Olga Trichtchenko

otrichtc@uwo.ca • otrichtchenko *(Skype)* • citizenship: *Canadian*

Research Interests

I am interested in solving problems arising in physics, specifically as they relate to fluids. In my work, I use a wide variety of methods both analytical and numerical. One part of my work is on compressible, reacting flows in the context of combustion, modelling the mechanism for soot production in order to minimise the negative impact of engines. Another part of my work is on incompressible fluids in the nonlinear regime with a particular application to water waves, accurately modelling what happens under different conditions such as the presence of surface tension and sea ice. The overarching theme of the work has been to use high performance computing techniques to find well resolved, highly accurate solutions that agree with the appropriate asymptotic regimes and help explain observed physical phenomena.

Current position

Assistant Professor   London, Canada

Department of Physics and Astronomy
University of Western Ontario   *June 2018 – current*

Past positions

Postdoctoral Research Fellow   Toronto, Canada

Institute for Aerospace Studies (UTIAS)
University of Toronto   *June 2017 – May 2018*

Postdoctoral Research Associate   Seattle, USA and Providence, USA

Applied Mathematics
University of Washington and ICERM at Brown University   *September 2016 – June 2017*

Postdoctoral Research Associate   London, England

Department of Mathematics
University College London   *January 2015 – May 2016*

Education

University of Washington   Seattle, USA
PhD in Applied Mathematics   *2009 – 2014*
Thesis title: *On the instability of water waves with surface tension.*

McGill University   Montreal, Canada
MSc in Mathematics and Statistics   *2007 – 2009*
Thesis title: *Electron transport in nano devices: mathematical introduction and preconditioning.*

McGill University   Montreal, Canada
BSc in Physics (honours)   *2003 – 2007*
Thesis topic: *Dynamic strain measurements in a sliding microstructured contact.*

Research Highlights

Modelling soot production in combustion engines

- Collaborating with industry to better understand the mechanism behind soot production.
- Working with PhD and master's students to combine thermal radiation, aerosol dynamics and chemical kinetic to obtain a comprehensive model.
- Contributing to development of an in-house code and comparing it against results from commercially available software.

Computation of three dimensional surface waves

- Collaborating on a project to make current solution methods more efficient using high performance computing techniques.
- Developping code to accurately compute fully nonlinear hydroelastic, capillary-gravity and gravity waves.
- Exploring new solution regimes in order to match asymptotic predictions.

Stability of periodic travelling water waves

- Derived the asymptotic equations for different models of waves underneath an ice sheet predicting different behaviours of solutions.
- Numerically computed the stability of solutions to the models comparing with the asymptotic approach, showing good agreement.
- Together with collaborators, developed a method for computing solutions in the resonant regime, with numerical solutions give new insight to the behaviour in the singular limit.

High frequency instabilities of small amplitude solutions of Hamiltonian PDEs

- Generalised a previously used method for stability analysis to include other Hamiltonian equations.
- Presented results to common Hamiltonian problems that follow the proposed method.
- Devised a scheme to not only numerically, but analytically examine growth rates of instabilities.
- Explored the validity of models for water waves based on the presence or absence of high frequency instabilities.
- Using a model equation, designed and effective and easy algorithm for the stability region.

Refereed Publications

- O. Trichtchenko. *Comparison of boundary conditions at the surface of the water.* In preparation.

- O. Trichtchenko, B. Deconinck and J. Wilkening. *The instabilities of near-resonant and resonant periodic travelling gravity-capillary waves.* In preparation.

- R. Kollar, B. Deconinck and O. Trichtchenko. *Direct characterization of spectral stability of small amplitude periodic waves in scalar Hamiltonian problems via dispersion relation.* Submitted for publication.

- O. Trichtchenko, B. Deconinck and R. Kollar. *Stability of periodic travelling wave solutions to the Kawahara equation.* Submitted for publication.

- O. Trichtchenko, J.-M. Vanden-Broeck, P. Milewski and E. Parau. *Stability of periodic travelling flexural-gravity waves in two dimensions.* Submitted for publication.

- O. Trichtchenko, E. Parau. J.-M. Vanden-Broeck and P. Milewski. *Solitary flexural-gravity waves in three dimensions*. To appear in Phil. Trans. A.

