DAVID P. NICHOLLS

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RESEARCH INTERESTS

Numerical analysis and applied PDE; Applied mathematics, scientific computation, and differential equations; High–order numerical methods for free boundary and boundary value problems; Fluid mechanics, electromagnetics, acoustics, and finance.

EXPERIENCE

Professor (Math., Stat., & Comp. Sci.), University of Illinois at Chicago, Fall 2010–present.

Associate Professor (Math., Stat., & Comp. Sci.), University of Illinois at Chicago, Fall 2007–Summer 2010.

Assistant Professor (Math., Stat., & Comp. Sci.), University of Illinois at Chicago, Fall 2005–Summer 2007.

Assistant Professor (Mathematics), University of Notre Dame, Fall 2001–Summer 2005.

Jackson Assistant Professor (Mathematics), University of Minnesota, Fall 1998–Summer 2001.

EDUCATION

Ph. D. Applied Mathematics, Brown University, Providence, RI. May 1998.

Sc. M. Applied Mathematics, Brown University, Providence, RI. May 1995.

B. S. Mathematics, University of Illinois, Urbana, IL. May 1993. *Summa Cum Laude.*

GRANTS

1. *Dept. of Energy*, $ 249,742 (App. Math). "High–Order Numer. Meth. for the Simul. of Linear and Non–Linear Waves: High Freq. Radiation and Dyn. Stab." September 2009–August 2012.

2. *Nat. Sci. Found.*, $ 12,653 (Comp. Math). "Numerical Algorithms for the Detection and Simulation of Surface Water Waves." June 2009–August 2009.

3. *Nat. Sci. Found.*, $ 142,487 (Comp. Math). "Numerical Algorithms for the Detection and Simulation of Surface Water Waves." July 2008–July 2011.

4. *Nat. Sci. Found.*, $ 90,471 (App. Math). "Free Surface Fluid Mechanics and Electromagnetic Scattering: Stable, High–Order Perturbation Techniques." July 2004–July 2008.

5. *Nat. Sci. Found.*, $ 5,000 (App. Math). "FRG: Collaborative Research: Fully Nonlinear, Three–Dimensional Surface Water Waves in Arbitrary Depth." July 2004–July 2005.

6. *Nat. Sci. Found.*, $ 20,000 (Analysis, co–PI). "Conference: Partial Differential Equations and Applications." September 2002–August 2003.

7. *Nat. Sci. Found.*, $ 61,474 (App. Math, co–PI). "FRG: Collaborative Research: Fully Nonlinear, Three–Dimensional Surface Water Waves in Arbitrary Depth." July 2002–July 2005.

8. *Nat. Sci. Found.*, $ 85,421 (App. Math). "High Order Boundary Perturbation Methods for Boundary Value and Free Boundary Problems." July 2000–July 2004.

9. *Nat. Sci. Found.*, Graduate Student Fellow. September 1994–August 1997.

ACCEPTED PUBLICATIONS (available at `www.math.uic.edu/~nicholls`)

1. (with A. Malcolm) A Field Expansions Method for Scattering by Periodic Multilayered Media. *Journal of the Acoustical Society of America*, *to appear*.

2. Spectral Stability of Traveling Water Waves: Eigenvalue Collision, Singularities, and Direct Numerical Simulation. *Physica D*, 240(4–5), 376–381, 2011.

3. (with J. Orville) A Boundary Perturbation Method for Vector Electromagnetic Scattering from Families of Doubly Periodic Gratings. *Journal of Scientific Computing*, 45(1), 471–486, 2010.

4. (with B. Akers) Traveling Waves in Deep Water with Gravity and Surface Tension. *SIAM Journal on Applied Mathematics*, 70(7), 2373–2389, 2010.

5. (with B. Hu) The Domain of Analyticity of Dirichlet–Neumann Operators. *Proceedings of the Royal Society of Edinburgh, A*, 140(2), 367–389, 2010.

6. (with C. Fazioli) Stable Computation of Variations of Dirichlet-Neumann Operators. *Journal of Computational Physics*, 229(3), 906–920, 2010.

7. (with M. Kakleas) Numerical Simulation of a Weakly Nonlinear Model for Water Waves with Viscosity. *Journal of Scientific Computing*, 42(2), 274–290, 2010.

