

**CHRISTOPHER HEIL**  
**CURRICULUM VITAE**

**APRIL 2008**

HEIL, CHRISTOPHER ..... Professor  
School of Mathematics  
Georgia Institute of Technology  
Atlanta, Georgia 30332-0160

**CONTACT AND PERSONAL DATA**

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Citizenship: United States of America

**EDUCATIONAL BACKGROUND**

B.S. Mathematics 1982 Columbia Union College, Takoma Park, MD  
B.A. Physics 1982 Columbia Union College, Takoma Park, MD  
Ph.D. Mathematics 1990 University of Maryland, College Park, MD

Ph.D. Thesis Advisor: John J. Benedetto  
Ph.D. Thesis Title: Wiener Amalgam Spaces in Generalized Harmonic Analysis  
and Wavelet Theory

**EMPLOYMENT HISTORY**

2004–present Professor, School of Math., Georgia Institute of Technology  
1999–2004 Associate Professor, School of Math., Georgia Institute of Technology  
1993–1999 Assistant Professor, School of Math., Georgia Institute of Technology  
1990–1993 National Science Foundation Postdoctoral Research Fellow, MIT  
1990–1992 Pure Mathematics Instructor, MIT  
1987–1992 Member of Technical Staff, The MITRE Corporation  
1985–1989 Graduate Assistant, Mathematics Department, University of Maryland

**CURRENT FIELDS OF INTEREST**

Primary: Harmonic analysis, especially time-frequency and wavelet analysis and  
their applications.  
Secondary: Functional and real analysis.

## BOOKS AND MANUSCRIPTS

1. C. Heil, “A Basis Theory Primer,” 1997 (unpublished manuscript, 93 pages).
2. C. Heil, P. E. T. Jorgensen, and D. R. Larson, Editors, “Wavelets, Frames, and Operator Theory” (College Park, 2003), Contemporary Math., Vol. 345, Amer. Math. Soc., Providence, RI, 2004 (xii+342 pp.).
3. C. Heil and D. F. Walnut, Editors, “Fundamental Papers in Wavelet Theory,” Princeton University Press, Princeton, NJ, 2006 (xix+878 pp.).
4. C. Heil, Editor, “Harmonic Analysis and Applications,” In honor of John J. Benedetto, Birkhäuser, Boston, 2006 (xxviii+374 pp.).

## REFEREED JOURNAL PUBLICATIONS

1. C. E. Heil and D. F. Walnut, *Continuous and discrete wavelet transforms*, SIAM Review, **31** (1989), pp. 628–666.
2. D. Colella and C. Heil, *The characterization of continuous, four-coefficient scaling functions and wavelets*, IEEE Trans. Information Theory, Special Issue on Wavelet Theory and Multiresolution Signal Analysis, **38** (1992), pp. 876–881.
3. D. Colella and C. Heil, *Characterizations of scaling functions: Continuous solutions*, SIAM J. Matrix Anal. Appl., **15** (1994), pp. 496–518.
4. J. J. Benedetto, C. Heil, and D. F. Walnut, *Differentiation and the Balian–Low theorem*, J. Fourier Anal. Appl., **1** (1995), pp. 355–402.
5. C. Heil, G. Strang, and V. Strela, *Approximation by translates of refinable functions*, Numerische Math., **73** (1996), pp. 75–94.
6. C. Heil and D. Colella, *Matrix refinement equations: Existence and uniqueness*, J. Fourier Anal. Appl., **2** (1996), pp. 363–377.
7. C. Heil, J. Ramanathan, and P. Topiwala, *Linear independence of time-frequency translates*, Proc. Amer. Math. Soc., **124** (1996), pp. 2787–2795.
8. O. Christensen and C. Heil, *Perturbations of Banach frames and atomic decompositions*, Math. Nachr., **185** (1997), pp. 33–47.
9. C. Heil, J. Ramanathan, and P. Topiwala, *Singular values of compact pseudodifferential operators*, J. Funct. Anal., **150** (1997), pp. 426–452.
10. C. Cabrelli, C. Heil, and U. Molter, *Accuracy of lattice translates of several multi-dimensional refinable functions*, J. Approx. Theory, **95** (1998), pp. 5–52.
11. V. Strela, P. N. Heller, G. Strang, P. Topiwala, and C. Heil, *The application of multiwavelet filterbanks to image processing*, IEEE Trans. Image Proc., **8** (1999), pp. 548–563.
12. C. Heil, *The Wiener transform on the Besicovitch spaces*, Proc. Amer. Math. Soc., **127** (1999), pp. 2065–2071.