- B. Deconinck and O. Trichtchenko. *High-frequency instabilities of small-amplitude solutions of Hamiltonian partial differential equations*. Discrete and Continuous Dynamical Systems A, 37, 1323–1358, (2016).

- O. Trichtchenko, B. Deconinck and J. Wilkening. *The instability of Wilton ripples*. O. Trichtchenko, B. Deconinck, and J. Wilkening. *The instability of Wilton ripples*. Wave Motion, 66, 147–155 (2016).

- B. Deconinck and O. Trichtchenko. *Stability of periodic gravity waves in the presence of surface tension*. European Journal of Mechanics - B/Fluids, 46, 97–108 (2014).

- C. I. Wynter, D. H. Ryan, O. Trichtchenko, C. J. Voyer, D. E. Brown, S. G. Sobel, A. L. Haigney, Leopold May, B. R. Hillery and N. S. Gajbhiye: *Mössbauer spectroscopy of 151-europium dicarboxylates*. Hyperfine Interactions 185, 123-127 (2008).

- R. Bennewitz, J. David, C.-F. de Lannoy, B. Drevniok, P. Hubbard-Davis, T. Miura and O. Trichtchenko. *Dynamic strain measurements in a sliding microstructured contact*. J. Phys.: Condens. Matter 20 015004 (7pp) (2008).

Teaching Experience

Instructor, University of Washington

- Taught a course on vector calculus and complex analysis with an enrollment of 40 students, 4 classroom hours a week as well as additional office hours.
- Taught a mathematical modeling class with an enrollment of 75 students, 3 classroom hours a week as well as additional office hours.
- Developed course material, homework assignments and exams using notes from previous instructors, but catered to the specific class.
- Managed a marker and a teaching assistant who held office hours and marked homeworks.

Teaching Assistant, University of Washington

- Fall 2014: Held problem classes once a week for a complex analysis and vector calculus class.
- Winter and spring 2010: held tutorials and office hours for a calculus 1 and 2 classes.

Teaching Assistant, Simon Fraser University

- Winter and spring 2009: Held homework answer sections and worksheet sessions for calculus 1 (differentiation) as well as calculus 2 (integration) for two sessions of 27 students each and marked worksheets, quizzes and exams as well as put together solutions and held office hours.
- Fall 2008: Held office hours in a workshop for students in linear algebra, discrete mathematics and precalculus and marked assignments and exams as well as put together solutions.

Teaching Assistant, McGill University

- Ran calculus 2 tutorials for 40 undergraduate students and marked quizzes and held office hours for extra help.
- Marked homeworks for a partial differential equations class.

Mentoring, Simon Fraser University, MITACS Industrial Summer School

- Mentored a team of undergraduate students from around the world during a month long industrial mathematics summer school.
- Helped devise an algorithm for mathematically modeling the shock demagnetization of unexploded ordnances.

Professional Development

- Spring 2017: Participated in a variety of workshops on grant writing and other skills for young researchers.

- November 2015: Participated in University of Bath's Mathwork's Training Session for MATLAB Programming Techniques.

- February 2015: Training for conducting interviews and hiring processes at University College London.

- August 2009: Participated in University of Washington's Centre for Teaching and Learning's workshops on teaching.

Conferences and Workshops

Select invited talks in conferences

- June 2018 (SIAM Conference on Nonlinear Waves and Coherent Structures, Anaheim, USA): Presented a talk titled "Computing Flexural-Gravity Waves in Three-Dimensions" as part of a mini-symposium on "Recent Advances in Nonlinear Water Wave Modeling with Applications".

- December 2017 (Schrödinger Institute, Vienna, Austria): Presented a talk titled "Stabilty of the Kawaraha equation" as part of the workshop on "Nonlinear Water Waves - an Interdisciplinary Interface".

- October 2017 (Newton Institute, Cambridge, UK): Presented a talk titled "Computing Flexural-Gravity Waves" as part of the seminar on "Ice-fluid interaction".

- August 2017 (Seattle, US): Presented a talk titled "Stability of periodic travelling wave solutions to Korteweg-de Vries and related equations" as part of "Recent Advances in Nonlinear Waves".

