Ronald D. Haynes (PhD) – updated June 2010

CONTACT INFORMATION

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AFFILIATIONS

Memorial University, St. John's, Newfoundland and Labrador
Associate Professor — **As of September 2009**

Acadia University, Wolfville, Nova Scotia
Adjunct Professor — **October 2009 – present**
Department of Mathematics and Statistics

Saint Mary's University, Halifax, Nova Scotia
Adjunct Professor — **August 2008 – present**
Department of Mathematics and Computing Science

Dalhousie University, Halifax, Nova Scotia
Adjunct Professor — **June 2006 – present**
Department of Mathematics and Statistics

PREVIOUS AFFILIATION

Acadia University, Wolfville, Nova Scotia
Associate Professor — **July 2008**
Tenured — **July 2009**
Assistant Professor — **July 2004 – June 2008**
Department of Mathematics and Statistics

EDUCATION

Simon Fraser University, Burnaby, B.C. Canada

Ph.D., Applied and Computational Mathematics, March 2003
- Supervisors: Dr. Manfred Trummer and Dr. Robert Russell

M.Sc., Applied and Computational Mathematics, 1998
- Supervisor: Dr. Manfred Trummer

Memorial University of Newfoundland, St. John's, Newfoundland, Canada

B.Sc. (Hons), Applied Mathematics, May, 1996
- Supervisor: Dr. Herman Brunner and Dr. Richard Charron

RESEARCH INTERESTS

Broadly my interests involve aspects of scientific computing and numerical analysis with particular interest in the numerical solution of ordinary and partial differential equations. Specifically I work with adaptive numerical methods known as moving mesh methods for PDEs. Related interests include numerical linear algebra, domain decomposition methods including Schwarz waveform relaxation, large scale optimization, and multirate methods for ODEs.

Research Grants

Atlantic Innovation Fund, J.P. Whitehead, C. Hurich, C. Farquharson, R. Haynes, $867,500
- Seismic Modeling and Inversion

IRIF/RDC Research Grant 2010–2012, total $100,000
- Optimization problems in the development of energy technologies.

NSERC Discovery Grant 2008–2013, $15,000 per year, total $75000
- Current research grant and first renewal with an increase in funding. Proposal entitled *Implementation and Analysis of Adaptive Algorithms for the Numerical Solution of Partial Differential Equations*.

Acadia University Research Fund (Article 25.55) 2007-2008 $2000
- University wide competition. Proposal entitled *Grid Selection for Two Point Boundary Value Problems*.

NSERC Research Tools and Instruments (Equipment) Grant 2007 $50,638 (co–applicant)
- Funds used to purchase Acadia University's first high performance computing cluster. Proposal entitled *Computing Equipment for Mathematical and Statistical Modelling*.

MITACS Networking Proposal 2007 $5,000 (co–applicant)
- MITACS funds used to support AARMS–ACENET HPC Workshop and Conference, Acadia University, July 9–14, 2007.

NSERC Discovery Grant 2005–2007 $13,000 per year, total $39000
- Initial NSERC research grant.

Acadia University Research Fund (Article 25.55) 2004–2005 $2500
- University wide competition. Proposal entitled *Practical Aspects of Adaptive Mesh Computations*.

Acadia University Research Startup Award 2004–2005 $15000

Other Grants

Acadia University Teaching & Learning Enhancement Award 2008–2009, $9500

Acadia University Teaching Innovation and Improvement Fund 2005 $18571

Honors and Awards

Natural Science and Engineering Research Council Post Doctoral Fellowship, 2003

Special Graduate Entrance Scholarship (Ph.D.) 1998

Natural Science and Engineering Research Council Post Graduate Scholarship (Ph.D. Level) 1998

Best Student Exhibit Award, British Columbia Advanced Systems Institute Exchange, 1998.

