meeting, Bakersfield, March 30-April 1, 1993.

Xiao, J. and Reynolds, A. C.: New Methods for the Analysis of Closed Chamber Tests, paper SPE 24059 Proceedings of the 1992 SPE Western Regional Meeting, Bakersfield, March 30-April 1, 1993.

Guehria, F. M., Thompson, L. G., and Reynolds, A. C.: A Robust Algorithm for Determining Hydrocarbon PVT Properties Using a Generalized EOS, Proceedings of the Petroleum Society of CIM/SPE International Technical Meeting, June 10-13, 1990, Calgary.

Peres, A. M. M., Onur, M., and Reynolds, A. C.: New Methods for the Analysis of Drillstem Test Data, paper SPE 19843, Proceedings of the 1989 SPE Annual Fall Meeting, San Antonio, Oct. 8-11, 1991.

Ding, W., Onur, M., and Reynolds, A. C.: Analysis of Well-Testing Data from a Restricted-Entry Well, paper SPE 18877, Proceedings of the 1989 SPE Production Operations Symposium, Oklahoma City, OK.

Iskander, R., McKinley, J., and Reynolds, A. C.: Minimizing Feedback Gains in Multi-Input, Multi-Output Systems, Proceedings of the 18th Midwest Symposium on Circuits and Systems, (1979) 640-644.

Verma, V., Reynolds, A. C., and Thomas, G. W.: A Theoretical Investigation of Forward Combustion in a One-Dimensional System, paper SPE 7526, 1978 SPE Annual Fall Meeting.

Bangia, V., Bennett, C. O., Reynolds, A. C., Raghavan, R., and Thomas, G. W.: Alternating Direction Collocation Methods for Simulating Reservoir Performance, paper SPE 7414, 1978 SPE Annual Fall Meeting.

Keys, R. G. and Reynolds, A. C.: On the Solution of Linear Parabolic Problems by Boundary Value Techniques, *Proceedings of the AICA International Symposium on Computer Methods for Partial Differential Equations* , (1975) 86-89.

RECENT RESEARCH FUNDING, PI

"University of Tulsa Petroleum Reservoir Exploitation Projects," funded by oil industry firms, 2002–2012 funding: \$2,171,100. (2012 Funding = \$244,100.)

"Development of a Coupled Reservoir/Wellbore Compositional Simulator for Injection and Production Testing of Reservoirs Containing Complex Multicomponent Fluids," funded by Petrobras, 2012-2016, \$1,804,027.

"Optimal Well Placement," funded by Schlumberger Oilfield Services, 2011, \$40,000.

"Data Assimilation with the Ensemble Kalman Filter," funded by Chevron Energy Technology Company, \$190,000, 2007-2009.

"SWPM History Matching," funded by Schlumberger Oilfield Services, 2007-2008, \$70,000.

"Data Integration for the Generation of High Resolution Reservoir Models," funded by U.S. Dept. of Energy, 2004–2008, \$752,000.

Mapping of Reservoir Properties and Facies by Automatic History Matching; funded by U.S. DOE, \$577,000, 2000–2003.

RECENT RESEARCH FUNDING, Co-PI

"Interpreting Wellbore Temperature Profiles for Injection Profiling and Fracture Diagnostics," funded by Shell Exploration and Production Company, 2009-2011, \$318,710 (PI: Jagan Mahadevan).

SPE PROFESSIONAL SERVICE ACTIVITIES

Co-chair of Session "Optimization and Reservoir Management," 2011 SPE Reservoir Simulation Symposium.

Member of Program Committee for 2009 and 2011 and 2013 SPE Reservoir Simulation Symposium.

Member of SPE Formation Evaluation Award Committee, 2007-2010.

Technical Editor for *SPE Reservoir Evaluation and Engineering,* 2007-2011.

Member of Steering Committee for SPE ATW, " History Matching: New Developments and Best Practices," Co-Chaired Session: "Assisted History Matching/Inverse Modeling," Houston, Oct. 2006.

Technical Session Co-Chairman: New Techniques in Data Measurement and Analysis, 2006 SPE ATCE, Sept. 2006.

Program Committee Chair, 2006 SPE Improved Oil Recovery Symposium.

SPE Reservoir Monitoring Committee, member 2004-2007.

Technical Session Co-Chairman: Innovations in Reservoir Monitoring and Mapping of Flow, 2005 SPE ATCE.

Program Committee Chair for 2006 SPE Improved Oil Recovery Symposium.

Member SPE Formation Evaluation Award Committee, Oct. 1996-1999, (Chairman, 1999).

SPE Technical Editor: May 1983-June 1985, June 1989-October 1992.