8. (with A. Fine and D. Mogul) Assessing Instantaneous Synchrony of Nonlinear, Nonstationary Oscillators in the Brain. *Journal of Neuroscience Methods* 186(1), 42–51, 2010.

9. (with J. Gorsky) A Small Dispersion Limit to the Camassa–Holm Equation: A Numerical Study. *Mathematics and Computers in Simulation*, 80(1), 120–130, 2009.

10. (with J. Shen) A Rigorous Numerical Analysis of the Transformed Field Expansion Method. *SIAM Journal on Numerical Analysis*, 47(4), 2708–2734, 2009.

11. (with T. Binford, N. Nigam, & T. Warburton) Exact Non–Reflecting Boundary Conditions on Perturbed Domains and *hp*–Finite Elements. *Journal of Scientific Computing*, 39(2), 265–292, 2009.

12. Spectral Data for Traveling Water Waves: Singularities and Stability. *Journal of Fluid Mechanics*, 624, 339–360, 2009.

13. A Rapid Boundary Perturbation Algorithm for Scattering by Families of Rough Surfaces. *Journal of Computational Physics*, 228(9), 3405–3420, 2009.

14. (with M. Taber) Detection of Ocean Bathymetry from Surface Wave Measurements. *European Journal of Mechanics B/Fluids*, 28(2), 224–233, 2009.

15. (with F. Reitich) Boundary Perturbation Methods for High–Frequency Acoustic Scattering: Shallow Periodic Gratings. *J. Acoust. Soc. Amer.*, 123(5), 2531–2541, 2008.

16. (with M. Taber) Joint Analyticity and Analytic Continuation for Dirichlet–Neumann Operators on Doubly Perturbed Domains. *J. Math. Fluid Mech.*, 10(2), 238–271, 2008.

17. (with C. Fazioli) Parametric Analyticity of Functional Variations of Dirichlet–Neumann Operators. *Differential and Integral Equations*, 21(5–6), 541–574, 2008.

18. (with P. Guyenne) A High–Order Spectral Method for Nonlinear Water Waves over Bottom Topography. *SIAM Journal on Scientific Computing*, 30(1), 81–101, 2007.

ACCEPTED PUBLICATIONS, cont.

19. Spectral Stability of Traveling Water Waves: Analytic Dependence of the Spectrum. *Journal of Nonlinear Science*, 17(4), 369–397, 2007.

20. (with Q. Fang & J. Shen) A Stable, High–Order Method for Three–Dimensional Bounded–Obstacle Scattering. *Journal of Computational Physics*, 224(2), 1145–1169, 2007.

21. Boundary Perturbation Methods for Water Waves. *GAMM–Mitteilungen*, 30(1), 44–74, 2007.

22. (with L. Chindelevitch & N. Nigam) Error Analysis and Preconditioning for an Enhanced DtN–FE Algorithm for Exterior Scattering Problems. *J. Comput. App. Math.*, 204, 493–504, 2007.

23. (with N. Nigam) Error Analysis of an Enhanced DtN–FE Method for Exterior Scattering Problems. *Numerische Mathematik*, 105(2), 267–298, 2006.

24. (with J. Shen) A Stable, High–Order Method for Two–Dimensional Bounded–Obstacle Scattering. *SIAM Journal on Scientific Computing*, 28(4) 1398–1419, 2006.

25. (with F. Reitich) Stable, High–Order Computation of Traveling Water Waves in Three Dimensions. *European Journal of Mechanics B/Fluids*, 25(4): 406–424, 2006.

26. (with B. Hu) Analyticity of Dirichlet–Neumann Operators on Hölder and Lipschitz Domains. *SIAM Journal on Mathematical Analysis*, 37(1): 302–320, 2005.

27. (with F. Reitich) On Analyticity of Traveling Water Waves. *Proceedings of the Royal Society of London, A*, 461(2057): 1283–1309, 2005.

28. (with P. Guyenne) Numerical Simulation of Solitary Waves on Plane Slopes. *Mathematics and Computers in Simulation*, 69: 269–281, 2005.

29. (with W. Craig, P. Guyenne & C. Sulem) Hamiltonian Long Wave Expansions for Water Waves over a Rough Bottom. *Proceedings of the Royal Society of London, A*, 461(2055): 839–873, 2005.

