

Dept. Mechanical Engineering, Brown Hall W410E, 1610 Illinois St., Golden Colorado 80401
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RESEARCH AREAS AND EXPERTISE

**Fluid Mechanics, Hydrodynamic Stability, Flow Through Porous Media,
 Membrane Filtration, CO₂ Sequestration, Flow Control**

I use complementary numerical and analytical methods to study fluid flows that interact with porous materials, with a focus on applications to membrane filtration systems, CO₂ sequestration, and flow control. These systems contain exciting problems in numerical methods, hydrodynamic stability, diffusion, and mixing. My numerical work focuses on spectral methods, projection methods, and multi-domain methods. My analytical work focuses on perturbation methods, linear and nonlinear stability, and volume-averaged models of flow through porous media.

EDUCATION

- Doctor of Philosophy**, Mechanical Engineering 2006 - 2009
 McGill University, Montreal, Canada
 Advisor: Dr. Luca Cortelezzi
 Thesis: *The effects of wall permeability on the linear stability of channel flow and the asymptotic suction boundary layer*
- Master of Engineering**, Mechanical Engineering 2004 - 2006
 McGill University, Montreal, Canada
 Advisor: Dr. Luca Cortelezzi
 Thesis: *A linear stability analysis of the destabilizing effects of wall-permeability in channel flows*
- Bachelor of Engineering**, Mechanical Engineering, Honors Program 1998 - 2003
 McGill University, Montreal, Canada
 Advisor: Dr. Paul Zsombor-Murray
 Honors Thesis: *The kinematic analysis of a planar double triangular parallel manipulator*

PROFESSIONAL EXPERIENCE

- Assistant Professor**, Colorado School of Mines, Golden CO 2014 - Present
- Visiting Professor**, Ecole Centrale de Marseille, France June 2015
- Postdoctoral Research Fellow**, University of Maryland, College Park 2011 - 2014
 Advisor: Dr. Amir Riaz
 Dissolution and convection phenomena occurring during the sequestration of CO₂ in subsurface aquifers. Funded by the Petroleum Institute in Abu Dhabi and the Abu Dhabi National Oil Company.
- Postdoctoral Research Fellow**, University of Aix-Marseille, France 2009 - 2011
 Advisors: Drs. Denis Martinand, Eric Serre, and Richard Lueptow
 Investigation of cross-flow filtration in Taylor-Couette cells and tubular membranes using asymptotic expansions and direct numerical simulation. Funded by the French National Research Agency (ANR).
- Graduate Research Assistant**, McGill University, Montreal, Canada 2003 - 2009
 Advisor: Dr. Luca Cortelezzi
 Effects of porous walls on the linear stability of channel flows, Couette flows, and flat plate boundary layers. Funded by the Natural Sciences and Engineering Research Council of Canada (NSERC).
- Undergraduate Research Assistant**, McGill University, Montreal, Canada 2000 - 2003
 Advisor: Dr. Zsombor-Murray
 Designed and built a novel robotic manipulator. Performed a kinematic analysis of the manipulator using kinematic mapping and projective geometry.
- Undergraduate Research Assistant**, McGill University, Montreal, Canada 2002
 Advisors: Drs. John Lee and Matei Radulescu
 Designed and built a high-speed Schlieren photography system to capture images of detonation waves.