13. K. Gröchenig and C. Heil, *Modulation spaces and pseudodifferential operators*, Integral Equations Operator Theory, **34** (1999), pp. 439–457.
14. O. Christensen, B. Deng, and C. Heil, *Density of Gabor frames*, Appl. Comput. Harmon. Anal., **7** (1999), pp. 292–304.
15. K. Gröchenig, C. Heil, and D. Walnut, *Nonperiodic sampling and the local three squares theorem*, Ark. Mat., **38** (2000), pp. 77–92.
16. C. Cabrelli, C. Heil, and U. Molter, *Accuracy of several multidimensional refinable distributions*, J. Fourier Anal. Appl., **6** (2000), pp. 483–502.
17. R. Ashino, C. Heil, M. Nagase, and R. Vaillancourt, *Microlocal filtering with multiwavelets*, Comput. Math. Appl., **41** (2001), pp. 111–133.
18. K. Gröchenig and C. Heil, *Gabor meets Littlewood–Paley: Gabor expansions in  $L^p(\mathbf{R}^d)$* , Studia Math., **146** (2001), pp. 15–33.
19. R. Ashino, S. J. Desjardins, C. Heil, M. Nagase, and R. Vaillancourt, *Microlocal analysis, smooth frames and denoising in Fourier space*, Asian Information-Science-Life, **1** (2002), pp. 153–160.
20. K. Gröchenig, D. Han, C. Heil, and G. Kutyniok, *The Balian–Low theorem for symplectic lattices in higher dimensions*, Appl. Comput. Harmon. Anal., **13** (2002), pp. 169–176.
21. R. Balan, P. G. Casazza, C. Heil, and Z. Landau, *Deficits and excesses of frames*, Adv. Comput. Math., Special Issue on Frames, **18** (2003), pp. 93–116.
22. K. Gröchenig, C. Heil, and K. Okoudjou, *Gabor analysis in weighted amalgam spaces*, Sampl. Theory Signal Image Process., **1** (2003), pp. 225–259.
23. R. Balan, P. G. Casazza, C. Heil, and Z. Landau, *Excesses of Gabor frames*, Appl. Comput. Harmon. Anal., **14** (2003), pp. 87–106.
24. R. Ashino, S. J. Desjardins, C. Heil, M. Nagase, and R. Vaillancourt, *Smooth tight frame wavelets and image analysis in Fourier space*, Comput. Math. Appl., **45** (2003), pp. 1551–1579.
25. C. Heil and G. Kutyniok, *Density of weighted wavelet frames*, J. Geometric Analysis, **13** (2003), pp. 479–493.
26. C. A. Cabrelli, C. Heil, and U. M. Molter, *Self-similarity and multiwavelets in higher dimensions*, Memoirs Amer. Math. Soc., Vol. **170**, No. 807 (2004), viii+82 pp.
27. K. Gröchenig and C. Heil, *Counterexamples for boundedness of pseudodifferential operators*, Osaka J. Math., **41** (2004), 681–691.
28. Á. Bényi, K. Gröchenig, C. Heil, and K. Okoudjou, *Modulation spaces and a class of bounded multilinear pseudodifferential operators*, J. Operator Theory, **54** (2005), 389–401.
29. R. Balan, P. G. Casazza, C. Heil, and Z. Landau, *Density, overcompleteness, and localization of frames, I. Theory*, J. Fourier Anal. Appl., **12** (2006), 105–143.

30. R. Balan, P. G. Casazza, C. Heil, and Z. Landau, *Density, overcompleteness, and localization of frames, II. Gabor systems*, J. Fourier Anal. Appl., **12** (2006), 307–344.
31. R. Balan, P. G. Casazza, C. Heil, and Z. Landau, *Density, overcompleteness, and localization of frames*, Electron. Res. Announc. Amer. Math. Soc., **12** (2006), 71–86.
32. C. Heil and A. M. Powell, *Gabor Schauder bases and the Balian–Low Theorem*, J. Math. Physics, **47** (2006), 113506-1–113506-21.
33. C. Heil, *History and evolution of the Density Theorem for Gabor frames*, J. Fourier Anal. Appl., **13** (2007), 113–166.
34. C. Heil and G. Kutyniok, *The Homogeneous Approximation Property for wavelet frames*, J. Approx. Theory, **147** (2007), 28–46.
35. C. Heil and G. Kutyniok, *Density of frames and Schauder bases of windowed exponentials*, Houston J. Math., **34** (2008), 565–600.
36. A. Aldroubi, C. Cabrelli, C. Heil, K. Kornelson, and U. Molter, *Invariance of a shift-invariant space*, submitted (14 pages).

