

# Justin Ruths

800 W Campbell Road, Richardson TX 75080  
T: 972 883 3856 F: 972 883 4659

[jruths@utdallas.edu](mailto:jruths@utdallas.edu)  
<http://justinruths.com>

**Research Topics:** control & optimization of complex dynamical systems and networks;  
neuroscience; cyber-physical system security; quantum control

## Appointments

2016 – Present: Assistant Professor of Mechanical Engineering and Systems Engineering  
University of Texas at Dallas (UTD)

2011 – 2016: Assistant Professor of Engineering Systems & Design,  
Singapore University of Technology and Design (SUTD)

## Education

2011 PhD Systems Science and Applied Mathematics, Washington University in Saint Louis (WUSTL)  
2008 MS Electrical Engineering, WUSTL  
2006 MS Mechanical Engineering, Columbia University, New York  
2004 BS Physics, Rice University, Houston

## Journal Papers

(supervised students/postdocs are underlined)

D. Ruths, J. Ruths. *Estimating the Minimum Control Count of Random Network Models*. *Scientific Reports*, vol. 6, article 19818, 2016.

S. Ghosh, J. Ruths. *Structural Control of Single-Input Rank One Bilinear Systems*. *Automatica*, vol. 64, pp. 8-17, 2016.

C. Campbell, J. Ruths, D. Ruths, K. Shea, R. Albert. *Topological Constraints on Network Control Profiles*. *Scientific Reports*, vol. 5, article 18693, 2015.

P.N. Taylor, J. Thomas, N. Sinha, J. Dauwels, M. Kaiser, T. Thesen, J. Ruths. *Optimal control based seizure abatement using patient derived connectivity*. *Frontiers in Neuroscience*, vol. 9, no. 202, 2015.

J. Ruths, D. Ruths. *Response to Comment on "Control profiles of complex networks"*. *Science*, vol. 346, no. 6209 p. 561, 2014.

J. Ruths, D. Ruths. *Control Profiles of Complex Networks*. *Science*, vol. 343, no. 6177, pp. 1373-1376, 2014.

I. Wijayasinghe, J. Ruths, U. Bttner, B. Ghosh, S. Glasauer, O. Kremmyda, J.-S. Li. *Potential and optimal control of human head movement using Tait-Bryan parametrization*. *Automatica*, vol. 50, no. 2, pp. 519529, 2014.

J.-S. Li, I. Dasanayake, J. Ruths. *Control and Synchronization of Neuron Ensembles*. IEEE Transactions on Automatic Control, vol. 58, 2013.

J. Ruths, J.-S. Li. *Optimal control of inhomogeneous ensembles*. IEEE Transactions on Automatic Control, Special Issue on Quantum Control, vol. 57, 2012.

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

## Papers Under Review

(supervised students/postdocs are underlined)

G. Sabaliauskaite, G.S. Ng, J. Ruths, A. Mathur. *Comparison of Corrupted Sensor Data Detection Methods in Detecting Stealthy Attacks on Cyber-Physical Systems*. 22nd IEEE Pacific Rim International Symposium on Dependable Computing (PRDC), 2017.

S. Ghosh, J. Ruths, A. Yeo. *Graphical coprime walk algorithm and structural controllability of bilinear systems*. Automatica.

G. Sartor, Y.K. Chia, L. Wynter, J. Ruths. *Structural Controllability and Influence Maximization*.

B. Ghosh, J. Ruths. *Optimal Strategies in Binocular Control*.

## Conference Papers

(supervised students/postdocs are underlined)

J. Thomas, S. Ghosh, D. Parekh, D. Ruths, J. Ruths. *Robustness of Network Controllability to Degree-Based Edge Attacks*. 5th International Workshop on Complex Networks and their Applications, Milan, 2016.

C. Murguia, J. Ruths. *Characterization of a CUSUM Model-Based Sensor Attack Detector*. 55th IEEE Conference on Decision and Control (CDC), Las Vegas, 2016.

D. Urbina, J. Giraldo, A. Cardenas, N. Tippenhauer, J. Valente, M. Faisal, J. Ruths, R. Candell, H. Sandberg. *Limiting the Impact of Stealthy Attacks on Industrial Control Systems*. 23rd ACM Conference on Computer and Communications Security (CCS), Vienna, 2016.