ARCHIVAL PUBLICATIONS

- [1] N. Tilton and L. Cortelezzi, 2015 “Stability of boundary layers over porous walls with suction,” *AIAA Journal*, **accepted for publication**.
- [2] M. A. Nomeli, N. Tilton, and A. Riaz, 2014 “A new model for the density of saturated solutions of CO₂-H₂O-NaCl in saline aquifers,” *International Journal of Greenhouse Gas Control*, **31**, 192–204.
- [3] N. Tilton and A. Riaz, 2014 “Nonlinear stability of gravitationally unstable transient boundary layers in porous media,” *Journal of Fluid Mechanics*, **745**, 251-278.
- [4] N. Tilton, E. Serre, D. Martinand and R. M. Lueptow, 2014 “A 3D pseudospectral algorithm for fluid flows with permeable walls: application to filtration,” *Computers & Fluids*, **93**, 129-145.
- [5] N. Tilton, D. Daniel and A. Riaz, 2013 “The initial transient period of gravitationally-unstable diffusive boundary layers developing in porous media,” *Physics of Fluids*, **25**, 092107.
- [6] D. Daniel, N. Tilton and A. Riaz, 2013 “Optimal perturbations of gravitationally unstable, transient boundary layers in porous media,” *Journal of Fluid Mechanics*, **727**, 456-486
- [7] N. Tilton, D. Martinand, E. Serre and R. M. Lueptow, 2012 “Incorporating Darcy’s law for pure solvent flow through porous tubes: asymptotic solution and numerical simulations,” *AIChE Journal*, **58**, 2030-2044.
- [8] N. Tilton, D. Martinand, E. Serre and R. M. Lueptow, 2010 “Pressure-driven radial flow in a Taylor-Couette cell,” *Journal of Fluid Mechanics*, **660**, 527-537.
- [9] N. Tilton and L. Cortelezzi, 2008 “Linear stability analysis of pressure driven flows in channels with porous walls,” *Journal of Fluid Mechanics*, **604**, 411-445.
- [10] N. Tilton and L. Cortelezzi, 2006 “The destabilizing effects of wall-permeability in channel flows: A linear stability analysis,” *Physics of Fluids*, **18**, 051702.

MANUSCRIPTS SUBMITTED OR IN PREPARATION

- [11] D. Martinand, N. Tilton, E. Serre, and R. M. Lueptow, “Global modes in Taylor-Couette-Poiseuille flow with a porous inner cylinder,” **in preparation**.

CONFERENCE PRESENTATIONS

- [1] N. Tilton and A. Riaz, 2013 “Onset of nonlinear convection in transient diffusive boundary layers: application to CO₂ sequestration,” APS DFD, Bulletin of the Amer. Phys. Soc. **58**, no. 18, pg. 251.
- [2] N. Tilton, D. Daniel and A. Riaz, 2012 “Transient diffusive boundary layers in porous media: The linear transition region,” APS DFD, Bulletin of the Amer. Phys. Soc. **57**, no. 17, pg. 421.
- [3] D. Daniel, N. Tilton and A. Riaz, 2012 “Transient diffusive boundary layers in porous media: Optimal perturbations,” APS DFD, Bulletin of the Amer. Phys. Soc. **57**, no. 17, pg. 421.
- [4] N. Tilton, D. Martinand, E. Serre and R. M. Lueptow, 2012 “A new solution for flow in porous tubes and channels incorporating Darcy’s law,” North American Membrane Society meeting, June 9-13, New Orleans.
- [5] N. Tilton, D. Martinand, E. Serre and R. M. Lueptow, 2011 “Pressure-driven flow in porous tubular membranes,” APS DFD, Bulletin of the Amer. Phys. Soc., **56**, no. 18, pg 368.
- [6] D. Martinand, E. Serre, N. Tilton and R. M. Lueptow, 2011 “Toroidal and helical modes in Taylor-Couette flow with axial and radial through-flows,” APS DFD, Bulletin of the Amer. Phys. Soc., **56**, no. 18, pg 88.
- [7] D. Martinand, N. Tilton, E. Serre and R. M. Lueptow, 2011 “Instabilities in Taylor-Couette-Poiseuille flow with porous walls,” Euromech Colloquium 525, 21-23 June, Ècully, France.
- [8] N. Tilton, D. Martinand, E. Serre and R. M. Lueptow, 2010 “Taylor-Couette-Poiseuille flow with a permeable inner cylinder,” APS DFD, Bulletin of the Amer. Phys. Soc., **55**, no. 16, pg. 158.

CONFERENCE PRESENTATIONS (CONTINUED)

- [9] D. Martinand and N. Tilton, 2010 “Subcritical and supercritical flow in a Taylor-Couette cell with pressure driven suction,” Euromech Fluid Mechanics Conference, Bad Reichenhall, Germany, 15 September, 2010.
- [10] N. Tilton and L. Cortelezzi, 2008 “A realistic model of a wall-transpiration actuator for boundary layer control,” APS DFD, Bulletin of the Amer. Phys. Soc., **53**, no. 15, pg. 227.
- [11] N. Tilton and L. Cortelezzi, 2007 “The effects of wall-permeability on the asymptotic suction boundary layer,” APS DFD, Bulletin of the Amer. Phys. Soc., **52**, no. 17, pg 135.
- [12] N. Tilton and L. Cortelezzi, 2006 “Linear stability analysis of Couette flow with a porous wall,” APS DFD, Bulletin of the Amer. Phys. Soc., **51**, no. 9, pg 99.
- [13] N. Tilton and L. Cortelezzi, 2005 “Linear stability analysis of a channel flow with porous walls,” APS DFD, Bulletin of the Amer. Phys. Soc., **50**, no. 9, pg 116.