Special Graduate Entrance Scholarship (M.Sc.) Simon Fraser University 1996

Natural Science and Engineering Research Council Post Graduate Scholarship (M.Sc.Level) 1996

University Mathematics Medal, convocation award (B.Sc.), Memorial University of Newfoundland, 1996

Governor General of Canada Silver Medal (B.Sc.), Memorial University of Newfoundland, 1996

Teaching Experience

Memorial University St. John's, NL
- *2010-2011* Numerical Methods for Differential Equations (Math 6210), MATH 3132 Numerical Analysis, CS 6739 Nonlinear Optimization.
- *2009-2010* Numerical Methods for Partial Differential Equations (AMATH 4162), Numerical Methods for Differential Equations (MATH 6210).

Acadia University, Wolfville, Nova Scotia
- *2008-2009* Calculus I (Differential), Numerical Methods, Calculus II (Integral), Advanced Numerical Methods (Graduate), Differential Equations I

- *2007-2008* Calculus I (Differential), Numerical Methods, Calculus IV (Vector), Advanced Numerical Methods
- *2006-2007* Calculus I (Differential), Calculus II (Integral), Calculus IV (Vector), Numerical Methods
- *2005-2006* Calculus I (Differential), Calculus II (Integral), Calculus IV (Vector), Numerical Methods, Advanced Numerical Methods
- *2004-2005* Numerical Methods, Calculus II (Integral), Calculus IV (Vector)

Simon Fraser University, Burnaby, British Columbia
- *2000-2001* Numerical Analysis
- *1999-2000* Precalculus

Other Academic Experience

University of Waterloo, Waterloo, Ontario

NSERC Postdoctoral Research Fellow **September 2003–June 2004**
School of Computer Science and Department of Applied Mathematics, Dr. Bruce Simpson (Computer Science) and Dr. Kevin Lamb (Applied Math) supervisors.

Simon Fraser University, Burnaby, B.C.

Research Associate **May–August 2003**
Continued development of a Schwarz Waveform Moving Mesh Solver with Professor Robert Russell.

Teaching Assistant **September 1996 - December 2002**
Duties included presentation of tutorials, assignments and exam grading for undergraduate courses including Linear Algebra, Numerical Analysis and Discrete Mathematics.

Publications in Refereed Journals

[1] Cao W., Haynes, R.D., and Trummer, M.R. Preconditioning for a Class of Spectral Differentiation Matrices. J. Sci. Comput. Vol. 24, No.3, pp. 343–371, September 2005.

[2] Haynes, R.D., Kennedy, S.C. and Trummer, M.R., Persistently Positive Inverses of Perturbed M–Matrices, Linear Algebra and Applications, Volume 422, Issue 2-3, Pages 742-754, 2007.

[3] Turner, C., Haynes, R.D. A Numerical and Theoretical Study of Blow-up for a System of Ordinary Differential Equations using the Sundman Transformation. Atlantic Electronic Journal of Mathematics, Vol. 2, No. 1, Summer Issue, 2007.

[4] Haynes, R.D., and Russell, R.D. A Schwarz Waveform Moving Mesh Method. SIAM J. Sci. Comput., Vol. 29, No. 2, pp. 656–673, 2007.

[5] Haynes, R.D., Huang, W., and Russell, R.D. A Moving Mesh Method for Time–dependent Problems based on Schwarz Waveform Relaxation, Proceedings of the 17th International Domain Decomposition Methods Meeting, Lecture Notes in Computational Science and Engineering (LNCSE), Springer–Verlag, Vol. 60, pages 229–236, 2008.

[6] Dulong, B., Haynes, R.D., Robertson, M. A study in the computation time required for the inclusion of strain field effects in Bloch-wave simulations of TEM diffraction contrast images, Ultramicroscopy, Vol. 108, Iss. 5, pp. 415–425, 2008.

[7] Karsten, R., McMillan, J., Lickley, M., Haynes, R.D. Assessment of Tidal Current Energy for Minas Passage, Bay of Fundy, Proc. IMechE Part A: J. Power and Energy, Vol. 222, pp. 493–507, 2008.

[8] McMillan, J., Lickley, M., Karsten, R., Haynes, R.D. Potential of Tidal Power and its Effects on the Bay of Fundy. SIAM Undergraduate Research Online, Vol. 1, Iss. 1, 2008.