C. Murguia, J. Ruths. *CUSUM and Chi-Squared Attack Detection of Compromised Sensors*. IEEE Multi-Conference on Systems and Control (MSC), Buenos Aires, 2016.

G. Sabaliauskaite, G.S. Ng, J. Ruths, A. Mathur. *Empirical Assessment of Corrupt Sensor Data Detection Methods in a Robot*. IEEE International Workshop on Dependable Software and Applications, Atlanta, 2016.

- C. Murguia, J. Ruths, H. Nijmeijer. *Robust Network Synchronization of Time-Delayed Coupled Systems*. 6th IFAC International Workshop on Periodic Control Systems (PSYCO), Eindhoven, 2016.
- J. Ruths, S. Ghosh, B. Ghosh. *Optimal Tracking of Version and Vergence Eye Movements in Human Binocular Control*. European Control Conference, Aalborg, 2016.
- B. Mannot, J. Ruths. *Sensitivity of Network Controllability to Weight-Based Edge Thresholding*. 7th Workshop on Complex Networks (CompleNet), Dijon, 2016.
- S. Ghosh, J. Ruths. *Closing the gap between controllability and structural controllability*. 54th IEEE Conference on Decision and Control (CDC), Osaka, 2015.
- Z. Costello, J. Ruths, M. Egerstedt. *On the Construction of Local Interaction Rules that Perform Global Linear Computation*. 54th IEEE Conference on Decision and Control (CDC), Osaka, 2015.
- G. Sabaliauskaite, G.S. Ng, J. Ruths, A. Mathur. *Experimental Evaluation of Stealthy Attack Detection in a Robot*. 21st IEEE Pacific Rim International Symposium on Dependable Computing (PRDC), 2015.
- S. Ghosh, J. Ruths. *On Structural Controllability of a Class of Bilinear Systems*. 53th IEEE Conference on Decision and Control (CDC), Los Angeles, 2014.
- D. Parekh, D. Ruths, J. Ruths. *Reachability-based Robustness of Network Controllability under Node and Edge Attacks*. 3rd Workshop on Complex Networks and their Applications, Morocco, 2014.
- S. Ghosh, J. Ruths. *Control Configuration Design for a Class of Structural Bilinear Systems*. 52nd Allerton Control Conference, UIUC, 2014.
- N. Sinha, P. Taylor, J. Dauwels, J. Ruths. *Development of optimal stimuli in a heterogeneous model of epileptic spike-wave oscillations*. IEEE International Conference on Systems, Man, and Cybernetics, San Diego, 2014.
- J. Ruths, P. Taylor, J. Dauwels. *Optimal Control of an Epileptic Neural Population Model*. International Federation of Automatic Control, Cape Town, 2014.
- J. Ruths, D. Ruths. *Robustness of Network Controllability under Edge Removal*. Complex Networks IV, Studies in Computational Intelligence (Springer), CompleNet, Berlin, 2013.
- J. Ruths, A. Zlotnik, J.-S. Li. *Convergence of the multidimensional pseudospectral method for optimal ensemble control*. 50th IEEE Conference on Decision and Control (CDC), Orlando, 2011.
- J. Ruths, D. Stefanatos, T.-Y. Yu, J.-S. Li. *A universal computational method for optimal pulse design in NMR & MRI*. Proceedings of NSF Engineering and Innovation Conference, Atlanta, GA, 2011. [not peer reviewed]
- J. Ruths, J.-S. Li. *Optimal ensemble control of open quantum systems with a pseudospectral method*. 49<sup>th</sup> IEEE Conference on Decision and Control (CDC), Atlanta, 2010.
- J.-S. Li, J. Ruths. *Optimal sampling and design of MR pulse sequences*. Proceedings of NSF Engineering and Innovation Conference, Honolulu, HI, 2009. [not peer reviewed]
- 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, 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, Orlando, FL, 2005.

## **Educational Conference Papers**

J. Liu, Y. Zhang, J. Ruths, D. Moreno, D.D. Jensen, K.L. Wood. *Innovations in Software Engineering Education: An Experimental Study of Integrating Active Learning and Design-based Learning*. 120th ASEE Annual Conference & Exposition, 2013.