#### OTHER RESEARCH PUBLICATIONS

1. C. Heil, *A discrete Zak transform*, Technical Report MTR-89W000128, The MITRE Corporation, 1989.
2. J. Benedetto, C. Heil, and D. Walnut, *Uncertainty Principles for time-frequency operators*, in: “Continuous and Discrete Fourier Transforms, Extension Problems and Wiener-Hopf Equations,” Oper. Theory Adv. Appl., **58**, I. Gohberg, ed., Birkhäuser, Basel (1992), pp. 1–25.
3. C. Heil, *Some stability properties of wavelets and scaling functions*, in: “Wavelets and Their Applications” (Il Ciocco, 1992), J. S. Byrnes et al., eds., NATO Adv. Sci. Inst. Ser. C: Math. Phys. Sci. **442**, Kluwer, Dordrecht (1994), pp. 19–38.
4. C. Heil and D. Colella, *Sobolev regularity for scaling functions via ergodic theory*, in: “Approximation Theory VIII,” Vol. 2 (College Station, TX, 1995), C. K. Chui and L. L. Schumaker, eds., World Scientific, Singapore (1995), pp. 151–158.
5. B. Deng and C. Heil, *Density of Gabor Schauder bases*, in: “Wavelet Applications in Signal and Image Processing VIII” (San Diego, CA, 2000), Proc. SPIE **4119**, A. Aldroubi et al., eds., SPIE, Bellingham, WA (2000), pp. 153–164.

#### RESEARCH/EXPOSITORY AND EXPOSITORY PUBLICATIONS

1. C. Heil, *Wavelets and frames*, in: “Signal Processing, Part I: Signal Processing Theory,” L. Auslander, T. Kailath, and S. Mitter, eds., IMA Vol. Math. Appl. **22**, Springer–Verlag, New York (1990), pp. 147–160.

2. C. Heil and D. Walnut, *Gabor and wavelet expansions*, in: “Recent Advances in Fourier Analysis and its Applications” (Il Ciocco, 1989), J. S. Byrnes et al., eds., NATO Adv. Sci. Inst. Ser. C: Math. Phys. Sci. **315**, Kluwer, Dordrecht (1990), pp. 441–454.
3. C. Heil, *Methods of solving dilation equations*, in: “Probabilistic and Stochastic Methods in Analysis, with Applications” (Il Ciocco, 1991), J. S. Byrnes et al., eds., NATO Adv. Sci. Inst. Ser. C: Math. Phys. Sci. **372**, Kluwer, Dordrecht (1992), pp. 15–45.
4. D. Colella and C. Heil, *Dilation equations and the smoothness of compactly supported wavelets*, in: “Wavelets: Mathematics and Applications,” J. J. Benedetto and M. W. Frazier, eds., CRC Press, Boca Raton, FL (1994), pp. 163–201.
5. C. Heil and G. Strang, *Continuity of the joint spectral radius: Application to wavelets*, in: “Linear Algebra for Signal Processing” (Minneapolis, MN, 1992), A. Bjanczyk and G. Cybenko, eds., IMA Vol. Math. Appl. **69**, Springer–Verlag, New York (1995), pp. 51–61.
6. J. J. Benedetto, C. Heil, and D. F. Walnut, *Gabor systems and the Balian–Low theorem*, in: “Gabor Analysis and Algorithms: Theory and Applications,” H. G. Feichtinger and T. Strohmer, eds., Birkhäuser, Boston (1998), pp. 85–122.
7. C. A. Cabrelli, C. Heil, and U. M. Molter, *Polynomial reproduction by refinable functions*, in: “Advances in Wavelets” (Hong Kong, 1997), K.-S. Lau, ed., Springer–Verlag, Singapore (1999), pp. 121–161.
8. C. A. Cabrelli, C. Heil, and U. M. Molter, *Necessary conditions for the existence of multivariate multiscaling functions*, in: “Wavelet Applications in Signal and Image Processing VIII” (San Diego, CA, 2000), Proc. SPIE **4119**, A. Aldroubi et al., eds., SPIE, Bellingham, WA (2000), pp. 395–406.
9. C. Heil, *Integral operators, pseudodifferential operators, and Gabor frames*, in: “Advances in Gabor Analysis,” H. G. Feichtinger and T. Strohmer, eds., Birkhäuser, Boston (2003), pp. 153–169.
10. C. A. Cabrelli, C. Heil, and U. M. Molter, *Multiwavelets in  $\mathbf{R}^n$  with an arbitrary dilation matrix*, in: “Wavelets and Signal Processing,” L. Debnath, ed., Birkhäuser, Boston (2003), pp. 23–39.
11. C. Heil, *An introduction to weighted Wiener amalgams*, in: “Wavelets and their Applications” (Chennai, January 2002), M. Krishna et al., eds., Allied Publishers, New Delhi (2003), pp. 183–216.
12. K. Gröchenig and C. Heil, *Modulation spaces as symbol classes for pseudodifferential operators*, in: “Wavelets and their Applications” (Chennai, January 2002), M. Krishna et al., eds., Allied Publishers, New Delhi (2003), pp. 151–169.
13. R. Ashino, S. J. Desjardins, C. Heil, M. Nagase, and R. Vaillancourt, *Pseudodifferential operators, microlocal analysis and image restoration*, in: “Advances in Pseudo-Differential Operators,” R. Ashino, P. Boggiatto, and M.-W. Wong, eds., Birkhäuser, Boston (2004), pp. 187–202.