Member of SPE Program Committee, for Annual Technical Conference and Exhibition 1993-94.

Member of SPE Pressure Transient Testing Technical Committee, October 1991- October 1994, Chairman 1993-94.

Member of SPE Well Testing Monograph Group for review of Bourdet/Gringarten Monograph on Well Testing, 1993 - 1995.

Technical Session Co-Chairman, Integration of Geoscience and Well Testing, 1994 SPE Annual Technical Conference and Exhibition.

Technical Session Co-Chairman, Well Testing Application and Models, 1993 SPE Annual Technical Conference and Exhibition.

Judge for B.S. Division of 1993 SPE International Student Paper Contest, Houston, Texas, October 3-6.

Judge for Ph.D. Division of 1993 SPE Western Regional Student Paper Contest, Anchorage, AK, May 26-28.

Moderator for Ph.D. Division of 1993 SPE Rocky Mountain/Mid-Continent Regional Student Paper Contest, Tulsa, OK.

Advances in Well Testing, two day course taught by invitation of the Brazilian Section of SPE, Rio de Janeiro, Sept. 1989.

Technical Session Co-Chairman, Testing of Fractured Wells and Reservoirs, 1992 SPE Annual Technical Conference and Exhibition.

Member of SPE Well Testing Committee for the Selection of Papers to be presented at the SPE Annual Fall Meeting, 1981,1982.

Discussion Leader, SPE Continuing Education Course, Pressure Drawdown and Buildup Analysis, May 1984.

Technical Session Co-Chairman: Analysis of Fractured Systems, 1981 SPE Annual Fall Meeting

OTHER PROFESSIONAL SERVICE AND INVITED TALKS

Occasional reviewer for *Mathematical Geosciences*, *Computational Geosciences*, *Journal of Petroleum Science and Engineering*, *SPE Journal*, *SPE Reservoir Evaluation and Engineering*, *IEEE Transactions on Automatic Control* and *Advances in Water Resources*.

Associate Editor of *In Situ*, 1992-2000.

AIME Rossiter Raymond Memorial Award Committee, Member 1991, Chairman 1992. (The award recognizes the best paper published in a journal of one of the four AIME professional societies and written by a member under 33 years of age.)

Chaired session on Inverse Methods and Discretization, European Conference on the Mathematics of Oil Recovery, Freiberg, Germany, Sept. 2002.

Invited Talk: "ES-MDA as a Replacement for EnKF for Data Assimilation and Uncertainty Quantification," presented at SPE/SIAM Conference on Mathematical Methods in Fluid Dynamics and Simulation of Giant Oil and Gas Reservoirs Conference, Istanbul, Turkey, Sept. 3-5, 2012.

Invited Talk: "Estimation of Optimal Well Controls Using the Augmented Lagrangian Function with Approximate Derivatives," International Federation of Automatic Control Workshop on Automatic Control in Offshore Oil and Gas Production (ACOOG 2012), Trondheim, Norway, May 31-June 01, 2012

Invited Talk: "Issues Related to Building a Robust Compositional Reservoir Simulator with Automatic History Matching Capability ," Petrobras, Rio de Janeiro, Brazil, March 2012.

Invited Talk: "Application of the Ensemble Kalman Filter to History Matching," Universidade Estadual do Norte Fluminense, Macae, Brazil, January 2011.

Invited Talk: "Application of the Ensemble Kalman Filter to History Matching," Graduate Seminar, Texas A&M University, November 2010.

Invited Talk: "SPSA and Other Non-Adjoint-Based Optimization Algorithms for Automatic History Matching," EngOpt 2010, Second International Conference on Engineering Optimization 2010, Lisbon, Portugal, Sept. 2010.

Invited Talk: "Conditioning Numerical Models for Large Scale Evolutionary Systems to Dynamic Data for Prediction and Uncertainty Quantification With Applications to Petroleum Reservoir Characterization," The eleventh international conference on Integral Methods in Science and Engineering, Brighton England, July 2010.

Invited Talk: "Localization Mitigates Sampling Error but Is the Data Match Good Enough for Bayes," Fifth International EnKF Workshop, Bergen, Norway, May, 2010.

Invited Talk: "Comments on Covariance Localization with Application to the Brugge Closed-Loop Test Case," CENPES (Research Center of Petrobras), Rio de Janeiro, Brazil, April 2010.

Invited Talk: "Failings and Fixes of EnKF for Nonlinear Dynamics," Fourth International EnKF Workshop, Bergen, Norway, June 2009.

Invited Talk: "The Ensemble Kalman Filter for History Matching," Istanbul Technical University, Istanbul, Turkey, May 2009.