[9] Kennedy, S. and Haynes, R.D. Inverse Positivity of Perturbed Tridiagonal M-Matrices, Linear Algebra and its Applications, Vol. 430, Issues 8–9, pp. 2312–2323, 2009.

[10] Haynes, R.D., Recent Advances in Schwarz Waveform Moving Mesh Methods, Lecture Notes in Computational Science and Engineering (LNCSE), Springer–Verlag, 8 pages, 2010.

SUBMITTED PAPERS

[11] Ranjan, P., Haynes, R.D. and Karsten, R. Gaussian Process Models and Interpolators for Deterministic Computer Simulators, Techometrics, Submitted August 2009.

BOOKS

[12] Brown, M. and Haynes, R.D. Student Solution's Manual for *Numerical Analysis and Scientific Computation: Jeffrey Leader*, Addison–Wesley,ISBN-10: 0321257332 ISBN-13: 9780321257338

PREPRINTS

[13] Haynes, R.D., Kwok, T–O and Ling, L., Coupling adaptive node refinement and adaptive greedy solvers for meshless approximation.

[14] Haynes, R.D., Equidistributing Grids via Domain Decomposition – Theory and Practice.

PAPERS IN PREPARATION

Haynes, R.D., Gander, M.J., Russell, R.D., Huang, W., Convergence of Schwarz Waveform Moving Mesh Methods.

Haynes, R.D., Huang, W., Russell, R.D. Optimal Schwarz waveform moving mesh methods.

Haynes, R.D., Huang, W., Russell, R.D. A Two–Dimensional Schwarz waveform moving mesh method.

Haynes, R.D., Russell, R.D., and Trummer, M.R., Determining Mesh Structure through Linear System Properties for Two–Point Boundary Value Problems.

NON–REFEREED PAPERS

Haynes, R.D. and Promislow, K., 2002. Degenerate transport and phase change in a porous fuel cell electrode. (Technical Report)

Haynes, R.D., Charron, R. and Brunner, H., 1996. On the Collocation Solution of Ordinary Differential Equations with Blow–up Properties. (Technical Report)

RESEARCH PRESENTATIONS

See next section for a list of student presentations

Invited Lectures

Title: TBD. Special Session on Spectral Methods in the Analysis of Differential Equations, 2010 CMS Summer Meeting, University of New Brunswick, June 4-6 2010.

Moving Meshes, Domain Decomposition and other initiatives, Department of Mathematics and Statistics, Memorial University of Newfoundland, Dynamical Systems Seminar, December 4, 2009.

Recent Advances in Schwarz Waveform Moving Mesh Methods, 19^{th} International Conference on Domain Decomposition Methods, Zhangjiajie, China, August 17, 2009.

Adaptive Space–Time Methods for Differential Equations, CAIMS 2009, London, Ontario, June 12, 2009.

Adaptive Space–Time Methods for Differential Equations, CMS/CSHPM 2009, St. John's, NL, June 7, 2009.

Multirate Moving Mesh Methods, Computational Science and Engineering Seminar Series, McGill Univeristy, February 8th, 2008.

Schwarz Waveform Moving Mesh Methods, Department of Mathematics and Statistics, Memorial University of Newfoundland, January 18th, 2008.

Schwarz Waveform Moving Mesh Methods, Department of Earth Sciences, Memorial University of Newfoundland, August 14, 2007.

Schwarz Waveform Moving Mesh Methods, Computational PDE Symposium, CAIMS*SCMAI 2007, BANFF Centre, Alberta, May 21, 2007.

The Story of two Schwarz Waveform Moving Mesh Methods, AARMS Session on Mathematical Modeling and Simulation, APICS Mathematics and Computer Science Conference, Sydney, N.S., October 14, 2006

Towards a 2D/3D Schwarz Waveform Moving Mesh Solver, 17^{th} International Conference on Domain Decomposition Methods, St. Wolfgang/Strobl, Austria, July 3-7, 2006.

Towards a Schwarz Waveform Moving Mesh Method, Bluenose Numerical Analysis Day, St. Francis Xavier University, Antigonish, Nova Scotia, June 23, 2006.

