R. Baker Kearfott
Department of Mathematics
University of Louisiana at Lafayette, Box 4-1010
Lafayette, LA 70504
Phone: (337) 482-5270
Email: rbk@louisiana.edu (Internet)
http://interval.louisiana.edu/kearfott.html

EDUCATION	B.A.	1972	University of Utah
	M.A.	1974	University of Utah
	Ph.D.	1977	University of Utah

EXPERTISE

- Numerical analysis, including nonlinear optimization, ordinary and partial differential equations, approximation theory, etc.
- Automatically verified computations (interval analysis).
- Mathematical modeling, including adsorption-reaction- diffusion networks, steady state chemical equilibrium models, and potential models for neurological activity.
- Scientific computing associated with modeling and numerical analysis research interests.
- Scientific software development.
- Industrial consulting on numerical methods.
- Scientific conference organization; editorial work.
- Programming language standards.

BIBLIOGRAPHY

- *Dissertation*

  "Computing the degree of maps and a generalized method of bisection," doctoral dissertation, University of Utah, June, 1977

- *Books*

  1. R. E. Moore, R. B. Kearfott, and M. Cloud, *Introduction to Interval Analysis*, SIAM, Philadelphia, January, 2009.
  2. *Knowledge Processing with Interval and Soft Computing*, Ch. Hu, R. B. Kearfott, A. de Korvin, and V. Kreinovich, eds., Springer Verlag, 2008.
  3. A. S. Ackleh, E. J. Allen, R. B. Kearfott, and P. Seshaiyer,*Classical and Modern Numerical Analysis: Theory, Methods, and Practice*, Taylor and Francis, 2010.
  4. *Numerical Software with Result Verification*, R. Alt, A. Frommer, R. B. Kearfott, and W. Luther, eds., Lecture Notes in Computer Science no. 2991, Springer Verlag, Springer Verlag, Berlin / Heidelberg, 2004.
  5. *Applications of Interval Computations*, R. B. Kearfott and V. Kreinovich, eds., Kluwer Academic Publishers, Dordrecht, Netherlands, 1996.
  6. R. B. Kearfott, *Rigorous Global Search: Continuous Problems*, Kluwer Academic Publishers, Dordrecht, Netherlands, 1996.

- *Articles in refereed journals*

  1. "A proof of convergence and an error bound for the method of bisection in $\mathbf{R}^n$," *Math. Comp.* **32**, 144 (Oct., 1978), pp. 1147–1153.
  2. "An efficient degree-computation method for a generalized method of bisection," *Numer. Math.* **32** (1979), pp. 109–127.
  3. "Some general bifurcation techniques," *SIAM J. Sci. Statist. Comput.* **4**, 1 (March, 1983), pp. 52–68.
  4. "A sinc approximation for the indefinite integral," *Math. Comp.* **41**, 164 (Oct., 1983), pp. 559–572.
  5. "Abstract generalized bisection and a cost bound," *Math. Comp.* **49**, 179 (July, 1987), pp. 187–202.
  6. "Some Tests of Generalized Bisection," *ACM Trans. Math. Software* **13**, 3 (Sept., 1987), pp. 197–220.
  7. "Preconditioners for the Interval Gauss-Seidel Method," *SIAM J. Numer. Anal.* **27** 3 (June, 1990), pp. 804–822.
  8. "Algorithm 681: INTBIS, a Portable Interval Newton/Bisection Package," joint with Manuel Novoa, *ACM Trans. Math. Software* **16**, 2 (June, 1990), pp. 152–157.
  9. "Interval Newton / Generalized Bisection When There Are Singularities Near Roots," *Annals of Operations Research* (Special issue on Computational Methods in Global Optimization) **25** (1990), pp. 181–196.

10. "Numerical Tests of a Method for Simulating Electrical Potentials on the Cortical Surface," joint with R. D. Sidman, D. J. Major, and C. D. Hill, *IEEE Trans. Biomed. Engrg.* **38** 3 (March, 1991), pp. 294–299.
11. "Decomposition of Arithmetic Expressions to Improve the Behavior of Interval Iteration for Nonlinear Systems," *Computing* **47** (1991), pp. 169–191.
12. "A Review of Preconditioners for the Interval Gauss–Seidel Method," joint with Manuel Novoa and Chenyi Hu, *Interval Computations* **1** 1 (1991), pp. 59–85.
13. "An Interval Branch and Bound Algorithm for Bound Constrained Optimization Problems," *Journal of Global Optimization* **2** (1992), pp. 259–280.
14. "INTLIB: A Portable Fortran-77 Elementary Function Library," joint with Dawande, M., Du K.-S. and Hu, C., in *Interval Computations* **3** (5) (1992).
15. "A Preconditioner Selection Heuristic for Efficient Iteration with Decomposition of Arithmetic Expressions for Nonlinear Systems," joint with X. Shi, *Interval Computations* no. 1, 1993, pp. 15–33.
16. "The Cluster Problem in Global Optimization: The Univariate Case," joint with K. Du, *Computing Suppl.* **9**, pp. 117–127, 1993.
17. "On Bounding the Range of Some Elementary Functions in Fortran-77," *Interval Computations* no. 3 1993 (appeared in 1994), pp. 29–39.
18. "An Interval Step Control for Continuation Methods," joint with Z. Xing, *SIAM J. Numer. Anal.* **31**, 3 (1994), pp. 892–914.
19. "The Cluster Problem in Multivariate Global Optimization", with K. Du, in *Journal of Global Optimization* **5**, pp. 253–265 (1994).
20. "ALGORITHM 737: INTLIB, A Portable Fortran-77 Elementary Function Library," joint with M. Dawande, K. Du and C. Hu, *ACM Trans. Math. Software* **20** (4) (December, 1994), pp. 447–459.
21. "A Fortran 90 Environment for Research and Prototyping of Enclosure Algorithms for Constrained and Unconstrained Nonlinear Equations," *ACM Trans. Math. Software* **21** (1), pp. 63–78 (March, 1995).
22. "A General Iterative Sparse Linear Solver and its Parallelization for Interval Newton Methods," joint with Hu, C., Yang, Q. and Frolov, A., *Reliable Computing* **1** (3), pp. 251–264 (1995).
23. "Optimizing INTBIS on the Cray YMP," joint with Hu, C., Sheldon, J. and Yang, Q., *Reliable Computing* **1** (3), pp. 265–274 (1995).
24. "Interval Computations: Introduction, Uses, and Resources," *Euromath Bulletin* **2** (1), pp. 95–112 (1996).