Invited Talk: "An Ideal Parameterization for Bayesian Data Integration," Shell International, The Hague, The Netherlands, January 2009.

Invited Talk: "An Ideal Parameterization for Bayesian Data Integration," Technical University of Delft, Delft, The Netherlands, January 2009.

Invited Talk: "Ensemble Kalman Filter for Data Assimilation with Application to History Matching," Institute for Computational Engineering and Sciences, U. of Texas at Austin, December 2008.

Invited Talk: "Integrating Production and Seismic Data into Gaussian and Pluri-Gaussian Models with EnKF(S)," 2008 Workshop on the Ensemble Kalman Filter, Voss, Norway.

Invited Talk: TUPREP Research on History Matching and Closed-Loop Reservoir Management, Occidental Petroleum, May 2008.

Invited Talk: The Ensemble Kalman Filter for Data Assimilation and Closed-Loop Reservoir Management, ConocoPhillips, June 2007.

Invited Talk: "EnKF for Data Assimilation and Closed-Loop Reservoir Management," Louisiana State University, Oct. 2007.

Invited Talk: EnKF for Nonlinear Non-Gaussian Problems, Workshop on the Ensemble Kalman Filter sponsored by CIPR and IRIS, Bergen, Norway, June, 2007.

Invited Talk: The Ensemble Kalman Filter for Data Assimilation and Closed-Loop Reservoir Management, ConocoPhillips, June 2007.

Invited Talk: "Combining the Ensemble Kalman Filter with the Gauss-Newton Method," Workshop on the Ensemble Kalman Filter sponsored by CIPR and IRIS, Voss, Norway, June, 2006

Invited Talk: "The Ensemble Kalman Filter for the Continuous Updating of Reservoir Models: Theoretical Remarks and Computational Experiments," Chevron, San Ramon, March 2006.

Invited Presentation: "Automatic History Matching, SPE Bartlesville Section, May 2003.

Invited Talk: TUPREP Research on Pressure Transient Analysis and Automatic History Matching, University of Bergen, June 2003.

Invited Talk: Injection/Falloff Testing, Stavanger University, June 2003.

Invited Talk: Automatic History Matching of Production Data, Conference on Integrated Reservoir Characterisation and Modeling, sponsored by IQPC, 23-24 July 2002, London (talk presented by co-author, Fengjun Zhang).

Invited Tutorial Lecture: Automatic History Matching, University of Southern California, April 2002.

Invited Seminar: Well Testing under Multiphase Flow Conditions, U. of Southern California, April 2002.

Invited Lecture: New Results in Automatic History Matching and Well Test Analysis, BP, June 2001.

Invited Presentation: "Conditioning Stochastic Channels to Pressure Data, SPE Applied Technology Workshop, History Matching, Applied Techniques, Feb. 28-March 3, 2000, University of Cambridge.

Invited Presentation: Conditioning Geostatistical Models to Production Data by Automatic History Matching, SIAM Geoscience Conference, March 24-27, 1999, San Antonio.

Invited Presentation and Discussion Leader: Conditioning Reservoir Models to Production Data, SPE Forum: Impact of Pore-Scale to Well-Test-Scale Data Relationships, July 12-17, 1998, Breckinridge, CO.

Invited Lecture: Applications of Inverse Problem Theory to Reservoir Characterization, Mobil Technology Company, Dec. 1997.

Invited Lecture: Analysis of Radial Flow Pressure Data From Heterogeneous Multiphase Flow Systems, presented at the Pressure Transient Well Testing Seminar of the Reservoir Engineering Study Group of the Dallas SPE Section, June 1994.

Invited Lecture: Analysis of Well-Test Pressure From Gas Condensate Reservoirs, presented at Mobil Exploration and Producing Technology Center, March 1994.

Invited Lecture: New Theory for Drawdown and Buildup Testing of Gas Condensate Reservoirs, presented at Mobil Exploration and Producing Technical Center, Oct. 21, 1994.

Invited Lecture: Application of Inverse Problem Theory to the Determination of Reservoir Description, presented at Mobil Exploration and Producing Technical Center, Oct. 21, 1994.

Invited Lecture: Analysis of Pressure Data Conditioned to Spatial Statistics, presented at Statoil-Saga-Norsk Hydro workshop on The Use of Well Test Information in Stochastic Modeling, Oslo, Sept. 5-6, 1994.

Invited Lecture: Pressure Transient Analysis for Heterogeneous Systems, BDM Seminar Series, July 1994.