Perturbed M–matrices and the Persistence of Positivity, Department of Mathematics and Statistics, Dalhousie University, May 26, 2006.

Persistently Positive Inverses of Diagonally Perturbed M–matrices, Department of Mathematics and Statistics, Memorial University of Newfoundland, February 24, 2006.

New Solution Strategies for Moving Mesh Partial Differential Equation Methods., Bluenose Numerical Analysis Day, Acadia University, May 28, 2004.

McGill Computational Science and Engineering Seminar Series, April 8, 2004.

Applied Mathematics Colloquium, University of Western Ontario, March 16, 2004.

Mathematics and Statistics Seminar, Wilfred Laurier University, February 12, 2004.

Applied Mathematics Seminar, University of Waterloo, October 2003.

Scicom Colloquium, School of Computer Science, University of Waterloo, May 2002.

Contributed Talks

Reflections on Negativity, Positivity and other Moods- a Matrix Theoretic Approach, Department of Mathematics and Statistics Seminar, Acadia University, Wolfville, Nova, November 21, 2008.

Inverse Positivity of Perturbed Tridiagonal M–Matrices, Bluenose Numerical Analysis Day, June 13, 2008, Dalhousie University, Halifax, Nova Scotia.

Jacobi–Based Moving Mesh Methods, AARMS/ACE-NET/MITACS HPC Workshop, Acadia University, July 14, 2007.

Persistently Positive Inverses of Diagonally Perturbed M–matrices, Department of Mathematics and Statistics, Acadia University, March 24, 2006.

Persistently Positive Inverses of Diagonally Perturbed M–matrices, Canadian Mathematics Society Winter Meeting, Victoria B.C., December 12, 2005.

An Introduction to LaTeX. Graduate Student Seminar, Acadia University, October 28, 2004.

Front Dynamics in PEM Fuel Cells., Industrial Mathematics Symposia, Canadian Mathematics Society Winter Meeting, 2001.

Numerical Analysis of a Toy Model of Phase Change. PIMS Computational Fuel Cell Dynamics Workshop, 2001.

Preconditioning spectral methods for first–order equations. Copper Mountain Conference on Iterative Methods, 2000.

Invariant Manifolds: Theory and Computation. Canadian Mathematics Society Summer Meeting, 1999.

On the Computation of Blow–up Solutions of Differential Equations. Canadian Undergraduate Mathematics Conference, 1996.

Dynamics of a Discrete Quintic Map. Canadian Undergraduate Mathematics Conference, 1995.

Latent Chaos: The complicated Behaviour of a Quintic Map. Atlantic Provinces Council of the Sciences Mathematics Conference, 1994.

Student Presentations

Contributed Talk, Amber Corkum, Optimization Strategies for Tidal Turbine Power, APICS, Dalhousie University, October 2009.

Contributed Talk, Amanda Swan, Optimizing Power Potential in the Bay of Fundy, APICS, Dalhousie University, October 2009.

Contributed Talk, Justine McMillan & Megan Lickley, Modelling the World's Highest Tides, Bluenose Numerical Analysis Day, Saint Mary's University, July 27, 2007.

Contributed Talk, Shannon Kennedy, Finding bounds on Perturbations of an M-matrix to Maintain Inverse Positivity, Canadian Undergraduate Mathematics Conference, Simon Fraser University, July 19, 2007.

Contributed Talk, Shannon Kennedy, Perturbations of M–matrices, APICS Mathematics and Computer Science Conference, Sydney, N.S., October 14, 2006

Contributed Talk, Braden Dulong, Efficient Numerical Methods for the Simulation of Transmission Electron Microscope Images, APICS Mathematics and Computer Science Conference, Sydney, N.S., October 14, 2006

Contributed Talk, Colin Turner, A Numerical and Theoretical Study of Blow–up for a System of Ordinary Differential Equations using the Sundman Transformation, Bluenose Numerical Analysis Day, St. Francis Xavier University, Antigonish, Nova Scotia, June 23, 2006.

