

Justin A. E. Ruths

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Education

Ph.D. Systems Science and Mathematics, 2011
Washington University in Saint Louis (WUSTL)
Department of Electrical and Systems Engineering
Thesis: *Optimal Control of Inhomogeneous Ensembles*
Advisor: Jr-Shin Li

M.S. Electrical Engineering, WUSTL, 2008
Advisor: Jr-Shin Li

M.S. Mechanical Engineering, Columbia University, New York, 2006
Advisor: Anouck Girard

B.S. Physics, Rice University, Houston, 2004
Honors: *Cum Laude*
Thesis: *Noncanonical Relativistic Hamiltonian Guiding Center Equations of Motion*

Honors & Awards

Student Travel Award, NSF CMMI Research & Innovation Conference, Jan. 2011
Student representative to give dedication speech for Green Hall engineering building, April 2010
Student Travel Award, Symposium Control & Modeling Biomedical Systems, U. Illinois, April 2010
Outstanding Teaching Assistant Fall 2004, Spring 2004, Fall 2005

Preprint Articles

J.-S. Li, J. Ruths, S. Glaser. *Exact broadband excitation of two-level systems: from spins to springs*, (In preparation for Science).

I. Wijayasinghe, J. Ruths, U. Buettner, B. K. Ghosh, S. Glasauer, O. Kremmyda, J.-S. Li. *Human Head Movement as a Generalized Gimbal*. (In preparation for Automatica).

J. Ruths, A. Zlotnik, J.-S. Li, *Convergence of the multidimensional pseudospectral method for optimal ensemble control*, 50th IEEE Conference on Decision and Control, Orlando, 2011 (Under Review).

Journal and Conference Publications

J. Ruths, J.-S. Li. *Optimal control of inhomogeneous ensembles*. IEEE Transactions on Automatic Control, Special Issue on Quantum Control (Accepted).

J.-S. Li, J. Ruths, T.-Y. Yu, H. Arthanari, G. Wagner. *Optimal pulse design in quantum control: a unified computational method*, Proceedings of the National Academy of Sciences, vol. 108, no. 5, 1879-1884, 2011.

J. Ruths, J.-S. Li. *A multidimensional pseudospectral method for optimal control of quantum ensembles*, Journal of Chemical Physics, 134, 044128, 2011.

D. Stefanatos, J. Ruths, J.-S. Li. *Frictionless atom cooling in harmonic traps: a time-optimal control approach*, Physical Review A, 82, 063422, 2010.

J. Ruths, J.-S. Li. *Optimal ensemble control of open quantum systems with a pseudospectral method*, 49th IEEE Conference on Decision and Control, Atlanta, 2010.

J.-S. Li, J. Ruths, D. Stefanatos. *A pseudospectral method for optimal control of open quantum systems*, Journal of Chemical Physics 131, 164110, 2009.

J. Ruths, D. Stefanatos, T.-Y. Yu, J.-S. Li. *A universal computational method for optimal pulse design in NMR & MRI*, Proceedings of 2011 NSF Engineering and Innovation Conference, Jan. 4-7, Atlanta, GA.

J.-S. Li, J. Ruths, *Optimal sampling and design of MR pulse sequences*, Proceedings of 2009 NSF Engineering and Innovation Conference, June 22-25, Honolulu, HI.

J. Ruths, J.-S. Li, *Global climate change: Control theory methods for a coupled climate model with carbon-cycle feedbacks*, 2nd International Symposium on Energy and Environment, McDonnell Academy Global Energy and Environment Partnership, Dec. 2008.

J. Ruths, J. Sousa, A. Girard, *Controlled vehicle exchange and allocation in dynamic teams*, Proceedings of the ASME International Mech. Eng. Congress and Exposition, November 5-11, 2005, Orlando, FL.