14. R. Balan, P. G. Casazza, C. Heil, and Z. Landau, *Excess of Parseval frames*, in: “Wavelets XI” (San Diego, CA, 2005), Proc. SPIE **5914**, M. Papadakis et al., eds., SPIE, Bellingham, WA (2005), pp. 39–46.
15. C. Heil, *Linear independence of finite Gabor systems*, in: “Harmonic Analysis and Applications,” C. Heil, ed., Birkhäuser, Boston (2006), pp. 171–206.
16. C. Heil and G. Kutyniok, *Convolution and Wiener amalgam spaces on the affine group*, in: “Recent Advances in Computational Science,” P. E. T. Jorgensen, X. Shen, C.-W. Shu, and N. Yan, eds., World Scientific, Singapore, to appear (9 pages).
17. C. Heil and D. R. Larson, *Operator theory and modulation spaces*, in: “Frames and Operator Theory in Analysis and Signal Processing” (San Antonio, 2006), D. R. Larson et al., eds., Contemp. Math., Vol. 451, Amer. Math. Soc., Providence, RI, 2008, pp. 137–150.
18. C. Heil, *The Density Theorem and the Homogeneous Approximation Property for Gabor frames*, in: “Representations, Wavelets, and Frames,” P. E. T. Jorgensen, K. D. Merrill, and J. D. Packer, eds., Birkhäuser, Boston, to appear (31 pages).

#### CONFERENCE PROCEEDINGS AND OTHER PUBLICATIONS

1. C. Heil, *Applications of the fast wavelet transform*, in: “Advanced Signal-Processing Algorithms, Architectures, and Implementations” (San Diego, CA, 1990), Proc. SPIE **1348**, F. T. Luk, ed., SPIE, Bellingham, WA (1990), 248–259.
2. C. Heil, J. Ramanathan, and P. Topiwala, *Asymptotic singular value decay of time-frequency localization operators*, in: “Wavelet Applications in Signal and Image Processing II” (San Diego, CA, 1994), Proc. SPIE **2303**, A. F. Laine and M. A. Unser, eds., SPIE, Bellingham, WA (1994), pp. 15–24.
3. P. N. Heller, V. Strela, G. Strang, P. Topiwala, C. Heil, and L. S. Hills, *Multiwavelet filter banks for data compression*, in: ISCAS ’95, Proc. International Symposium on Circuits and Systems (Seattle, WA, 1995), Vol. 3, IEEE, Piscataway, NJ (1995), pp. 1796–1799.
4. C. Heil, *Existence and accuracy for matrix refinement equations*, Z. Angew. Math. Mech., Special issue on Applied Stochastics and Optimization, **76** (1996), pp. 251–254.
5. C. Heil, *Wavelets*, Section 7.13.6 in the CRC Standard Mathematical Tables and Formulae, 30th Edition, D. Zwillinger, ed., CRC Press, Boca Raton, FL (1996), pp. 663–667 (Section 7.15.5 in the 31st Edition, 2003, pp. 723–726).
6. R. Ashino, C. Heil, M. Nagase, and R. Vaillancourt, *Microlocal analysis and multiwavelets*, in: “Geometry, Analysis and Applications” (Varanasi, India, 2000), R. S. Pathak, ed., World Scientific, Singapore (2001), pp. 293–302.
7. R. Ashino, C. Heil, M. Nagase, and R. Vaillancourt, *Multiwavelets, pseudodifferential operators and microlocal analysis*, in: Wavelet Analysis and Applications (Guangzhou, China, 1999), D. Deng et al., eds., AMS/IP Stud. Adv. Math., **25**, American Mathematical Society, Providence, RI (2002), pp. 9–20.