25. "Algorithm 763: `INTERVAL_ARITHMETIC`, a Fortran 90 Module for an Interval Data Type," *ACM Trans. Math. Software* **22** (4) (December, 1996), pp. 385–392.
26. "Interval Extensions of Non-Smooth Functions for Global Optimization and Nonlinear Systems Solvers," *Computing* **57**, 2 (1996), pp. 149–162.
27. "Empirical Evaluation of Innovations in Interval Branch and Bound Algorithms for Nonlinear Systems," *SIAM J. Sci. Comput.*, **18** (2) (1997), pp. 574–594.
28. "A Comparison of some Methods for Solving Linear Interval Equations," joint with S. Ning, *SIAM J. Numer. Anal.* **34** (1), pp. 1289–1305 (August, 1997)
29. On Proving Existence of Feasible Points in Equality Constrained Optimization Problems, *Mathematical Programming* **83** (1), pp. 89–100 (September, 1998).
30. "Existence Verification for Singular Zeros of Complex Nonlinear Systems," joint with J. Dian and A. Neumaier, *SIAM J. Numer. Anal.* **38** (2), pp. 360–379 (2000).
31. "On Stopping Criteria in Verified Nonlinear Systems or Optimization Algorithms", joint with G. W. Walster, *ACM Trans. Math. Software* **26** (3), pp. 323–351 (September, 2000).
32. "An Example of Singularity in Global Optimization," *Reliable Computing* **7** (5), pp. 425–429 (2001).
33. "Verifying Topological Indices for Higher-Order Rank Deficiencies," *Journal of Complexity* **18** (2), pp. 589–611 (2002).
34. "On Existence and Uniqueness Verification for Non-Smooth Functions," *Reliable Computing* **8** (4), pp. 267–282 (2002).
35. J. Dian and R. B. Kearfott, "Existence Verification for Singular and Nonsmooth Zeros of Real Nonlinear Systems," Math. Comp. **72** (242), pp. 757–766 (2003).
36. R. B. Kearfott and J. Dian, "Existence Verification for Higher Degree Singular Zeros of Complex Nonlinear Systems," *SIAM Journal on Numerical Analysis* **41** (6), pp. 2350–2373 (2003).
37. H. Muñoz and R. B. Kearfott, "Slope Interval, Generalized Gradient, Semigradient, and Slant Derivative," *Reliable Computing* **10** (3), pp. 163–193 (2004)
38. "Validated Constraint Solving – Practicalities, Pitfalls, and New Developments," *Reliable Computing* **11** (5), pp. 383–391 (2005)
39. R. B. Kearfott and S. Hongthong, "Validated Linear Relaxations and Preprocessing: Some Experiments," *SIAM J. Optim.* **16** (2), pp. 418–433 (2005).

40. V. Kreinovich and R. B. Kearfott, "Beyond Convex? Global Optimization is Feasible Only for Convex Objective Functions: A Theorem," *Journal of Global Optimization* **33** (4), pp. 617–624 (December, 2005).
41. R. B. Kearfott, "Discussion and Empirical Comparisons of Linear Relaxations and Alternate Techniques in Validated Deterministic Global Optimization," *Optimization Methods and Software* **21** (5), pp. 715–731 (2006).
42. George Corliss, Christopher Foley, and R. Baker Kearfott, "Formulation for Reliable Analysis of Structural Frames," *Reliable Computing* **13** (2), pp. 125–147 (2007).
43. R. B. Kearfott, "A Comparison of Some Methods for Bounding Connected and Disconnected Solution Sets of Interval Linear Systems," *Computing* **82** (1), pp. 77–102 (April, 2008).
44. R. B. Kearfott, "GlobSol User Guide," *Optimization Methods and Software* **24**, 4–5, pp. 687–708 (August, 2009)
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- *Reports, Editorials, etc. in Journals in the Field*

  1. COCOS'02, A Workshop on Global Constrained Optimization and Constraint Satisfaction, Held October 2–4, 2002, Sophia–Antipolis, *Reliable Computing* **9** (1), pp. 81–87 (2003)
  2. "Dear Colleagues" (Preface, Validated Computing 2002 Proceedings Issue I), *Reliable Computing* **9** (2), pp. 89–90 (2003)
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  1. "Interval Analysis: Intermediate Terms," *Encyclopedia of Optimization*, Kluwer, Dordrecht, Netherlands, 2001, (vol. 3, pp. 18–21).
  2. "Interval Analysis: Nondifferentiable Problems," *Encyclopedia of Optimization*, Kluwer, Dordrecht, Netherlands, 2001, (vol. 3, pp. 21–23).
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  4. "Interval Analysis: Verifying Feasibility," *Encyclopedia of Optimization*, Kluwer, Dordrecht, Netherlands, 2001, (vol. 3, pp. 43–45).
  5. "Interval Analysis: Interval Fixed Point Theory," *Encyclopedia of Optimization*, Kluwer, Dordrecht, Netherlands, 2001, (vol. 3, pp. 48–51).

6. “Interval Analysis: Interval Newton Methods,” *Encyclopedia of Optimization*, Kluwer, Dordrecht, Netherlands, 2001, (vol. 3, pp. 76–78).

