Malcolm Roberts — Curriculum Vitae

Contact Information	malcolm.i.w.roberts@gmail.com	Canada: (+1) 780 452 9462
	www.malcolmiwroberts.com	France: (+33) 649 56 19 19

Research Interests

Mathematical modelling, numerical analysis, and high-performance computing.

Education

PhD in Applied Mathematics, **University of Alberta**, 2011
- *Multispectral Reduction of Two-Dimensional Turbulence*
- Adviser: John C. Bowman

MSc in Applied Mathematics, **University of Alberta**, 2006
- *A Multi-Spectral Decimation Scheme for Turbulence Simulations*
- Adviser: John C. Bowman

BSc, Honors Applied Mathematics, **University of Alberta**, 2001

Work history

Postdoctoral Researcher, **IRMA** (Institut de Recherche Mathématique Avancée), Univsité de Strasbourg, France, since 2014.
- Member of the TONUS project for numerical simulation in Tokamaks.
- Developed a `OpenCL`/`GPU`-based Discontinuous Galerkin solver for numerical solution of the Vlasov equation.

Postdoctoral Researcher, **Laboratoire de Mécanique, Modélisation et Procédés Propres**, Aix-Marseille University, France, 2012 to 2014.
- Designed software for simulating magneto-hydrodynamic turbulence in a grid computing environment using spectral methods and penalisation.
- Aided in the supervision of PhD students.

Sessional Lecturer, **University of Alberta**, Canada, 2010.
- Lectured engineering differential equations.
- Design and deliver lectures and exams in a team-teaching environment.

Graduate Student, **University of Alberta**, Canada, 2003 to 2011.
- Develop a coherent research program in applied mathematics.
- Implement ideas and verify results.
- Write papers and present results at international conferences.
- Teach undergraduate math labs and help sessions.

English Teacher, Private Academy, South Korea, 2003 to 2004.
- Teach English as a second language in an after-school program.

Summer Undergraduate Researcher, **University of Alberta**, Canada,

1998 to 2000.

Publications In Progress

Comparison the Discontinuous Galerkin and Semi-Lagrangian Methods for Simulations of the Vlasov Equation
With Philippe Helluy et al.

Detection of Periods and Sationarity in Agent-Based Models
With Frederik Schaff and Anna Klabunde

Structures in spinup of helicaly forced MHD Turbulence
With Matthieu Leroy and Kai Schneider

Implicitly Padded Convolutions and Correlations on Real Data

Parallel Implementation of Implicitly Padded Convolutions
With John C. Bowman.

Renormalisation Limits of Shell Models of Turbulence
With John C. Bowman and Bruno Eckhardt.

Submitted

Asynchronous OpenCL/MPI numerical simulations of conservation laws, with Philippe Helluy, Thomas Strub, Michel Massaro. Submitted to IWOCL (2015).

Lagrangian/Eulerian Solvers and Simulations for Vlasov, with Sebastien Guisset, Philippe Helluy, Michel Massaro, Laurent Navoret, and Nhung Pham. Submitted to ESAIM Proceedings and Surveys (2015).

Peer-Reviewed Articles

Self-organisation of helicaly forced MHD flows in confined cylindrical geometries, with M. Leroy, J. Morales, W. Bos, and K. Schneider. Submitted to Fluid Dynamics Research, (2014) in press.

Adaptive Matrix Transpose Algorithms for Distributed Multicore Processors, with John C. Bowman. Submitted to Springer Proceedings of the Applied Mathematics, Modelling and Computational Science, (2013).

Multithreaded Implicitly Dealiased Pseudospectral Convolutions, with John C. Bowman. Proceedings of the 20th Annual Conference of the CFD Society of Canada (2012)

Pseudospectral Reduction of Incompressible Two-Dimensional Turbulence, with John C. Bowman. Communications in Nonlinear Science and Numerical Simulation **17:5**, 2008-2013 (2012)

Dealiased Convolutions for Pseudospectral Simulations, with John C. Bowman. Proceedings of the 13th European Turbulence Conference (2011)

Efficient Dealiased Convolutions without Padding, with John C. Bowman. SIAM Journal on Scientific Computing, **33:1**, 386-406 (2011)

Links between dissipation, intermittency, and helicity in the GOY model revisited, with John C. Bowman, Charles R. Doering, Bruno Eckhardt, Jahanshah Davoudi, and Jörg Schumacher. Physica D **218**, 1-10 (2006)

Dissertations

Multispectral Reduction of Two-Dimensional Turbulence, PhD Thesis, University of Alberta (2011)

A Multi-Spectral Decimation Scheme for Turbulence Simulations, M. Roberts, Masters Thesis, University of Alberta (2006)

Conference Proceedings

Dealiased convolutions for pseudospectral simulations, with John C. Bowman, Proceedings of the 13th EUROMECH European Turbulence Conference, Journal of Physics: Conference Series **318** 072037 (2011)

Report on the Math-Stat Graduate Education Round table (2010)