8. R. Ashino, S. J. Desjardins, C. Heil, M. Nagase, and R. Vaillancourt, *Image restoration through microlocal analysis with smooth tight wavelet frames*, in: Theoretical Development and Feasibility of Mathematical Analysis on the Computer (Japanese) (Kyoto, 2002), Sūrikaisekikenkyūsho Kōkyūroku No. 1286 (2002), pp. 101–118.

## RECENT TALKS (CONFERENCES, MEETINGS, AND COLLOQUIA)

- 1–75. Conferences, meetings, and colloquia, 1988–2001.
76. Special Session on Banach Spaces and Their Applications, AMS Regional Meeting, Georgia Tech, March 2002.
77. Miniconference on Wavelets, Frames, and Operator Theory, Texas A&M U., April 2002.
78. DIMACS Workshop on Source Coding and Harmonic Analysis, Rutgers U., May 2002.
79. Invited research visit, Time-Frequency Seminar, U. Vienna, Austria, June 2002.
80. Concentration Week on Frames, Wavelets, and Operator Theory, Texas A&M U., July 2002.
81. Special Session on Functional and Harmonic Analysis of Wavelets, Frames and their Applications, AMS Regional Meeting, U. Central Florida, November 2002.
82. Department Colloquium, Kennesaw State U., November 2002.
83. FRG Workshop, Louisiana State U., March 2003.
84. FRG Workshop, Vanderbilt U., May 2003.
85. FRG Workshop, U. Colorado, June 2003.
86. Workshop on Wavelets, Frames, and Operator Theory, Oberwolfach, Germany, February 2004.
87. Department Colloquium, Workshop on Wavelets, Washington U. St. Louis, March 2004.
88. Department Colloquium, U. Colorado, April 2004.
89. Keynote lecture, Second International Conference on Computational Harmonic Analysis, Vanderbilt U., May 2004.
90. Analysis Seminar, Cornell U., September 2004.
91. Special Session on Wavelets, Frames, and Sampling, AMS Regional Meeting, Vanderbilt U., October 2004.
92. Department Colloquium, U. Maryland, March 2005.
93. Workshop on Sparse Data Representation: The Role of Redundancy in Data Processing, CSCAMM, U. Maryland, May 2005.
94. International Conference on Wavelets and Splines, U. Georgia, May 2005.
95. Nebraska IMMENSE (Intensive Mathematics: A Mentoring, Education, and Research Summer Experience) Program, U. Nebraska, July 2005.
96. Conference Wavelets XI, SPIE Annual Meeting, San Diego, CA, August 2005.
97. Department Colloquium, U. Toledo, September 2005.
98. Workshop on Time-Frequency Analysis and Nonstationary Filtering, Banff International Research Station, Banff, Canada, September 2005.

99. Special Session on Wavelets, Frames, and Related Expansions, AMS Regional Meeting, U. Oregon, November 2005.
100. Department Colloquium, Augusta State U., December 2005.
101. Workshop on Recent Progress in Wavelet Analysis and Frame Theory, U. Bremen, Germany, January 2006.
102. Department Colloquium and February Fourier Talks (FFT), U. Maryland, February 2006.
103. FRG Workshop, Vanderbilt U., April 2006.
104. Current Trends in Harmonic Analysis and Its Applications: Wavelets and Frames, U. Colorado, May 2006.
105. Informal Regional Functional Analysis Seminar (SUMIRFAS), Texas A&M U., August 2006.
106. Concentration Week on Frames, Banach spaces and Signal Processing, Texas A&M U., August 2006.
107. Summer Time-Frequency Talks (STFT), U. Maryland, June 2007.
108. Invited address, MAA SoCal sectional meeting, Santa Ana College, CA, October 2007.
109. Department Colloquium, Augusta State U., October 2007.
110. Special Session on Splines and Wavelets, AMS Regional Meeting, Middle Tennessee State U., November 2007.
111. Department Colloquium, U. Houston, January 2008.
112. 24th Southeastern Analysis Meeting, Vanderbilt U., March 2008.
113. Department Colloquium, Georgia Southern U., March 2008.