- June 2017 (BIRS, Oaxaca): Presented a talk titled "Stability of periodic travelling wave solutions to Korteweg-de Vries and related equations" as part of "Geometrical Methods, non Self-Adjoint Spectral Problems, and Stability of Periodic Structures".

- May 2017 (ICMS, Edinburgh, UK): Presented a talk titled "Solutions and stability for fexural-gravity waves" as part of "Applied and computational complex analysis Workshop".

- Spring 2017 (ICERM, Providence, RI): Presented several talks as part of the semester program ICERM Semester Program on "Singularities and Waves In Incompressible Fluids".

- October 2016 (BIRS, Banff, Canada): Workshop on Theoretical and Computational Aspects of Nonlinear Surface Waves. Presented a talk titled "Computing three-dimensional flexural-gravity water waves"

- August 2016 (Amsterdam, Netherlands): Gave a seminar talk on "Comparison of Solutions to Hamiltonian Water Wave Models" as part of the UvA-VU Dynamic Analysis Seminar.

- July 2016 (ICMS, Edinburgh, UK): Trapped waves and wave radiation in fluid mechanics, presented a talk entitled "Stability of solutions to models for flexural-gravity waves".

- May 2016 (Surrey, UK): Seminar on "Fluids, Meteorology and Symmetry", presented a talk titled "Comparison of Solutions to Hamiltonian Water Wave Models".

- April 2016 (Oxford, UK): British Applied Mathematics Colloquium. Presented a talk titled "Computing three-dimensional water waves".

- November 2015 (London, UK): Applied and Computational Complex Analysis network Student Chapter Meeting. Presented a talk titled "Solutions to Euler's equations for water waves"

- September 2015 (Bratislava, Slovakia): Departmental colloquium at Comenius University. Presented a talk titled "Stability of periodic gravity-capillary water waves"
- August 2015 (Daejong, Korea): Workshop on Nonlinear Waves and Fluid Mechanics at the National Institute for Mathematical Sciences. Presented a talk titled"Comparison of stability of solutions to Hamiltonian water wave models"
- May 2015 (Norwich, UK): Applied Maths Research Seminars at UEA. Presented a talk titled "Stability of periodic gravity-capillary water waves"
- April 2015 (Athens, USA): The Ninth IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory. Presented a talk titled "Stability of water waves in the presence of surface tension"
- April 2015 (London, UK): Applied and Computational Complex Analysis (ACCA) Group Workshop on computational complex analysis for free surface flows and other applications. Presented a talk titled "Stability of capillary-gravity and flexural-gravity water waves"
- February 2015 (London, UK): Applied Mathematics Seminar at UCL. Presented a talk titled "Stability of periodic gravity-capillary water waves "
- August 2014 (Cambridge, UK): SIAM Conference on Nonlinear Waves and Coherent Structures Presented a talk titled "Stability of near-resonant gravity-capillary waves"
Together with Bernard Deconinck, organised a minisymposium titled "Water Waves in the Presence of Surface Tension".
- April 2014 (Albuquerque, USA): AMS Sectional Meeting - AMS Special Session. Presented a talk titled "Stability of near-resonant gravity-capillary waves".
- January 2014 (Toronto, Canada): Conference on Hamiltonian PDEs: Analysis, Computations and Applications. Presented a talk titled "Stability of near-resonant gravity-capillary waves"
- July 2013 (Banff, Canada): Water Waves: Computational Approaches for Complex Problems. Presented a talk titled "Stability of water waves in the presence of surface tension"
- July 2013 (San Diego, USA): SIAM Annual Meeting. Presented a talk titled "Stability of water waves in the presence of surface tension".
- June 2013 (Beijing, China): The Third International Conference: Nonlinear Waves - Theory and Applications. Presented a talk titled "Stability of water waves in the presence of surface tension".
- March 2013, (Athens, USA): The Eighth IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory. Presented a talk titled "Stability of water waves in the presence of surface tension"
Organised a minisymposium titled "Water Waves" together with John Carter, Katie Oliveras, Christopher Curtis, Harvey Segur, Bernard Deconinck, Diane Henderson and Vishal Vasan.
- April 2011 (Athens, USA): The Seventh IMACS International Conference on Nonlinear Evolution Equations and Wave Phenomena: Computation and Theory.. Presented a talk titled "Stability of gravity waves with surface tension".
- June 2009 (Pau, France): WAVES International Conference on Mathematical and Numerical Aspects of Waves Propagation. Presented a talk titled"Preconditioning for nano-electronic devices".
- January 2009 (Vancouver, Canada): Applied Mathematics Graduate Student Conference. Presented a talk titled "Creating harmonies using an artificial neural network".

