Dr. Guangning Tan

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OBJECTIVES Software developer, numerical/data analyst, computational scientist

SUMMARY Highly motivated PhD in Computational Science and Engineering with over 7 years' experience in numerical analysis and scientific computing/programming. Extensive knowledge in data structure, algorithms, and C++/MATLAB software development. Comprehensive technical writing skills and meticulous attention to details. Strong abilities to collaborate with team members on multi-disciplinary projects and work independently. Passionate about learning and acquiring new skills.

EXPERIENCE

Postdoctoral associate, Massachusetts Institute of Technology, Cambridge, MA, US
Jan. 2017–Dec. 2017

- Collaborated with former postdocs, PhDs, and researchers in Process Systems Engineering Lab to develop software, theory, and numerical methods in dynamic systems
- Designed the software architecture of PERKS (Parameter Estimation in Reaction Kinetic Systems) and its GUI in Excel to be delivered to Novartis pharmaceutical company in May 2017

Technical editing assistant, Cardiff University, Wales, UK **Sept. 2016–Dec. 2016**

- Assisted Prof Pryce from Cardiff in drafting the proposal of MANDAE (Modeling and Advanced Numerics for Differential-Algebraic Equations), an international research project proposed to the European Horizon 2020 programme

Research assistant, McMaster University, Ontario, Canada **Sept. 2016–Dec. 2016**

- Collaborated with Prof Nedialkov and Prof Pryce on developing numerical C++/MATLAB code for solving differential-algebraic equations (DAEs), specifically those arising form mechanical systems in constrained Lagrange form
- Supervised two Master students on developing C++ code for automatic differentiation (AD)
  (1) Extended AD package FADBAD++ to multiple precision
  (2) Adopted incremental computation to improve AD in our DAE solver; achieved speedups > 10

Research assistant, McMaster Centre for Software Certification, Canada **Jan. 2016–Aug. 2016**

- Participated in McMaster and Fiat-Chrysler Automobiles (FCA) Leadership in Automotive Powertrain embedded software project; collaborated with McMaster and FCA research scientists
- Improved optimization algorithms for solving the motor torque determination problem

Research assistant, EnviroSim Associates Ltd., Hamilton, ON, Canada **Sept. 2015–Mar. 2016**

- Developed C++ code to accelerate wastewater process model simulations in BIOWIN simulator

Teaching assistant, Department of Computing & Software, McMaster University

- Led other TAs and coordinate with them and instructors
- Scientific Computation (SE/CS 4X03) **2013, 2014, 2016**
- Machine-Level Programming (SE/CS 3F03) **2012, 2013, 2014**
- Signals and Systems (SE 3MX3) **2015**

Education

McMaster University, Hamilton, Ontario, Canada

PhD of Computational Science and Engineering **Jan. 2012–Aug. 2016**

- Thesis: Conversion methods for improving structural analysis of DAEs. Slides
- GPA: 12.0/12.0 during PhD, overall 11.7/12.0 during all graduate programs

Master of Computational Science and Engineering **Sept. 2010–Dec. 2011**

- Project: DAESA, a MATLAB package for structural analysis of DAEs

Sun Yat-sen University, Guangzhou, Guangdong, China

Bachelor of Communication and Electrical Engineering **Sept. 2006–June 2010**

Honors and Awards

First awards in the 2015 and 2016 CSE Student Symposia for best presentation	**2015, 2016**
Best Teaching Assistant awarded by McMaster Software Engineering Club	**2015**
International Excellence Award	**2012–2016**
McMaster Internal Award Scholarship (Dalley Fellowship)	**2012–2014**
Student excellence scholarship at Sun Yat-sen University	**2007, 2008**

Graduate Courses

- CSE 700 Foundations of Scientific Computing
- CSE 701 Foundations of Scientific Programming
- CSE 702 Advanced Computational Methods and Models
- CSE 703 Computational Linear Algebra
- CSE 706 Shared Memory Parallel Computing
- CSE 710 Engineering Optimization
- CSE 722 Algorithms for Constrained Optimization
- CSE 752 Optimization in Chemical Processes
- CSE 739 Introduction to Iterative Methods
- CSE 782 Data Structure and Algorithms
- CSE 799 Special Topics in Numerical Methods for ODEs/DAEs
- MATH 772 Topics in Financial Mathematics
- CSE 6Q03 Numerical Methods of Differential Equations