Contributed Talk, Shannon Kennedy, Finding Numerical Evidence for the Bound on a Perturbation of an M–Matrix, Bluenose Numerical Analysis Day, St. Francis Xavier University, Antigonish, Nova Scotia, June 23, 2006.

Contributed Talk, Colin Turner, A Numerical Investigation of Blowup of Solutions to the Maxwell–Debye System, 29th Annual APICS Mathematics, Statistics and Computer Science Meeting, October 22, 2005.

Student Supervision

Graduate Students Khaled Mohammad (PhD), 2010–present, Khaled Mohammad (MSc), 2009–2010, Memorial University of Newfoundland, Blaine Mayo (with P. Muir - St. Mary's University, Halifax NS), currently on leave, Yuheng Wu (with H. Chipman) (MSc), defense December 2007, Acadia University.

Research Assistants Amanda Swan and Amber Corkum (with R. Karsten Math) 2009–2010, Shannon Kennedy and Donald Patterson 2008–2009, Shannon Kennedy 2006–2007, Colin Turner (with H. Teismann Math) 2005–2006, Braden Dulong (with M. Robertson Physics) 2005–2006, Shannon Kennedy 2005–2006, Colin Turner 2004–2005

Honours Students Alexander Howse 2010–2011 (at Memorial) (NSERC USRA), Amber Corkum 2009-2011 (at Acadia with R. Karsten), Amanda Swan 2009-2011 (at Acadia with R. Karsten), Matthew Rideout 2008–2009 (NSERC USRA) Megan Lickley (with R. Karsten Math) 2008–2009 (NSERC USRA), Shannon Kennedy 2007–2008 (NSERC USRA), Dayang Wang 2006–2007, Braden Dulong (with M. Robertson Physics) 2006–2007 (NSERC USRA), Colin Turner (with H. Teismann Math) 2005–2006 (NSERC USRA), Yifan Yang 2005–2006

Other Professional Experience

- **Research Assistant, MITACS–PIMS MMSC Group & Ballard Power Systems**, Burnaby, B.C.
- **Coordinator of Parallel Computing Study Group**, Department of Mathematics and Statistics, SFU, Burnaby, B.C.

Service

Memorial University of Newfoundland

- Member – High Performance Computing Group for Geophysical Applications
- University Senate Committee on Academic Appeals, September 2010–present
- Invited Speaker, *Root–finding, Optimization, and other (numerical) Pursuits*, Department of Mathematics and Statistics Annual Blundon Seminar, May 20, 2010.
- High School Competitions Committee, Department of Mathematics and Statistics, 2010–2011.
- Undegraduate Studies Committee, Department of Mathematics and Statistics, 2010–2011.
- High School Interviewing Program Volunteer, Spring 2010.
- CFI Grant Reviewer, 2010.
- Board of Study for the MSc in Computational Science Interdiscriplinary Program, October 2009 – present

Acadia University

- Acting Head, Department of Mathematics and Statistics, April 25 - May 1, 2009
- Univeristy NSERC USRA Adjudication Committee, 2009

- NSERC Discovery Grant Reviewer, 2009
- University NSERC PGS/CGS Adjudication Committee, 2008
- **Graduate Program Coordinator**, Department of Mathematics & Statistics, 2007–2009
- AUFA University Appointments Committee, 2008-2009
- Acadia Centre for Mathematical Modelling and Computation Board of Directors, 2007-2010
- Coordinator and Editor, Department of Mathematics and Statistics Recruiting Newsletter, 2007–2009
- University Faculty Working Group for Student Recruitment, 2007–2009
- University Faculty of Pure and Applied Sciences Student Recruitment Committee, 2007–2009
- University Senate Graduate Studies Committee, 2007–2009
  - Special working group to investigate part–time graduate studies, 2008–2009
- Faculty of Pure and Applied Science Nominating Committee, 2006–2009
  - Chair 2008–2009
- Acadia Advantage Software Stream Committee, 2007–2008
- Acadia University Senate Curriculum Committee, 2006–2007
- Department of Mathematics and Statistics Calculus Co-ordinator, 2006–2007
- University Research Funds Allocation Committee, 2005–2007
- Department of Mathematics & Statistics Computer, Co–op, Problem Solving Committees, & Student Society Liaison Committee 2006-2007
- Department of Mathematics & Statistics Computer, Co–op, Recruiting, & Problem Solving Committees 2004–2006