The Multispectral Method: Progress and Prospects, with John C. Bowman, and Bruno Eckhardt, Advances in Turbulence XII, Proceedings of the 12th EUROMECH European Turbulence Conference 2009, Marburg, Springer Proceedings in Physics (2009)

General Statistical Design of an Experimental Problem for Harmonics, with Bill Mawby, Sean Bohum, Peter Gibson, Michael Lamoureux, et al. Proceedings of the Eighth PIMS-MITACS Industrial Problem Solving Workshop (2004)

Modelling the temperature distribution in concrete structures, with Tim Myers et al. Proceedings of the 7th PIMS-MITACS Graduate Math Modelling Camp, (2004)

Other Publications

Lab Manual for Math 201: Differential Equations for Engineers, with S. Marion (2011)

`FFTW++`: *Fast Fourier Transform C++ Header Class for FFTW3*, with John C. Bowman. `fftwpp.sourceforge.net`, (2010)

Selected Presentations

Self-organisation of helically forced MHD flow in confined cylindrical geometries, Instabilities and Transport in Magnetized Plasmas, Geophysical and Astrophysical Flows, Institute for Advanced Study of Aix-Marseille University, 2014

Helices in MHD Flow: Numerical Results from Penalized Pseudospectral Simulations, Seminaire Equations aux derivees partielles, Strasbourg University, France, 2014

Pseudospectral Simulations in Complex Geometry via Penalisation, Journee Calcul scientifique performant en mecanique de la Federation Nicolas-Claude Fabri de Peiresc, Aix-Marseille University, France, 2013

Implicitly Dealiased Convolutions for DNS: Preliminary MPI results, Euromech 542, Lyon, 2013

Convolutions for HPC, CEMRACS 12, Marseille, 2012

Multithreaded Implicitly Dealiased Pseudospectral Convolutions, CFD Canada, 2012

Mathtastic!, Skeptically Speaking, 2012

On the Calculation of Higher-Order Convolutions, CMS Winter Meeting, Toronto, 2011

The Pseudospectral Method: Recent Advances and Prospects, The Nature of Turbulence Workshop, UCSB, 2011

Dealiasing Convolutions for Pseudo-Spectral Simulations, Ruhr Universität Bochum, Germany, 2011

The Multispectral Method, CAIMS Annual Meeting, 2010

Teaching Collaboration on Hot Topics and *Outcomes for Graduate Students*, PIMS Math and Stat Graduate Education Round Table, BIRS, 2010.

The Multispectral Turbulence Decimation Method, Politecnico di Torino, Italy, 2009

Turbulence: Analytic Results from Shell Models, Complex Systems Research Seminar, Germany, 2008

The Multi-Spectral Method, 6^{th} International Congress on Industrial and Applied Mathematics, Switzerland, 2007

Spectral Reduction of the GOY model, 5^{th} International Conference on Scientific Computing and Applications, 2006

General Statistical Design of an Experimental Problem for Harmonics, Eighth PIMS-MITACS Industrial Problem Solving Workshop, 2004

Teaching Experience

Lecturer, University of Alberta, 2010

- Lectured differential equations for engineers.
- Administered homework and exams.
- High student evaluations and outcomes.

Teaching Assistant, University of Alberta, 2004 to 2010

- Ran undergraduate help sessions covering a wide range of topics.
- Graded homework and exams.
- Lab instructor
  - Designed and delivered lectures and quizzes.
  - Excellent evaluation from students.
  - Instructor for 38 labs constituting more than 1000 students.

Private Tutor in Mathematics, 2004-2010 English as a Second Language Instructor, South Korea, 2003 to 2004

Volunteering & Committees

Thousand Faces Performance Art Festival
- President of the Board 2011 to 2013

PIMS Mathematical and Statistical Graduate Education Round table
- Brought together faculty, students, and administration from seven universities.
- Resulted in new policies and programs being implemented.

Canadian Young Researchers Conference in Mathematics and Statistics
- Organising Committee (2006, 2008, 2010)

Volunteer Mechanic/Instructor, Edmonton Bicycle Commuter's Association, 2009 to 2013, Collectif Vélos en Ville, 2012 to 1013

University of Alberta Math and Stat Grad Association
- President 2005 to 2006, Treasurer 2006 to 2007

University of Alberta Math Fair and Math Outreach, 2004 to 2011

Technical Skills

Project management and public speaking.

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Computer skills:

- Programming languages: `C/C++`, `OpenCL`, `Python`, `R`, and `FORTRAN`.
- Parallelism: `OpenMP`, `MPI`, and `OpenCL` (for GPUs).
- Environments:
  - Linux, Windows, and Mac operating systems.
  - National-level grid computing environments.
- Data analysis and presentation: Asymptote, LaTeX, `ParaView`, `HDF5`, `gmsh`.
- Version control: `git`, `Mercurial`, `svn`.

Languages	Native English speaker, advanced French, intermediate German.
Citizenship	Canadian