30. (with F. Reitich) Shape Deformations in Rough Surface Scattering: Improved Algorithms. *Journal of the Optical Society of America, A*, 21(4): 606–621, 2004.

31. (with F. Reitich) Shape Deformations in Rough Surface Scattering: Cancellations, Conditioning, and Convergence. *Journal of the Optical Society of America, A*, 21(4): 590–605, 2004.

32. (with N. Nigam) Exact Non–Reflecting Boundary Conditions on General Domains. *Journal of Computational Physics*, 194(1): 278–303, 2004.

33. (with M. Haragus & D. Sattinger) Solitary Wave Interactions of the Euler–Poisson Equations. *Journal of Mathematical Fluid Mechanics*, 5: 92–118, 2003.

34. (with F. Reitich) Analytic Continuation of Dirichlet–Neumann Operators. *Numerische Mathematik*, 94(1): 107–146, 2003.

35. (with W. Craig) Traveling Gravity Water Waves in Two and Three Dimensions. *European Journal of Mechanics B/Fluids*, 21(6): 615–641, 2002.

36. (with F. Reitich) A New Approach to Analyticity of Dirichlet–Neumann Operators. *Proceedings of the Royal Society of Edinburgh, A*, 131(6): 1411–1433, 2001.

37. (with F. Reitich) A Stable High–Order Perturbative Method for the Computation of Dirichlet–Neumann Operators. *Journal of Computational Physics*, 170(1): 276–298, 2001.

ACCEPTED PUBLICATIONS, cont.

38. On Hexagonal Gravity Water Waves. *Mathematics and Computers in Simulation*, 55: 567–575, 2001.

39. (with W. Craig) Traveling Two and Three Dimensional Capillary Gravity Water Waves. *SIAM Journal on Mathematical Analysis*, 32 (2): 323–359, 2000.

40. Traveling Water Waves: Spectral Continuation Methods with Parallel Implementation. *Journal of Computational Physics*, 143(1): 224–240, 1998.

SUBMITTED PUBLICATIONS (available at `www.math.uic.edu/~nicholls`)

41. (with D. Ambrose and J. Bona) Well–Posedness of a Model for Water Waves with Viscosity.

42. (with B. Akers) Spectral Stability of Deep Two–Dimensional Gravity Water Waves: Repeated Eigenvalues.

43. Efficient Enforcement of Far–Field Boundary Conditions in the Transformed Field Expansions Method.

HONORS AND AWARDS

Guest Research Faculty, Division of Mathematics & Computer Science, Argonne National Laboratory, May 2009–May 2010.
Participant, Mathematisches Forschungsinstitut Oberwolfach, (Oberwolfach, Germany), Nov. 2006.

Visiting Member, Fields Institute (Toronto), Aug. 2003–Jun. 2004.

Visiting Member, Isaac Newton Institute (Cambridge, England), Aug. 2001.

CONFERENCES ORGANIZED

- "WAVES 2011," Vancouver, BC, July 2011.
- "Advances in Computational Scattering," Banff International Research Station, February 2006.
- "Workshop on Free Surface Water Waves," Fields Institute (Toronto), June 2004.
- "Partial Differential Equations and Applications," University of Notre Dame, August 2003.

CONFERENCE SCIENTIFIC COMMITTEES

- Fifth, Sixth, and Seventh IMACS Inter. Conf. on Nonlinear Evol. Eqns. & Wave Phen., Athens, GA (April 2007, 2009, 2011).