## EDITORIAL WORK

### Editorial Boards

1. *Journal of Fourier Analysis and Applications*, September 1999–present.
2. *Applied and Computational Harmonic Analysis*, September 2005–present.
3. Book Series “Applied and Numerical Harmonic Analysis,” Birkhäuser, September 1995–present.
4. Guest editor (with K. Gröchenig), Special Issue on Modulation Spaces and Time-Frequency Analysis, *Sampling Theory in Signal and Image Processing*, Vol. 5, No. 2 (2006).
5. Guest editor (with J. Stöckler and R.-Q. Jia), Special Issues on Frames, *Applied and Computational Harmonic Analysis*, Vol. 17, Nos. 1, 2 (2004) and Vol. 18, No. 1 (2005).
6. *SIAM Journal on Scientific Computing*, January 1995–December 1998.
7. *PanAmerican Mathematical Journal*, June 1994–June 1996.

### Invited Book Reviews

1. Review of: I. Daubechies, *Ten Lectures on Wavelets*, SIAM (1992) and C. K. Chui, *An Introduction to Wavelets*, Academic Press (1992); appeared in: *Computers in Physics*, **6** (1992), p. 697.
2. Review of: I. Daubechies, *Ten Lectures on Wavelets*, SIAM (1992); appeared in: *SIAM Review*, **35** (1993), pp. 666–669.
3. Review of: D. W. Kammler, *A First Course in Fourier Analysis*, Prentice Hall (2000); appeared in *SIAM Review*, **43** (2001), pp. 722–724.

### **STUDENTS**

#### Doctoral Students (Year of Graduation, Thesis Title)

1. Demetrio Labate (2000), *Time-frequency analysis of pseudodifferential operators*. Received Georgia Tech Sigma Xi Best Ph.D. Thesis award (one of five institute awards for 2000).
2. Denise Jacobs (2001), *Multiwavelets in higher dimensions*.
3. Kasso Okoudjou (2003), *Characterization of function spaces and boundedness of bilinear pseudodifferential operators through Gabor frames*. Received Georgia Tech Sigma Xi Best Ph.D. Thesis award (one of five institute awards for 2003).

#### Master's Students (Year of Graduation, Thesis Title if applicable)

1. Sandie Leach (2003), *Density conditions on Gabor frames*.
2. Becky Upchurch (2004).
3. Sung Won Han (current).

#### Undergraduate Research Interns

1. Nicholas Brönn, Summer 2001.

#### Postdoctoral and Visiting Graduate Student Supervisor

1. Brody Johnson (GA Tech VIGRE Postdoc), August 2002–July 2003.
2. Keri Kornelson (visiting Texas A&M VIGRE Postdoc), January–May 2003.
3. Norbert Kaiblinger (Postdoc, Austrian Science Foundation), January–December 2003.
4. Gerard Ascensi (visiting graduate student, U. Barcelona), January–April 2005.

### **MEMBERSHIP IN PROFESSIONAL SOCIETIES**

1. American Mathematical Society (AMS).
2. Society for Industrial and Applied Mathematicians (SIAM).

## HONORS AND AWARDS

1. Merit Scholarship Finalist, 1979.
2. Outstanding Mathematics Student, Columbia Union College, 1982.
3. Outstanding Contribution to the Mathematics Department, Columbia Union College, 1982.
4. Graduated Summa Cum Laude, Columbia Union College, 1982.
5. Publication Awards, The MITRE Corporation: 1990, 1993, 1994, 1996.
6. The MITRE Corporation 1995 Best Paper Award, for *Characterizations of scaling functions: Continuous solutions*.
7. Nominated for the *W. Roane Beard Outstanding Teacher Award*, Georgia Tech, 1999.