Journal Referee Duties

- *Transactions on Mathematics Software*,Association for Computing Machinery (2)
- *Mathematics of Computation*, American Mathematics Society (1)
- *Applied Mathematics Letters*, Elsevier Publishing (1)
- *SIAM Journal of Scientific Computing*, SIAM (5)
- *Atlantic Electronic Journal of Mathematics* (1)
- *Numerical Mathematics: Theory, Methods, and Applications* (1)
- *Applied Mathematics and Computation* (1)
- *Linear Algebra and its Applications* (1)
- *Numerical Algorithms* (1)
- *Springer Lecture Notes Computational Science and Engineering* (1)
- *Computing* (1)

Conference & Workshop Organization

- CAIMS–SCMAI 2010 Scientific Program Committee, St. John's, NL
- Scientific Computing and Numerical Analysis Invited Minisymposium Organizer, CAIMS–SCMAI 2010, St. John's, NL
- *Parallelizing your Differential Equation Solver*, Contributed Session Organizer, CAIMS-SCMAI 2010, St. John's, NL
- APICS 2009 Special Session and Scientific Computing and Applied Mathematics, APICS, Dalhousie University, Halifax NS, October 24, 2009.
- Organizer (with R. Karsten (Acadia), P. Keast (DAL), P. Muir (SMU)), *The Tenth Annual Bluenose Numerical Analysis Day*, Acadia University, Wolfville, Nova Scotia, July 10, 2009.
- Organizer (with P. Keast (DAL), P. Muir (SMU)), *The Ninth Annual Bluenose Numerical Analysis Day*, Dalhousie University, Halifax, Nova Scotia, June 13, 2008.
- Organizer (with P. Keast (DAL), P. Muir (SMU)), *The Eighth Annual Bluenose Numerical Analysis Day*, St. Mary's University, Halifax, Nova Scotia, July 27, 2007.
- Organizer, (with H. Chipman (Acadia), R. Karsten (Acadia)), *AARMS–ACENET HPC Workshop and Conference*, Acadia University, July 9–14,2007.
- Organizer (with G. Chen (UCB)), *APICS—AARMS* Workshop on Mathematical Modelling and Simulation, Sydney, Nova Scotia, October 13–15 2006.
- Organizer (with P. Keast (DAL), P. Muir (SMU)), *The Seventh Annual Bluenose Numerical Analysis Day*, St. Francis Xavier University, Nova Scotia, June 23, 2006.
- Organizer (with P. Keast (DAL), P. Muir (SMU)), *The Sixth Annual Bluenose Numerical Analysis Day*, Cape Breton University, Sydney, Nova Scotia, June 10, 2005.

Other Activities

- Coordinator, *2nd Annual Acadia Undergraduate Mathematics Competition* (with F. Mendivil) , 2009.
- Acadia University Residence Faculty Mentor, Eaton House, 2008–09.
- Developer and Coordinator, *1st Annual Acadia Undergraduate Mathematics Competition* (with F. Mendivil), 2008.
- Marker, *2007 Maritime Mathematics Competition*,
- Presenter, *Annapolis Valley High School Math League Session*, February 2007.
- Marker, *2006 Maritime Mathematics Competition*,
- Problem Contributor, *2005 Maritime Mathematics Competition*,
- BC Advanced Systems Institute (ASI) Graduate Advisory Committee member, 1999–2001.
- Mentor, *IAM-CSC-PIMS Senior Undergraduate Math Modeling Workshop*, February 17–18, 2001 SFU/UBC.
- Invited Speaker, *Solving Polynomial Equations*, International Mathematical Olympiad Candidate Camp, Simon Fraser University, 2001.
- Co–organizer of the 1999 CMS summer meeting graduate session.
- Treasurer of Mathematics Graduate Society, Simon Fraser University, 1998–2000.