SELECTED CONFERENCE SESSIONS ORGANIZED

- "Water waves with gravity and surface tension" (IMACS Inter. Conf. on Nonlinear Evol. Eqns. & Wave Phen.), Athens, GA, April 2011.
- "Special Session on Computational Electromagnetics and Acoustics" (AMS Central Sectional Meeting), Notre Dame, IN, November 2010.
- "Numerical Methods for Nonlinear Dispersive Wave Equations" (IMACS Inter. Conf. on Nonlinear Evol. Eqns. & Wave Phen.), Athens, GA, March 2009.
- "Well-Posedness for Nonlinear Dispersive Wave Equations" (IMACS Inter. Conf. on Nonlinear Evol. Eqns. & Wave Phen.), Athens, GA, April 2007.
- "Numerical Methods for Nonlinear Dispersive Wave Equations" (IMACS Inter. Conf. on Nonlinear Evol. Eqns. & Wave Phen.), Athens, GA, April 2007.
- "Recent Advances in High–Order/Spectral Methods" (SIAM Annual Meeting), Boston, MA, July 2006.
- "Special Session on Water Waves" (AMS Central Sectional Meeting), Notre Dame, IN, April 2006.
- "Novel Computational Methods for Nonlinear Wave Equations" (IMACS Inter. Conf. on Nonlinear Evol. Eqns. & Wave Phen.), Athens, GA, April 2005.
- "Numerical and Theoretical Aspects of Free–Surface Ocean Dynamics" (SIAM Conf. on Analysis of PDE), Houston, TX, December 2004.
- "Numerical Methods in Electromagnetics and Acoustics" (Partial Differential Equations and Applications), University of Notre Dame, August 2003.
- "Truncation Techniques for Exterior Scattering Problems" (International Congress for Industrial and Applied Mathematics), Sydney, Australia, July 2003.

SEMINARS ORGANIZED

- "Applied Mathematics Seminar," University of Notre Dame, January 2002–May 2005.
- "Mathematics and Its Applications Seminar," University of Illinois–Chicago, August 2008–present.

PROFESSIONAL SERVICE

- Proposal Referee:
  - National Science Foundation (Applied Math, Computational Math)
  - National Research Council
  - City University of Hong Kong
  - U.S.–Israel Binational Science Foundation
- Journal Referee (selected):
  - Analysis and Applications
  - Applied Numerical Mathematics
  - Communications in Mathematical Sciences
  - European Journal of Mechanics B/Fluids
  - IMA Journal of Applied Mathematics
  - Inverse Problems
  - Journal of Computational and Applied Mathematics
  - Journal of Computational Physics
  - Journal of Fluid Mechanics
  - Journal of Mathematical Fluid Mechanics
  - Journal of the Optical Society of America A
  - Journal of Scientific Computing
  - Mathematics and Computers in Simulation
  - Nonlinearity
  - Physica D
  - Physics of Fluids
  - Physics Letters A
  - Proceedings of the American Mathematical Society
  - Proceedings of the Royal Society of London A
  - Science in China
  - SIAM Journal on Mathematical Analysis
  - SIAM Journal on Numerical Analysis
  - SIAM Journal on Scientific Computing

UNIVERSITY SERVICE

- Faculty Senate (UIC: 2006–2010).
- Campus Research Board: Natural Science and Engineering Subcommittee (UIC: 2010–present).
- Researcher of the Year Award Review Committee: Natural Science and Engineering Subcommittee (UIC: 2010).

DEPARTMENTAL SERVICE

- Advisory Committee (UIC: 2010–present).
- Tenure–Track Hiring Committee (UIC: 2006–2010, 4 years).
- Research Assistant Professor Hiring Committee (UIC: 2005–2006, 2010–2011).
- Admissions, Fellowships, Assistantships Committee (UIC: 2006–present, 5 years).
- Mathematics and Information Sciences for Industry (MISI) Advisor (UIC: 2007–present, 3 years).
- Graduate Committee (UIC: 2005–present, 6 years).

POSTDOCTORAL ASSOCIATES SUPERVISED

- Ben Akers (Fall 2008–present), Univ. of Illinois–Chicago.

GRADUATE STUDENTS SUPERVISED

- Jun Niu (Fall 2010–present), Ph.D. (expected 2013), Univ. of Illinois–Chicago.
- Travis McBride (Spring 2008–present), Ph.D. (expected 2011), Univ. of Illinois–Chicago.
- Robyn Canning (Spring 2008–present), Ph.D. (expected 2011), Univ. of Illinois–Chicago.
- Maria Kakleas (Spring 2007–Spring 2009), Ph.D. 2009, Univ. of Illinois–Chicago.
- Carlo Fazioli (Spring 2007–Spring 2009), Ph.D. 2009, Univ. of Illinois–Chicago.
- Mark Taber (Fall 2003–Spring 2007), Ph.D. 2007, Univ. of Illinois–Chicago.
- Silas Bowman (Fall 2005–Spring 2007), M.S.(thesis) 2007, Univ. of Illinois–Chicago.