- *Articles in refereed conference proceedings*

  1. "A summary of recent experiments to compute the topological degree," in *Applied Nonlinear Analysis*, ed. V. Lakshmikantham, Academic Press, New York, 1979, pp. 627–635.
  2. "A method for identifying noise-free evoked potential components – Applications of DLM (Dipole Localization Method) to these components," joint with R. D. Sidman and D. Smith, *IEEE 1980 Frontiers of Engineering in Health Care*, 137–140 (Abstract in *IEEE Trans. Biomedical Engrg.* **27**, 9 (1980), p. 534).
  3. "A derivative-free arc continuation method and a bifurcation technique," in *Numerical Solution of Nonlinear Equations*, ed. E. L. Allgower, K. Glashoff, and H. O. Peitgen, Lecture Notes in Mathematics 878, Springer, Berlin, 1981, pp. 182–198.
  4. "The use of equivalent source models in EP research and differential diagnosis," joint with D. B. Smith, R. D. Sidman and J. S. Henke, in *IEEE 1982 Frontiers of Engineering in Health Care*, ed. B. A. Kohen, pp. 64–70.
  5. "Continuation methods and parametrized nonlinear least squares: techniques and experiments," in *Numerical Methods*, ed. V. Pereyra and A. Reinoza, Lecture Notes in Mathematics 1005, Springer, Berlin, 1983, pp. 142–151.
  6. "On a general technique for finding directions proceeding from bifurcation points," in *Numerical Methods for Bifurcation Problems*, ed. T. Küpper, H. D. Mittelmann, and H. Weber, International Series of Numerical Mathematics 70, Birkhäuser, Basel, 1984, pp. 210–218.
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  8. "The inverse problem of electroencephalography using an imaging technique for simulating cortical surface data," joint with C. Denson Hill and R. D. Sidman, in the *Proceedings of the Twelfth IMACS World Congress on Scientific Computation*, vol. 3, R. Vichnevetsky, P. Borne, and J. Vignes, eds., 1988, pp. 729–731.
  9. "The role of homotopy techniques in biomedical modeling: a case study," in the *Proceedings of the Twelfth IMACS World Congress on Scientific Computation*, vol. 3, R. Vichnevetsky, P. Borne, and J. Vignes, eds., 1988, pp. 732–734.
  10. "Resting and P300 auditory responses in normal subjects and psychiatric patients: analysis using DLM and brain imager," joint with M.

R. Ford and R. D. Sidman, in the *Proceedings of the Twelfth IMACS World Congress on Scientific Computation*, vol. 3, R. Vichnevetsky, P. Borne, and J. Vignes, eds., 1988, pp. 739–740.

11. "The inverse problem of electroencephalography assuming double layer neural generators," joint with R. D. Sidman and C. Schlichting, in the *Proceedings of the Twelfth IMACS World Congress on Scientific Computation*, vol. 3, R. Vichnevetsky, P. Borne, and J. Vignes, eds., 1988, pp. 726–728.

12. "Interval arithmetic methods for nonlinear systems and nonlinear optimization: an introductory review," pp. 533–542, in *Impact of Recent Computer Advances on Operations Research*, ed. R. Sharda, B. L. Golden, E. Wasil, O. Balci, and W. Stewart, North-Holland, New York, 1989.

13. "Interval mathematics techniques for control theory computations," in *Computation and Control* (pp. 169–178), proceedings of a conference in Bozeman, Montana, August 1-11, 1988, ed. J. Lund and K. Bowers, Birkhäuser, Boston, 1989 (Progress in Systems and Control Theory series).

14. "Development and Application of Mathematical Techniques for the Non-Invasive Localization of the Sources of Scalp-Recorded Electric Potentials," joint with R. D. Sidman, D. J. Major, C. D. Hill, M. R. Ford, D. B. Smith, L. Lee, and R. Kramer, in *Biomedical Systems Modeling and Simulation*, vol. 5 of the IMACS Transactions on Scientific Computing, J. Eisenfeld and D. S. Levine, eds., J. C. Baltzer, Basel, 1989, pp. 133–157.

15. "Interval arithmetic techniques in the computational solution of nonlinear systems of equations: introduction, examples, and comparisons," in *Computational Solution of Nonlinear Systems of Equations*, Lectures in Applied Mathematics vol. 26, ed. E. L. Allgower and K. Georg, American Mathematical Society, Providence, R. I., 1990, pp. 337–358.

16. "A pivoting scheme for the interval Gauss-Seidel method: numerical experiments," joint with Chenyi Hu, in *Approximation, Optimization, and Computing*, ed. A. G. Law and C.- L. Wang, Elsevier, 1990, pp. 97–100.

17. "A Parallelized Algorithm for the All-Row Preconditioned Interval Newton / Generalized Bisection Method," joint with C.-Y. Hu, M. Bayumi, and Q. Yang, in *Parallel Processing for Scientific Computing*, SIAM, Philadelphia, 1992, pp. 205–209.

18. " Solving Nonlinear Systems on a Vector Supercomputer," joint with Hu., C., Sheldon, J., and Yang, Q., in *Proc. ISCA Seventh International Conference on Parallel and Distributed Computing Systems*, pp. 832–835, ISCA, 1994.