CONFERENCE POSTERS

- [1] C. Strebinger, N. Tilton, E.Serre, D. Martinand. R. M. Lueptow, 2015 “A dedicated numerical method for simulating fluid flow and solute transport in membrane filtration systems,” 25'th Annual Meeting of the North American Membrane Society, June 1, Poster Session, Boston.
- [2] N. Tilton and A. Riaz, 2013 “Onset of nonlinear convection during CO₂ sequestration,” Fall Meeting of the American Geophysical Union, 10 December, Poster Session H21E, San Francisco.

INVITED SEMINARS

- [1] “Gravitational Instability and Convective Mixing in CO₂ Sequestration,” Ecole Central Marseille, France, June, 2015.
- [2] “Optimization and Perturbation Methods for Predicting Onset of Convection in CO₂ Sequestration,” Boulder Fluid Dynamics Seminar, CU Boulder, November, 2014.
- [3] “Optimization and Perturbation Methods for Predicting Onset of Convection in CO₂ Sequestration,” Applied Math & Statistics Seminar, Colorado School of Mines, September, 2014.

REVIEWER FOR:

Journal of Fluid Mechanics, Physics of Fluids, Computers and Fluids, Transport in Porous Media, Journal of Porous Media, Fluid Dynamics Research, Chem Eng Commun, Trans Can Soc Mech Eng, SIAM Journal on Applied Mathematics, Water Resources Research

TEACHING

Lecturer , Colorado School of Mines, Golden CO Fluid Mechanics I (Undergraduate), Advanced Fluid Mechanics (Graduate)	2014 - Present
Lecturer , University of Maryland, College Park Undergraduate fluid mechanics. Graduate lectures on hydrodynamic stability and spectral methods.	2012 - 2014
Lecturer , École Centrale de Marseille, Marseille, France Undergraduate numerical methods.	2010 - 2011
Teachers Assistant , McGill University, Montreal, Canada Courses: Numerical Methods, Descriptive Geometry, Statics, Dynamics	2000 - 2009

SUPERVISION AND MENTORSHIP

Supervisor , Colorado School of Mines, Golden CO Currently supervising 3 Ph.D. students, and 2 Undergraduates.	2014 - Present
Supervisor , University of Maryland, College Park Supervised four undergraduate researchers in an experimental study of flow through porous media.	2013 - 2014
Mentor , University of Maryland, College Park Mentored two Ph.D. students and an undergraduate assistant in numerical methods, linear stability methods, and effective writing and presenting.	2012 - 2014

SCHOLARSHIPS AND AWARDS

NSERC Doctoral Scholarship , \$21,000 per year federal research grant	2006-2009
Dean's Doctoral Student Recruitment Award , \$15,000 per year McGill research grant	2006-2009
FQRNT Doctoral Scholarship , \$20,000 Québec research grant (declined for NSERC)	2006-2009
NSERC Canada Graduate Scholarship , \$17,500 federal research grant	2004
FQRNT Masters Research Scholarship , \$15,000 Québec research grant (declined for NSERC)	2004
McGill Graduate Studies Fellowship , \$5000 McGill fellowship	2003
British Association Medal , for taking highest position in final examinations	2003
Distinction and Dean's Honor List , given upon graduation from B.Eng. Honors	2003
David E. and Ronnie Schouela Prize , \$750 award for best Honors thesis	2003
McGill Engineering Award , \$750 award for academic excellence	2003
Richard Lawrence Weldon Award , \$750 award for academic excellence	2003
Clifford C.F. Wong Scholarship , \$1,400 scholarship for academic excellence	2001
James McGill Award , \$1,100 award for academic excellence	2001
Joan Weir Scholarship , \$1,000 scholarship for academic excellence	2000