Teaching

Courses at WUSTL

Teaching Assistant, ESE 230 (Undergraduate) *Introduction To Electrical & Electronic Circuits*, Fall 2009

Teaching Assistant, ESE 551 (Graduate) *Linear Systems*, Fall 2008

Undergraduate Courses at Columbia University

Teaching Assistant, *Laboratory I & II for Mechanical Engineers*, Spring & Fall 2005

Teaching Assistant, *Thermodynamics*, Fall 2004

High School NSF GK-12 Fellow at Saint Louis Public Schools

NSF GK-12 fellow at Webster Groves High School teaching Robotics, Fall 2007 & Spring 2008

NSF GK-12 fellow at Metro High School teaching Robotics, Fall 2006 & Spring 2007

Advising

Undergraduate Summer Research, *Optimal Control of Carbon-Climate Dynamics*, Summer 2010

Undergraduate Senior Research, *Feedback Control of Climate Dynamics*, Spring 2010

Undergraduate Summer Research, *A Feedback Linearizable Approach to Magnetorheological Dampers for Earthquake Mitigation*, Summer 2007

Invited Talks

Optimal Control of Ensembles and the Pseudospectral Method, Technische Universität München, Jan. 2010

Advances in Imaging Through Control Theory, National Taiwan University, June 2008

Importance of Mathematics, Pattonville High School, Saint Louis, Feb. 2008

Conference Presentations & Abstracts

J. Ruths, J.-S. Li, *A Universal Computational Method for Optimal Pulse Design in NMR & MRI*, NSF CMMI Research and Innovation Conference, Jan. 2011.

J. Ruths, J.-S. Li, *A Universal Computational Method for Pulse Sequence Design*, Symposium on Control and Modeling of Biomedical Systems, UIUC, Apr. 2010.

J. Ruths, J.-S. Li, *On MRI Pulse Sequence Design with Pseudospectral Methods*, SIAM 2009, May 2009.

J. Ruths, et al. *Engineering, Science, and Math Education for a Global, Technological Society*, NSF GK-12 Annual Conference, Mar. 2007.

Leadership

Systems Science & Mathematics Student Representative to Graduate Council, 2007-2011

Executive Graduate Council subcommittee, Fall 2007 & Spring 2008

Experience

PhD Student, WUSTL; Saint Louis, Missouri (2006-2011)

I studied a class of parameterized dynamical systems, motivated by spin systems in quantum control applications (e.g. NMR, MRI, quantum optics). I developed a general framework and numerical method for solving pulse design problems cast as optimal ensemble control problems. This methodology has also been adapted to other areas, including neuroscience and climate dynamics.

Masters Student, Columbia University; New York, New York (2004-2006)

My work dealt with group switching control of autonomous vehicles in co-operative scenarios - such as battlefield damage assessment and forest fire fighting.

Intern at Chevron Corporation; Houston, Texas (Summer 2005)

I aided in the analysis of the reliability of deep-sea oil field components, including building a online database for failure and maintenance data, contractor site visits, and comprehensive drilling course.

Technical Consultant & Designer, NanoKids; Houston, Texas (2003-2006)

I guided the technical and creative development of an educational outreach program (NanoKids, with Dr. James Tour) to teach science through nanotechnology.

Co-founder & Designer, Tryphon Arts; Houston, Texas (2002-2006)

I developed and implemented custom animated, web, print, and interactive content. Clients included major a oil company, university departments & researchers, and nationwide pest control company.

Proficiencies

Significant experience, major project(s).

Familiar experience.

Operating Systems: *Mac, Windows, Linux/Unix*

Programming: *MATLAB, Mathematica, Python, Java, Objective-C, C++, Visual Basic, Embedded*

Web Design & Programming: *HTML, PHP, SQL, Flash, Actionscript*

Graphic Design: *Adobe Photoshop, Illustrator, Premiere*

Mobile Platforms: *iOS (iPhone)*

References

Jr-Shin Li (Research Advisor)
Assistant Professor of Systems Science and Mathematics
Washington University in Saint Louis
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Hiro Mukai
Professor of Systems Science and Mathematics
Washington University in Saint Louis
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Heinz Schaettler
Associate Professor of Systems Science and Mathematics
Washington University in Saint Louis
(314) 935-6019
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Daniel Rode (Teaching Advisor)
Professor of Electrical Engineering
Washington University in Saint Louis
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Joseph O'Sullivan
Professor of Electrical Engineering
Washington University in Saint Louis
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