Audited courses

- MATH 774 Mathematics of Credit Risk
- MATH 775 Portfolio Theory and Incomplete Market

Publications

Journal articles

- J.D. PRYCE, N.S. NEDIALKOV, **G. Tan** AND X. LI, *How automatic differentiation can help solve differential-algebraic equations*. Submitted to Optimization Methods and Software, 2017. 19 pages
- **G. Tan**, N.S. NEDIALKOV, AND J.D. PRYCE, *Conversion methods for improving structural analysis of differential-algebraic equation systems*. BIT Numerical Mathematics, 2017. 20 pages

- N.S. Nedialkov, J.D. Pryce and **G. Tan**, *Algorithm 948: Daesa: a Matlab tool for structural analysis of differential-algebraic equations: Software*, ACM Trans. Math. Softw., 41 (2015), pp. 12:1–12:14. 15 pages
- J.D. Pryce, N.S. Nedialkov, and **G. Tan**, *Daesa: a Matlab tool for structural analysis of differential-algebraic equations: Theory*, ACM Trans. Math. Softw., 41 (2015), pp. 9:1–9:20. 20 pages

Book chapters

- **G. Tan**, N.S. Nedialkov and J.D. Pryce, *Symbolic-numeric methods for improving structural analysis of DAEs.* Mathematical and Computational Approaches in Advancing Modern Science and Engineering, pp. 763-773. Springer International Publishing, Cham (2016). 11 pages
- **G. Tan**, N.S. Nedialkov and J.D. Pryce, *A simple method for quasilinearity analysis of DAEs*. Interdisciplinary Topics in Applied Mathematics, Modeling and Computational Science, pp. 445–450. Springer International Publishing, Cham (2015). 6 pages
- J. Pryce, N. Nedialkov, **G. Tan** and R. McKenzie, *Exploiting block triangular form for solving DAEs: reducing the number of initial values.* Interdisciplinary Topics in Applied Mathematics, Modeling and Computational Science, pp. 363–373. Springer International Publishing, Cham (2015). 6 pages

Technical reports

- **G. Tan**, N.S. Nedialkov, and J.D. Pryce, *Conversion methods, block triangularization, and structural analysis of differential-algebraic equation systems*. CAS-16-04-NN, Department of Computing and Software, McMaster University, August 2016. 20 pages
- **G. Tan**, N.S. Nedialkov and J.D. Pryce, *Symbolic-numeric methods for improving structural analysis of DAEs.* CAS-15-07-NN, Department of Computing and Software, McMaster University, 2015. 84 pages
- N.S. Nedialkov, J.D. Pryce, and **G. Tan**, *Exploiting fine block triangularization and quasilinearity in DAEs.* CAS-14-08-NN, Department of Computing and Software, McMaster University, 2014. 18 pages
- J.D. Pryce, N.S. Nedialkov, and **G. Tan**, *Graph theory, irreducibility, and structural analysis of DAEs.* CAS-14-09-NN, Department of Computing and Software, McMaster University, 2014. 24 pages
- R. McKenzie, N. Nedialkov, J. Pryce, **G. Tan**, Daesa *user guide.* CAS-13-04-NN, Department of Computing and Software, McMaster University, 2013. 48 pages

Manuscripts to be submitted

- **G. Tan**, N.S. Nedialkov and J.D. Pryce, *Computing the canonical dual solution of a linear assignment problem*
- J.D. Pryce, N.S. Nedialkov, and **G. Tan**, *Fine block triangular structure of DAEs and its uses*
- N.S. Nedialkov, J.D. Pryce, and **G. Tan**, *Exploiting fine block triangularization and quasilinearity in DAEs*

Software

Daesa, Differential-Algebraic Equation Structural Analyzer in Matlab

- http://www.tgn3000.com/daesa.html

DAETS 1.2 (under development), a C++ numerical package solving DAEs by Taylor Series