19. “Applications of Interval Computations: An Introduction,” joint with V. Kreinovich, in *Applications of Interval Computations*, ed. R. B. Kearfott and V. Kreinovich, Kluwer, Dordrecht, Netherlands, pp. 1–22, 1996.
20. “Preface” to *Applications of Interval Computations*, ed. R. B. Kearfott and V. Kreinovich, Kluwer, Dordrecht, Netherlands, pp. xiii–xvii, 1996.
21. “A Review of Techniques in the Verified Solution of Constrained Global Optimization Problems, in *Applications of Interval Computations*, ed. R. B. Kearfott and V. Kreinovich, Kluwer, Dordrecht, Netherlands, pp. 23–60, 1996.
22. “Computing Uncertainty in Interval Based Sets,” joint with L. M. Rocha and V. Kreinovich, in *Applications of Interval Computations*, ed. R. B. Kearfott and V. Kreinovich, Kluwer, Dordrecht, Netherlands, pp. 337–380, 1996.
23. “Test Results for an Interval Branch and Bound Algorithm for Equality-Constrained Optimization,” in *State of the Art in Global Optimization: Computational Methods and Applications*, ed. C. Floudas and P. M. Pardalos, Kluwer, pp. 181–200, 1996.
24. “Treating Non-Smooth Functions as Smooth Functions in Global Optimization and Nonlinear Systems Solvers,” in *Scientific Computing and Validated Numerics,* ed. G. Alefeld, A. Frommer, and B. Lang, Akademie Verlag, pp. 160–172, 1996.
25. “Optimal Preconditioners for Interval Gauss–Seidel Methods,” joint with X. Shi, in *Scientific Computing and Validated Numerics,* ed. G. Alefeld, A. Frommer, and B. Lang, Akademie Verlag, pp. 173–178, 1996.
26. “Automatic Differentiation of Conditional Branches in an Operator Overloading Context,” in *Computational Differentiation: Techniques, Applications, and Tools*, M. Berz, C. Bischof, G. Corliss, and A. Griewank, SIAM, Philadelphia, pp. 75–81, 1996.
27. “Where to Bisect a Box: A Theoretical Explanation of the Experimental Results,” joint with V. Kreinovich, for the proceedings of the Fourth World Congress on Expert Systems, *Interval Computations and its Applications to Reasoning under Uncertainty, Knowledge Representation and Control Theory*, ed. G. Alefeld and R. A. Trejo, 1998
28. Rigorous “Global Search: Industrial Applications,” joint with G. F. Corliss, in *Developments in Reliable Computing*, ed. T. Csendes, Kluwer Academic Publishers, Dordrecht, The Netherlands, pp. 1–16, 1999
29. “Taylor Series Models in Deterministic Global Optimization” (joint with A. Arazyan), in *Automatic Differentiation of Algorithms: From*

Simulation to Optimization, (proceedings of AD 2000, the Third International Conference and Workshop on Automatic Differentiation, June 19-23, 2000, Nice, France), ed. G. Corliss, Ch. Faure, A. Griewank, L. Hascoët, and U. Naumann, Springer Verlag, New York, etc., 2002, pp. 365–372.

30. "GlobSol: History, Composition, and Advice on Use," in the proceedings of "COCOS'02" Lecture Notes in Computer Science no. 2861, Springer Verlag, New York, etc., 2003, pp. 17–31.
31. "Libraries, Tools, and Interactive Systems for Verified Computations: Four Case Studies," (joint with M. Neher, S. Oishi, and F. Rico), Lecture Notes in Computer Science no. 2991, ed. R. Alt, A. Frommer, R. B. Kearfott, and W. Luther, Springer Verlag, Heidelberg, 2004.
32. G. F. Corliss, R. Baker Kearfott, N. Nedialkov, and J. D. Pryce, "Interval Subroutine Library Mission," in *Reliable Implementation of Real Number Algorithms: Theory and Practice*, Lecture Notes in Computer Science no. 5045, Springer Verlag, P. Hertling, C. Hoffmann, W. Luther and N. Revol, eds., 2008, pp. 28–43.
33. R. B. Kearfott, J. Pryce, and N. Revol, "Discussions on an Interval Arithmetic Standard at Dagstuhl Seminar 09021," in *Numerical Validation in Current Hardware Architectures*, Lecture Notes in Computer Science no. 5492, Springer Verlag, A. Cuyt, W. Kraemer, W. Luther .and P. Markstein, eds., 2009, pp. 1-6.

- *Refereed book reviews appearing in journals*

  1. Of *Computational Complexity and Feasibility of Data Processing and Interval Computations*, by V. Kreinovich, A. Lakeyev, J. Rohn, and P. Kahl, in *Reliable Computing* **4**, 4, pp. 405–409 (November, 1998)
  2. Of *Global Optimization: Scientific and Engineering Case Studies* by János Pintér, in *Journal of Global Optimization* **38**, 3, pp. 503–505 (July, 2007).
  3. Of *Real Optimization with SAP APO* by Josef Kallrath and Thomas I. Maindl, *SIAM Review* **49**, 2, pp. 331–333 (June, 2007).

- Accepted manuscripts

  1. R. B. Kearfott, "Interval Computations, Rigor and Non-Rigor in Deterministic Continuous Global Optimization," accepted for publication in *Optimization Methods and Software* (2010).

- *Book manuscript reviews and short book reviews*

  1. in 1994, of *Numerical Toolbox for Verified Computing I*, by R. Hammer, M. Hocks, U. Kulisch and D. Ratz, for *Zentralblatt f. Mathematik*

2. Of *Numerica: A modeling Language for Global Optimization*, by P. van Hentenryck, L. Michel, and Y. DeVille, in *Math.Comp.* **67**, 224, pp. 1744–1748 (October, 1998)
3. In 2004, reviewed portions of the manuscript, *Optimization with Mathematica – Scientific, Engineering, and Economic Applications*, by Frank J. Kampas and János D. Pintér, for the authors and Elsevier.
4. Reviewed the "Habilitationsschrift" for several candidates.
5. Reviewed the manuscript *Introduction to Interval Analysis* by Ramon E. Moore and Michael J. Cloud, in 2006.

- *Miscellaneous*

  – Translation from German to English of one third of A. Neumaier, *Introduction to Numerical Analysis*, Cambridge University Press, Cambridge, England, 2001.

- *Other proceedings articles and abstracts*

  1. "Modeling the sources of evoked cerebral potentials -single dipole versus dipole layers," joint with R. D. Sidman, presented at the October, 1978 meeting of the Southern EEG Society.
  2. "Localization of neural generators in the visual evoked responses," joint with R. D. Sidman, D. B. Smith, and J. Henke, presented at the 35-th annual meeting of the American EEG Society, Chicago, 1981.
  3. "An optimal strategy of electrode placement for adequate spatial sampling of evoked scalp potential fields," joint with R. D. Sidman, presented at the 36-th annual meeting of the American EEG Society, Phoenix, 1982.
  4. "Second-order predictors and continuation methods: implementation and practice," in the proceedings of the seventh lecture series in the mathematical sciences, University of Arkansas, 1983
  5. "When Simplicity, Practicality, and Significance Meet: Elegance in Scientific Computation," in *Elegance, Beauty and Truth*, ed. L. Pyenson, Center for Louisiana Studies, University of Louisiana at Lafayette.