UNDERGRADUATE STUDENTS SUPERVISED

- Joshua Lawrence (Spring 2008), Univ. of Illinois–Chicago.
- Bryan Dolan (Fall 2004–Spring 2005), Univ. of Notre Dame.
- Kelly Deckelman (Spring 2004), Univ. of Notre Dame.

MEMBERSHIPS

- Society for Industrial and Applied Mathematics.
- American Mathematical Society.
- Sigma Xi, Phi Beta Kappa, Phi Kappa Phi, Golden Key.

TEACHING EXPERIENCE

Taught graduate courses in Numerical Analysis of Partial Differential Equations, Linear & Nonlinear Waves, Supercomputing, and Computational Finance. Have also taught a variety of lower and upper division undergraduate courses including Numerical Analysis, Linear Algebra, Differential Equations, Probability, Calculus, Pre–Calculus, and College Algebra.

SELECTED INVITED TALKS

1. Waves in Fluids III, Rio de Janiero, Brazil, June 2011.
2. IMACS Inter. Conf. on Nonlinear Evol. Eqns. & Wave Phen., Athens, GA, April 2011.
3. SIAM Conf. Comput. Sci. Engin. (*High Order Num. Meth.*), Reno, NV, February 2011.
4. Colloquium, Southern Methodist University, January 2011.
5. AMS 2010 Central Sectional Meeting (*Comput. Electro. Acous.*), Notre Dame, IN, November 2010.
6. SIAM Conf. Nonlin. Waves (*Models of Water Waves*), Philadelphia, PA, August 2010.
7. Dept. of Energy Applied Math Program Meeting, Berkeley, CA, May 2010.
8. SIAM Conf. Anal. PDE (*Math. Topics Water Waves*), Miami, FL, December 2009.
9. Colloquium, University of Illinois at Urbana–Champaign, October 2009.
10. Advances in Boundary Integral Equations, Newark, DE, August 2009.
11. Frontiers in Applied and Computational Mathematics, New Jersey Inst. Tech., May 2008.
12. Computational and Applied Mathematics Seminar, Purdue University, April 2008.
13. Calderón–Zygmund Analysis Seminar, University of Chicago, March 2008.
14. Joint Mathematics Meetings (*Dyn. Stab. Coherent Structures*), San Diego, January 2008.
15. SIAM Conf. Anal. PDE (*Math. Topics Oceanography*), Mesa, AZ, December 2007.
16. AMS 2007 Central Sectional Meeting (*Math. Model. Numer. Meth.*), Chicago, October 2007.
17. Amer. Inst. Math. (*High-order Meth. Comput. Wave Prop. Scatt.*), Palo Alto, Sept 2007.
18. Colloquium, University of Washington (Applied Mathematics), March 2007.
19. Joint Mathematics Meetings, (*Recent Adv. Comput. Scatt.*), New Orleans, January 2007.
20. Math. Forsch. Oberwolfach (*Mathematical Theory of Water Waves*), Oberwolfach, Germany, Nov 2006.
21. SIAM Conf. Nonlin. Waves (*Model. & Anal. Nonlin. Waves*), Seattle, WA, September 2006.
22. SIAM Annual Meeting (*High–Order Spectral Methods*), Boston, MA, July 2006.
23. Banff International Research Station (*Adv. Comput. Scatt.*), Banff, Canada, February 2006.
24. Colloquium, Rice University (CAAM), November 2005.
25. WAVES 2005 (*Direct Scattering*), Providence, RI, June 2005.
26. IMACS Inter. Conf. on Nonlinear Evol. Eqns. & Wave Phen., Athens, GA, April 2005.
27. Applied Mathematics Seminar, McGill University, Montréal, March 2005.
28. Computational and Applied Mathematics Seminar, Purdue University, March 2004.
29. Fields Colloq. in Applied Mathematics, Fields Institute, Toronto, Ontario, February 2004.
30. Intl. Cong. Ind. Appl. Math. (*Surf. Waves Water Arb. Depth*), Sydney, Australia, July 2003.
31. Applied Mathematics Seminar, University of Chicago, February 2003.
32. Surface Water Waves 2001, Isaac Newton Institute, Cambridge, England, August 2001.