- http://www.cas.mcmaster.ca/~nedialk/daets/

Reviewed Articles

- G. LI, Y. FENG, X. QIN, *An effective approach for structural analysis of differential-algebraic equations*, Mathematical Problems in Engineering, Hindawi Publishing Corporation (2016). Rejected
- A. STEINBRECHER, *Regularization and numerical integration of DAEs based on the Signature method*, Mathematical and Computational Approaches in Advancing Modern Science and Engineering, pp. 749-761. Springer International Publishing, Cham (2016).
- SCHOLZ, L., STEINBRECHER, A., *Regularization of DAEs based on the Signature method.* BIT Numerical Mathematics **56**(1), 319–340 (2016)
- SCHOLZ, L., STEINBRECHER, A., *Structural-algebraic regularization for coupled systems of DAEs.* BIT Numerical Mathematics **56**(2), 777–804 (2016)

Invited Seminar Presentations

Structural analysis and numerical methods for solving high-index DAEs. Physical Modeling Group, MathWorks Apple Hill Campus, Natick, MA, 2017

Conversion methods for improving structural analysis of DAEs. Interview seminar talk, Process System Engineering Laboratory, Massachusetts Institute of Technology, April 2016

Conversion methods for improving structural analysis of DAEs. Numerical Analysis Seminar, Department of Computer Science, University of Toronto, April 2016

Conversion methods for improving structural analysis of DAEs. CSE/Sharcnet Seminar Series, School of Computational Science and Engineering, March 2016

Seminar / Conference Presentations

Computing the canonical dual solution of a linear assignment problem. Group seminar talk, Process System Engineering Laboratory, Massachusetts Institute of Technology, March 2017

Conversion methods for improving structural analysis of DAEs. The 10th International Conference on Scientific Computing and Applications (ICSCA), the Fields Institute, Toronto, ON, Canada, June 2016

Computing derivatives of a DAE solution in parallel. The 2016 South Ontario Numerical Analysis Day, University of Waterloo, Waterloo, ON, Canada. May 2016

Computing derivatives of a DAE solution in parallel. The 2016 Student Symposium of School of Computational Science and Engineering, McMaster University. April 2016

Symbolic-numeric methods for improving structural analysis of differential-algebraic equations. The 2015 AMMCS-CAIMS Congress, Wilfrid Laurier University, Waterloo, ON, Canada. June 2015

Symbolic-numeric methods for improving structural analysis of differential-algebraic equations. The 2015 South Ontario Numerical Analysis Day (SONAD) and Algorithms and Complexity in Mathematics, Epistemology, and Science (ACMES), Western University, London, ON, Canada. May 2015

Symbolic-numeric methods for improving structural analysis of differential-algebraic equations. The 2015 Student Symposium of School of Computational Science and Engineering, McMaster University.

April 2015

A simple method for quasilinearity analysis of DAEs. The 2014 Student Symposium of School of Computational Science and Engineering, McMaster University. April 2014

A simple method for quasilinearity analysis of DAEs. The 2013 AMMCS-CAIMS Congress, Wilfrid Laurier University, Waterloo, ON, Canada. August 2013

DAESA: A Matlab tool for structural analysis of DAEs. The 2013 South Ontario Numerical Analysis Day, University of Ontario Institute of Technology, Oshawa, ON, Canada. May 2013

Research

- Focus: Structural Analysis of DAEs, Numerical Methods for Solving ODEs/DAEs, Automatic Differentiation, Computer Algebra
- Area: Numerical Analysis, Scientific Computing/Programming, Software Development/Documentation, Data Structure and Algorithms

Technical Skills

- Languages: Matlab, C/C++, Fortran, LaTeX, Java, Python, Perl, Ruby
- Systems: Windows (Vista, 7, 8, and 10), Linux (Ubuntu), Unix (MacOS)
- Software: GNU Scientific Library, SVN, Git, Microsoft Office

Languages

Cantonese, Mandarin (native), English (fluent), French (basic), Japanese (basic)

Contact of References on Work

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