- *Submitted articles*

- *Work in progress, manuscripts, and ideas*

  1. Parallelization and improvement of the state of the art in Geographic Information Systems (with Mark Delcambre, in collaboration with Prasanth Chintamaneni at the Center for Business Information Technologies (CBIT), University of Louisiana at Lafayette

2. Utilization of higher-order information in ill-posed global optimization problems, with Julie Roy.
3. "Notation in Interval Analysis," joint with M. T. Nakao, A. Neumaier, S. M. Rump, S. P. Shary, and P. van Hentenryck (a proposal for standardization)
4. "Improved and Simplified Validation of Feasible Points: Inequality and Equality Constrained Problems"
5. "Validated Bounds on Basis Vectors for the Null Space of a Full Rank Rectangular Matrix"
6. "Construction of Validated Uniqueness Regions for Nonlinear Programs in which Convex Subspaces have been Identified,"

- "A review of iteration techniques for verification of approximate solutions"
- *Technical reports*

1. "Scientific software library installation guide," ER&E company report, September, 1985
2. "Low hydrogen sulfide leak model," ER&E proprietary company report, November, 1985
3. "Numerical analysis component - cat cracking," ER&E proprietary company report, November, 1985
4. "Exxon Scientific Software Library," ER&E company report, February, 1986
5. "Scoping - Corporate Research catalytic cracking model," ER&E proprietary company report, March, 1986
6. "Corporate Research cat cracking - matrix diffusion/adsorption," ER&E proprietary company report, April, 1986
7. "Corporate Research catalytic cracking model update," ER&E presentation graphics, April, 1986
8. "The model for matrix reaction chemistry - catalytic cracking ," ER&E proprietary company report, April, 1986
9. "On Verifying Feasibility in Equality Constrained Optimization Problems."

GRADUATE STUDENTS

1. Chenyi Hu (Ph.D. obtained Summer, 1990)
2. Chen-Huan Jan (Ph.D. obtained: Spring, 1992)
3. Milind Dawande (M.S. with thesis obtained: Summer, 1993)

4. Zhao Yun Xing (Ph.D. obtained: December, 1993)
5. Kaisheng Du (Ph.D. obtained: Spring, 1994)
6. Xiaofa Shi (Ph.D. obtained: Spring, 1995)
7. Jianwei Dian (Ph.D. obtained: Fall, 2000)
8. Humberto Muñoz (Ph.D. obtained December, 2001)
9. Mihye Kim (Ph.D. obtained December, 2004)
10. William Dean (Ph.D. obtained May, 2006)
11. Siriporn Hongthong (Ph.D. obtained May, 2006)
12. Julie Roy (Ph.D. anticipated in June, 2010)
13. Haochun Zhang (Ph.D, in progress)

INVITED COLLOQUIUM LECTURES (not included above)

April, 1982 "A survey of continuation methods," presented to the Department of Mathematical Sciences at Rice University

May, 1985 "Is the generalized method of bisection practical for large sparse problems?," presented to the Computer Science Department at Columbia University

December, 1985 "A review of continuation methods," presented to the Department of Chemical Engineering at Clarkson University

October, 1986 "A survey of generalized bisection," presented to the Mathematics Department at General Motors Research Laboratories

March, 1987 "Generalized bisection, theory and practice," presented to the Mathematics Department at Southern Methodist University

April, 1988 "On preconditioners for the interval Gauss–Seidel method," presented to the Mathematics Department at General Motors Research Laboratories

April, 1989 "An interval step control for continuation methods," presented to the Mathematics Department at General Motors Research Laboratories

March, 1990 "A review of preconditioners for the interval Gauss–Seidel method," presented at a conference on Interval methods for Numerical Computation, held in Oberwolfach on March 4–10, 1990.

March, 1991 A series of three one-hour lectures given at the Universität Leipzig:

1. Interval mathematics and nonlinear systems of equations: preconditioners and the interval Gauss–Seidel method.
2. An interval step control for continuation methods.
3. (Presented in the Felix Klein Hörsaal as a function of the Naturwissenschaftlich–Theorisches Centrum) Applications of linear programming preconditioners for the interval Gauss–Seidel method.

March, 1992 "Interval Nonlinear Equation Software – Recent Improvements and Applicability," colloquium given to the U.S.L. mathematics department.

September, 1992 "The Cluster Problem in Global Optimization," invited talk given at *Interval '92*, Moscow, Russia.

September, 1992 "INTLIB: A Portable Fortran 77 Elementary Function Library," invited talk given at *Interval '92*, Moscow, Russia.

April, 1993 *Software Libraries to Support Research and Practice in Nonlinear Algebraic Systems and Global Optimization*, ACM Lecture to the Mathematical Sciences Department, University of Houston–Downtown.

September, 1993 *Portable and Available Software Tools for Interval Arithmetic*, Introductory lecture, conference on Mathematical Modeling and Scientific Computation, Sozopol, Bulgaria

September, 1993 *A Fortran-90 Environment for Research and Prototyping of Global Optimization and Numerical Nonlinear Algebra Algorithms*, plenary lecture, IMACS / GAMM International Symposium on Scientific Computing, Computer Arithmetic, and Validated Numerics (SCAN'93), Vienna, Austria.