Workshops

- October 2017 (Cambridge, UK): Participated in part of a semester long program on Mathematics of Sea Ice Phenomena.
- January 2017-May 2017 (Providence, RI): Participated in semester long program on Singularities and Waves In Incompressible Fluids.

- June 2016 (Maryland, US): Summer Research School on Fluid Dynamics: Topics in Nonlinear Water Waves Participated in a summer school at University of Maryland and presented a poster titled "Computing Flexural0Gravity Waves In Three Dimensions".
- July-August 2014 (Cambridge, UK): Theory of Water Waves. Participated in a month long program at the Newton Institute. Presented a talk on "Stability of periodic travelling waves of the water wave problem in one dimension".
- May-June 2013 (Toronto, Canada): Thematic Program on the Mathematics of Oceans. Participated in a month long program at the Fields Institute.
- July 2008 (Troy, USA) : Graduate Student Mathematical Modeling Conference. Worked on a problem titled "Modeling the Release of a Chemical Breaker" which involved the solution of a reaction-diffusion equation and its proper formulation. Helped write the code for the numerical solution of the model and put together the final report.
- July 2008 (Worcester, USA): Mathematical Problems in Industry (MPI). Worked on a problem titled "Modeling Li+ Ion Battery Electrode Properties" with faculty members and graduate students. Helped set up the formulation of the model for the Battery and helped write the MATLAB code for a Monte Carlo simulation.
- August 2006 (Toronto, Canada): Fields-MITACS Industrial Problem Solving Workshop (FWIPW). Participated in a week long workshop aimed at linking industries with faculty and students. Worked on a problem titled "Incorporating Estimation Error into Optimal Consumption and Portfolio Allocation in Continuous Time" with faculty members and a PhD student from McGill.

Additional Experience

Technical expertise: Proficient with Python, MATLAB, Maple and Mathematica and LaTeX. Experience with C/C++, and HTML.

Professional services: Member of Society of Industrial and Applied Mathematics, American Mathematical Society, Association for Women in Mathematics and WISE (a campaign to promote women in science, technology and engineering). Involved with the Applied and Computational Complex Analysis group in London. Presented at and organized minisymposia at national and international conferences.

Community service: I have written articles for Society of Industrial and Applied Mathematics and other mathematics newsletters. I have participated in mathematical modeling camps. I have also organised and participated in mathematical outreach for schools in the Seattle and London areas.

Referee for Journals: I have reviewed manuscripts for Studies in Applied Mathematics, Journal of Wave Motion, SIAM Journal on Applied Mathematics (SIAP) and European Journal of Mechanics / B Fluids.

Honours, Awards and Fellowships

- Visiting researcher at the Isaac Newton Institute (INI) Research Programme Mathematics of Sea Ice Phenomena Fall 2017.
- SOSCIP-OCE TalentEdge Fellowship (June 2017-June 2019).
- Semester Postdoctoral Fellowship at the Institute for Computational and Experimental Research in Mathematics (ICERM) Spring 2017.
- SIAM award to attend the conference on Nonlinear Waves and Coherent Structures (August 2014).
- NSF Award to attend 8th IMACS International Conference (April 2013).
- Best Student Paper, 7th IMACS International Conference (April 2011).

- NSF Award to attend 7th IMACS International Conference (April 2011).

- NSERC Postgraduate scholarship (fall 2010-fall 2013).

- Boeing Fellowship, University of Washington (fall 2009).

- MITACS Accelerate Fellowship, Simon Fraser University and SkyResearch (summer 2009)

- Dean's Multidisciplinary List, McGill

- Principal's Graduate Fellowship Award, McGill (fall 2008).

- German Academic Exchange Service, Research Internship in Science and Engineering (summer 2007).

- Undergraduate Student Research Award (NSERC USRA) (summer 2006).

- Mathematical Contest in Modelling, Honourable Mention, 2006.

- Honourable Mention T.A. Award for the winter 2008, McGill.