Invited Lecture: Computation of Sensitivity Coefficients With Applications to the Integration of Static and Well-Test Pressure Data, presented at the Eclipse International Forum, Milan, Sept. 6-10, 1994.

Invited Lecture: Well Testing for Heterogeneous Reservoirs, presented at Pennsylvania State University, Petroleum Engineering and Natural Gas Section, Oct. 28, 1993

Invited Lecture: New Techniques for the Analysis of Slug and Drillstem Test Data, presented at University of Texas at Austin, Department of Petroleum Engineering, Nov. 19, 1990.

Invited Lecture: Analysis of Well Test Data Under Multiphase Flow Conditions, presented at the University of Campinas and at the Petrobras Research Center, September 1989.

Invited Lecture: New Derivative Type Curves for Well Test Analysis, presented at the University of Oklahoma, Department of Petroleum Engineering, March 1987.

Invited Lecture: Analytical and Approximate Analytical Solutions of Initial-Boundary-Value Problems of Interest in Well Testing, 1986 Texas-Oklahoma SIAM Sectional Meeting, Feb. 1986.

Invited Lecture: Well Testing Research Methodology, SOHIO Distinguished Speaker Series, Jan. 1984.

UNIVERSITY OF TULSA, UNIVERSITY AND COLLEGE SERVICE ACTIVITIES

Faculty Senate, 2004-2006.

Faculty Affairs Committee of Faculty Senate, 2004-2006.

Activities for Tulsa Chapter of Phi Beta Kappa Historian, 1988-1990 Member Executive Committee, 1988-1991. Audit Committee, 1992-94. Member Committee on Selection of Alumni/ae and Honorary Members, 2009. Committee on Members in Course, 2001, 2002, 2003, 2011.

Member of University of Tulsa Graduate Council, 1980-1982, 1985-1986, 2001-2003.

Member of University of Tulsa College Committee on Rank and Continuing Appointments, 1977-1979, 1982-1984, 1985-1988, 1990-1994.

Associate Dean of the Graduate School and Associate Director of Research, September 1986-1990

Presidents Blue Ribbon Committee for Program Review, University of Tulsa, 1990-91.

University of Tulsa Representative to Geoscience Institute for Oil and Gas Recovery Research, 1988-1993.

University of Tulsa representative for National Center for Supercomputing Applications University Affiliates Program, 1987-1989.

Awards Selection Committee for the Outstanding Junior Researcher Award, College of Engineering and Applied Sciences, University of Tulsa, 1992.

Member of the Subcommittee of the University of Tulsa Graduate Council for the Selection of Doctoral Faculty, 1980-1982, 1985.

Appeals Committee of the University of Tulsa Graduate Council, 1977-1980.

University Library Committee, 1972-1975.

University Traffic Policies Committee, 1972-1976.

Untenured Faculty Representative to the Engineering College Tenure Committee, 1974.

Engineering College Library Committee, 1974-1979.

UNIVERSITY OF TULSA, DEPARTMENT SERVICE ACTIVITIES

Director of University of Tulsa Petroleum Reservoir Exploitation Projects, 1990-2012.

Member of the Undergraduate Curriculum Committee, 2009, 2010, 2011, 2012.

Advisor of all MEN petroleum engineering graduate students, 2011-2012.

Member of Search Committee for four new faculty members, 2011-2012.

Petroleum Engineering Graduate Seminar Coordinator, Spring 1992, Spring 1994, Fall 2006, 2007

Directed the research of 34 Ph.D. students and 27 Masters students. Have served on the Research Advisory Committee for over 60 other graduate students.

Petroleum Engineering Department Chairman, 1990-1992.

Graduate Program Coordinator (Advisor) , 1985, 1995-2004.

Chairman of Petroleum Engineering Department Review Committee for the following people: L. G. Thompson (1992), O. Shoham (1993), Z. Schmidt (1993).

Petroleum Engineering Department Graduate Committee, Chairman, 1991 - 1994.

Chairman of Petroleum Engineering Department Committee for Developing Policies and Procedures Governing Research Associates, 1994.

Chairman of Petroleum Engineering Department Self-Study Committee related to 1998 Graduate School internal review of petroleum engineering graduate programs.

Member Search Committee for Drilling Engineering Faculty Member, 2001-2002.

Member Search Committee for Petroleum Engineering Department Chairman, 2001-2002.

Member Search Committee for Petroleum Engineering Faculty Members, 2002-2003.

Member of Committee for Developing Ph.D. Program in Computer Science, 1987.

Mathematics Curriculum Committee, 1973-1980.

Faculty Sponsor of the University of Tulsa Mathematics Club, 1973-1977.

Lectures to Tulsa High School Math Clubs, 1971-1978.