September, 1993 Colloquium lecture, Universität Leipzig

September, 1993 Colloquium lecture, Universität Dresden

January, 1994 *A Fortran-90 Environment for Research in Numerical Nonlinear Algebra, Global Optimization, and Symbolic and Automatic Differentiation*, colloquium lecture, Computer Science Department, University of Texas at El Paso

January, 1994 *Interval Arithmetic – An Elementary Introduction and Successful Applications*, presented to the Rio Grande Chapter of the ACM (won an award for the best presentation of a topic to non-experts in the subfield)

February, 1995 "Techniques in the Verified Solution of Constrained Global Optimization Problems," feature lecture delivered at the International Conference on Applications of Interval Computations, El Paso, Texas, February 23–25, 1995.

October, 1995 "Treating Non-Smooth Functions as Smooth Functions in Global Optimization and Nonlinear Systems Solvers," given to the Applied Mathematics department at the University of Karlsruhe, October 2, 1995, and also delivered as a highlighted lecture at the SCAN'95 meeting, Bergische Universität Wuppertal, September 26–29, 1995.

November, 1995 "A Proposed Standard for Interval Arithmetic in Fortran," tutorial given to the November, 1995 International Standards organization SC22/WG5 meeting.

February, 1996 "Automatic Differentiation of Conditional Branches in an Operator Overloading Context," presented at the Second International Workshop on Computational Differentiation, Santa Fe, New Mexico, February 12–15, 1996

July, 1996 "`INTOPT_90`: A Suite of Fortran 90 Programs for Verified Global Optimization," presented

1. to the Mathematics Department, University of Dresden
2. to the Mathematics Department, University of Vienna

April, 1997 "An Overview of `INTOPT_90`," presented at the Sun Cooperative Research grant kickoff meeting, Cupertino, California, April 18–21, 1997.

July, 1997 "Computational Differentiation in Global Optimization Software," presented at SIAM Annual Meeting, Stanford, California, July 14–18, 1997.

August, 1997 "`GlobSol`: A Fortran 90 Package for Rigorous Global Search," presented at the International Symposium on Mathematical Programming, Lausanne, Switzerland, August 25–29, 1997.

October, 1997 "A Brief Introduction to Global Optimization and a Preview of `GlobSol`," one-hour invited colloquium lecture, Department of Mathematics, Statistics, and Computer Science, Marquette University, Milwaukee, Wisconsin, October 16, 1997.

November, 1997 "Automatic Verification of Dynamical System Properties," presented at an Institute of Mathematics and its Applications workshop on the Dynamics of Algorithms, University of Minnesota, Minneapolis, November 17–21, 1997.

September, 1998 "Existence and Uniqueness Verification for Singular Zeros of Nonlinear Systems," plenary talk given at the SCAN'98 meeting (IMACS / GAMM International Symposium on Scientific Computing, Computer Arithmetic and Validated Numerics), Budapest, Hungary, September 22–25.

May, 1999 "The GlobSol Project: Rigorous Global Solutions (Overview and Recent Developments), minisymposium presentation at the 1999 joint SIAM Annual Meeting and Optimization Conference, Atlanta, Georgia, USA, May 11, 1999.

September, 1999 "Rigorous Global Optimization and the GlobSol package," delivered September 23, 1999 to the Mathematical and Computer Sciences Department of the University of Houston-Downtown.

November, 1999 "An Overview of the GlobSol Package," sponsored session talk given at the Fall, 1999 INFORMS meeting, Philadelphia, Pennsylvania, November 7, 1999.

March, 2000 "Multivariate Taylor Models in Global Optimization," colloquium lecture given at the Department of Mathematics, University of Louisiana at Lafayette, March 16, 2000.

June and July, 2000 While visiting the Institute for Scientific Computing at the Technical University of Dresden:

1. "Efficient Verification of the Topological Index of Real Solutions to Algebraic Systems"
2. "An overview of the GlobSol Package for Verified Global Optimization"

November, 2001 "Applications of Interval Global Optimization Technology – Thoughts and Experiences with GlobSol," given at the High Performance Computing Consortium 2001, Denver, Colorado, November 10, 2001 (sponsored by Sun Microsystems).

October, 2002 "GlobSol: History, Composition, Advice on Use, and Future," talk given at COCOS'02, first COCONUT International Workshop on global optimization and constraint propagation, Sophia Antipolis, October 4.

January, 2003 "GlobSol Overview," talk given at Schloss Dagstuhl Seminar 3041, Numerical Software with Result Verification, Schloss Dagstuhl, Germany, January 23.

May, 2004 "Global Optimization and the GlobSol Package," guest lecture for the honors numerical analysis class, May 31, University of Pretoria, South Africa.

June, 2004 "Interval Arithmetic – An Elementary Introduction and Successful Applications," colloquium given at the University of Pretoria, South Africa, June 3, 2004.

June, 2004 "Relaxations and Probing: Highly Successful Techniques for Branch and Bound Search," talk given for the Institute of Computational Mathematics and Mathematical Geophysics, Siberian Branch of the Russian Academy of Sciences.

June, 2004 "Validated Constraint Solving – Practicalities, Pitfalls, and New Developments," joint plenary talk given at isiCAD 2004 ("Constraint-based Approaches and Methods of Mathematical Modeling for Intelligent Product Lifecycle Management") and associated Workshop on Interval Mathematics.

September, 2004 "Validation in Linear Underestimation Technology – Preliminary Comparisons," talk given at the National Science Foundation Workshop on Reliable Engineering Computing, Savannah, Georgia, September 15, 2004.

December, 2004 "Formulation for Reliable Analysis of Structural Frames," colloquium given by George Corliss and joint with Chris Foley, Department of Computing and Software, McMaster University, December 6, 2004.

January, 2006 "Structure and Problem Solving in ISL," presented at the Schloß Dagstuhl Seminar 06021, "Reliable Implementation of Real Number Algorithms: Theory and Practice," January 10, 2006.

October, 2006 "A Current Assessment of Interval Techniques in Global Optimization," one-hour plenary lecture given at the Fields Institute, University of Toronto.

December, 2006 "An Introduction and Example of Interval Techniques in Global Optimization," presented at the GICOLAG workshop, Erwin Schrödinger Institute, University of Vienna.

February, 2007 "GlobSol — Present state and Future Developments," presented at INVA-2007 (International Workshop on Numerical Verification and its Applications), Waseda University, Tokyo

May, 2007 "Degree Computation and Global Optimization – A Personal Perspective," presented at "Optimal Algorithms and Computational Complexity for Numerical Problems," a conference honoring Prof. Frank Stenger's retirement, Salt Lake City, Utah, May 7–8, 2007.

August, 2007 "Verified Solution of Singular Linear and Nonlinear Programs," talk presented at an invited session at the "Second Mathematical Programming Society International Conference on Continuous Optimization/ Modeling and Optimization: Theory and Applications" (ICCOPT / MOPTA), Hamilton, Ontario, August 13–16, 2007.

October, 2007 "Verified Solution of Singular Linear and Nonlinear Programs," invited colloquium lecture given in the series hosted by the Department of Computer Science, University of Central Arkansas.

January, 2008 "Issues for General Users of Validated Optimization Software: What Does the Answer Mean?" presented at Schloß Dagstuhl Seminar 08021, "Numerical Validation in Current Hardware Architectures," January 6 to January 11, 2008.

March, 2008 "Narrowing Bounds on Solution Sets to Non-Regular Interval Linear Systems: Several Alternate Techniques," invited talk given at the 2008 International Workshop on Numerical Verification and its Applications (INVA2008), Okinawa, Japan.

March, 2008 "Verified versus Unverified Deterministic Global Optimization - Issues and Software," talk given at the joint Japan SIAM and Japan Society for Simulation Technologies conference in Tokyo.

April, 2008 "Global Optimization and Ill-Posed Nonlinear Programs: Preliminary Explorations," talk given at the Southwest Regional INFORMS (operations research society) conference, Texas A&M University.

September, 2008 "Mainstream Contributions of Interval Computations in Engineering and Scientific Computing," invited one-hour plenary given to a general audience from the College of Engineering at the University of Texas at El Paso, and simultaneously as the first talk at the SCAN 2008 conference, El Paso, Texas.

September, 2008 "An IEEE Standard for Interval Arithmetic: Call for Participation, Organizational Committee," presented at a SCAN 2008 plenary session.

September, 2008 (joint work with Julie Roy) "Global Optimization and Singular Nonlinear Programs: New Techniques," a contributed talk given at SCAN 2008.

October, 2008 "Constraint Propagation in General Global Optimization Software: Comparisons and Contrasts," a talk given at an NSF-funded conference on constraint propagation, October 4, 2008, following SCAN 2008

SHORT COURSES AND SPECIAL TALKS

June, 2004 Two day short course given at the University of the Witswatersrand. (See `http://interval.louisiana.edu/preprints/2004_Witswatersrand_short_course_contents.html`

PROFESSIONAL EXPERIENCE

University of Louisiana at Lafayette

Assistant Professor of Mathematics	1977–1982
Associate Professor of Mathematics	1982–2000
Professor of Mathematics	2000-present

Exxon Research and Engineering Company 1985–1986

Senior mathematician, Computer and Information Support Division

University of Texas at Austin 1976–1977

Computer programmer, Center for Numerical Analysis

Teaching assistant, Department of Mathematics

University of Utah (Teaching fellow) 1972–1976

AWARDED GRANTS

1981 Consultant on a project to analyze evoked cerebral potentials via mathematical models of the neural sources, funded by the National Institute of Health and administered by R. D. Sidman.

1988 U.S.L. Summer Research Award.

1990 U.S.L. Summer Sabbatical.

1992 National Science Foundation Grant CCR-9203730, *Interval Methods for Nonlinear Algebraic Systems*, $111,536 funding for graduate students, summer salary and travel for three years, beginning September, 1992.

1992 National Science Foundation Grant DMS-9216120, *Conference on Numerical Analysis with Automatic Result Verification*, $7,500, funding for participant support and publication costs.

1994 Equipment Supplement of $7,500 for CCR-9203730.

1997 National Science Foundation Grant DMS-9701540, $40,301.82, *Computational Refinement and Existence Proofs for Singularities in Nonlinear Systems*, three years.

1997 SunSoft Cooperative Research Grant: *The* `GlobSol` *project* (interval computations; verified global optimization software and applications), $71,058 cash plus twelve Sparc System 5's and 4 Sparc Ultra's, one year.

1998 Supplement for graduate student summer support and travel for DMS-9701540, $4,194.

2002 Travel funds and living expenses while attending the Workshop on Global Constrained Optimization and Constraint Satisfaction (COCOS'02), Sophia-Antipolis, France, October 2–4, 2002. (Funds were paid from an EEC grant.)

2003 Travel funds while in Germany and local living expenses for the seminar on Numerical Software with Result Verification, SchloßDagstuhl, January 19–24, 2003. (Funds were from the Dagstuhl conference budget and from the Universität Wuppertal.)

2003 Travel funds and living expenses for the Global Optimization Theory Institute, Argonne National Laboratories, September 8-10.

2004 Travel funds and living expenses from the University of Witswatersrand and the University of Pretoria (approximately $3,000).

2004 Travel funds and living expenses from LEDAS, Ltd. (a Russian software developer; see `http://ledas.com`; funds totalled approximately $3,000.)

2004 Travel funds and living expenses from the conference budget, National Science Foundation Workshop on Reliable Engineering Computing, Savannah, Georgia, September, 2004 ($901.24)

2005–2006 Travel funds for three meetings from the British Engineering and Science Research Council (principal investigator: John Pryce, Royal Military College, Cranfield), for planning an interval subroutine library project.

2006 Travel and lodging from the hosts for a colloquium lecture at the Fields Institute, University of Toronto.

2006 Living expenses for two weeks from the Erwin Schrödinger Institute, Vienna, for participation in the GICOLAG (Global Optimization — Integrating Comvexity, Optimization, Logic Programming, and Computational Algebraic Geometry) program.

2007 Travel funds (complete reimbursement) from the conference hosts for participation in INVA-2007 (International Workshop on Numerical Verification and its Applications), Waseda University, Tokyo, February 26 to March 3, 2007.

SELECTED CURRENT UNIVERSITY SERVICE WORK

- Primary contact, computer support for the Mathematics Department at the University of Louisiana at Lafayette, and chair of the departmental committee on hardware and software needs.

SELECTED ADDITIONAL PROFESSIONAL ACTIVITIES

- Managing Editor, *Reliable Computing*
- Vice Chair (and acting chair, 2008-2009) IEEE P-1788 working group for standardization of interval arithmetic.
- Member, editorial board, *Optimization Letters*
- Official member of the U.S. Delegation, `ISO/SC22/WG5` meeting, through 1998 (This international committee sets Fortran programming language standards.)
- Member, editorial board, *Reliable Computing* (formerly *Interval Computations*)
- Representative, Western Hemisphere, *Reliable Computing* (formerly *Interval Computations*)
- Primary organizer, international conference on *Numerical Analysis with Automatic Result Verification*, Lafayette, Louisiana, February, 1993 (includes three refereed proceedings volumes).
- Member, organizing committee, "Interval '92" (held in September, 1992 in Moscow).
- Member, organizing committee, CSAM '93 (International Congress on Computer Systems and Applied Mathematics, to be held in St. Petersburg, Russia, July 19–23, 1993.
- Vice chairman, organizing committee, MMSC93 (Mathematical Modeling and Scientific Computing, in Sozopol, Bulgaria, September 14–17, 1993, funded by IMACS.
- Session organizer, session on Topics in Global Optimization, ORSA/TIMS meeting, Boston, April 24–27, 1994.
- Co-Organizer, Workshop on Applications of Interval Methods, held in El Paso, Texas, February 1994 (Includes a refereed and edited proceedings volume.)
- Member, Scientific Committee, SCAN'95, IMACS / GAMM International Symposium on Scientific Computing, Computer Arithmetic, and Validated Numerics, Wuppertal, Germany , September 26–29, 1995 (This involved significant referee work).
- Member, Scientific Committee, INTERVAL'96, Würzburg, September, 1996.
- Reviewer for *Zentralblatt für Mathematik* and for *Mathematical Reviews*.

- Project editor, a proposal for Interval Arithmetic Support in Fortran, for the International Standards Organization workgroup on the Fortran programming language.

- Co-organizer, double-length minisymposium, "Verification Theory, Techniques, Software: Components of Modern Reliable Scientific Computing I and II," SIAM National Meeting, Kansas City, July 22-26, 1996.

- Local organizer, INCITS/J3 (Fortran programming language standardization, see `http://www.ionet.net/ jwagener/j3/index.html`) committee meeting no. 144, February 16–20, 1998, Hotel Acadiana, Lafayette, LA. (See `http://interval.usl.edu/conferences/Lafayette_J3.html`)

- Member, scientific committee, SCAN'98 conference (IMACS / GAMM International Symposium on Scientific Computing, Computer Arithmetic and Validated Numerics), Budapest, Hungary, September 22–25, 1998. (See `http://www.inf.u-szeged.hu/ scan98/`)

- Organizer of the minisymposium, "Verified Global Optimization," at the 1998 SIAM Annual Meeting, Toronto, July 13–17, 1998 (See `http://www.siam.org/meetings/an98/index.htm`)

- Organizer of the minisymposium "Rigorous Deterministic Search in Global Optimization" at the 1999 SIAM Annual meeting and Conference on Optimization, Atlanta, May 10–15, 1999 (See `http://www.siam.org/meetings/an99/`)

- Scientific committee member and managing paper editor for *Validated Computing 2002*, Toronto, May 23-25, 2002

- Co-organizer (with Tibor Csendes) of a Fields Institute informal week on Validated Global Optimization, May 27–31, 2002.

- Scientific Committee member and proceedings co-editor (with three others), Dagstuhl seminar 03041, "Numerical Software with Result Verification," January 2004. (The proceedings are in the *Springer Lecture Notes in Computer Science no. 2991*).

- Member, scientific committee, isiCAD 2004 (Constraint Based Approaches and Methods of Mathematical Modeling for Intelligent Product Lifecycle Management). (This involved refereeing several papers.)

- Member, scientific committee, National Science Foundation Workshop on Reliable Engineering Computing, Savannah, Georgia, September, 2004. (This involved refereeing several papers.)

- Member, scientific committee, SCAN 2004; see `http://scan2004.math.kyushu-u.ac.jp/`. (This involved referee work and selection of the Moore prize recipient.)
- Member, scientific committee, SCAN 2008.
- Referee for the *SIAM Journal on Numerical Analysis*, *Mathematical Programming*, the *ACM Transactions on Mathematical Software*, *Computer Aided Geometric Design*, for various conference proceedings, the *SIAM Journal on Optimization*, the *Journal of Global Optimization*, for the *SIAM J. Sci. Statist. Comput.*, for *Interval Computations*, and for various proceedings.
- Organizer of an FTP site and electronic mailing list for information on Interval Computations.
- Participant at numerous meetings and seminars of the AMS and SIAM
- Elected member of the U.S.L. Faculty Senate, 1988-1990

PROFESSIONAL AFFILIATIONS

Society of Industrial and Applied Mathematicians, American Mathematical Society, Association for Computing Machinery, American Association for the Advancement of Science, INFORMS (The Institute for Operations Research and the Management Sciences)

FOREIGN LANGUAGES

German (Regularly read newspapers, and have translated text books)

French (Proficiency at or above the second year college level – listen to news on radio)

Spanish (Use as a communications medium in all high school course work at Colegio Loyola-Gumilla, Pto. Ordaz, Venezuela)

Russian (Rudimentary knowledge)

HONORARY SOCIETIES

Phi-Beta-Kappa, Phi-Kappa-Phi, Pi-Mu-Epsilon, etc.

OTHER HONORS

1999 USL Foundation Distinguished Professor