F. Tsai, K. Natarajan, S.D. Ahipasaoglu, C. Yuen, H. Lee, N.-M. Cheung, J. Ruths, S. Huang, T. Magnanti. *From boxes to bees: Active learning in freshmen calculus*. IEEE Global Engineering Education Conference (EDUCON), 2013.

## **Talks (invited\*)**

Winter Workshop\*, Complexity Institute at Nanyang Technological University, Mar 2016

Mechanical Engineering\*, University of Houston, Feb 2016

Mechanical Engineering\*, University of Texas at Dallas, Jan 2016

Research Group, MIT, May 2015

Controls Group, Harvard University, May 2015

Electrical Engineering, Rice University, May 2015

Control, Dynamics, and Systems Seminar, University of Colorado, May 2015

European Conference on Complex Systems\*, Lucca, September 2014

Institute of High Performance Computing\*, A\*STAR, Singapore, July 2014

Control & Signal Processing Seminar\*, University of Melbourne, June 2014

Biomedical Engineering Seminar\*, University of Melbourne, June 2014

International Conference on Computational Science, Cairns, June 2014

Winter Workshop\*, Complexity Institute at Nanyang Technological University, Feb 2014

Novel Technologies for Neurology Workshop, Nanyang Technological University, May 2012

Barbados Workshop on Control in Biological Systems\*, McGill Univ. Bellairs Research Institute, April 2012

Chemistry\*, Technische Universität München, Jan. 2010

## **Professional Activities & Leadership**

Co-organizer of workshop: *Paradigms for Control in Social Systems*

Held at the International Conference on Computational Science 2015

Session co-chair at the Conference on Decision and Control 2014, SIAM Control and Its Applications 2013

PC Member	International Conference on Computational Science (ICCS 2016); Conference on Complex Systems (CCS 2016); Cyber-Physical Systems Security & Privacy (CPS-SPC 2016)
Reviewer	Conferences: CDC, ACC, ECC, MSC, etc IEEE TAC, TCNS, TCAS, TNNLS; Automatica; System & Control Letters Science; Nature Reviews; Physical Review; Nature Communications Physica; Scientific Reports; PLOS One; Entropy; Journal of the Franklin Institute
ESD Dept Service	Undergraduate Program, Website, Research Space Committees
SUTD Service	Founder & Director of Innovative Digital Arts Lab Supervised the two person team supporting the SUTD academic websites Learning Management System (LMS) ESD Faculty Representative

## Advising

2015 – Present	Carlos Murguia, Postdoctoral Fellow	<i>[cyber-physical security]</i>
2015 Fall	Jairo Giraldo, Visiting Postdoctoral Fellow	<i>[cyber-physical security]</i>
2015 – Present	Giorgio Sartor, PhD student, IBM internship	<i>[network control &amp; traffic]</i>
2015 – 2016	Jijju Thomas, Research Assistant	<i>[robustness of network control &amp; optimal control]</i>
2014 – Present	Sibo Song, PhD student (ISTD)	<i>[classification of networks]</i>
2014 – 2015	Barnabe Monnot, PhD student	<i>[effect of thresholding in network control]</i>
2014 – 2015	Deven Parekh, co-supervised MS at McGill Univ.	<i>[robustness of network control]</i>
2014	Rajnish Sharma <i>Employed by McKinsey &amp; Company (Shanghai)</i>	<i>[computational optimal control]</i>
2013 – 2016	Supratim Ghosh, Postdoctoral Fellow	<i>[network control &amp; bilinear systems]</i>
2013 – 2014	Nikhil Jain, SUTD-MIT Dual-Degree MS Program <i>Employed by Amazon126 (Sunnyvale, CA)</i>	<i>[robustness of network control]</i>
2012 Summer	Kimberly Toy, MIT Undergraduate Exchange Program	<i>[material conductivity models]</i>

## Funding

*[Total funding raised: USD\$2,331,790]*

2016 – 2017	J. Ruths, R. Bouffanais, S. Ahipasaoglu, D. Rhodes, D. Hastings, <i>Characterizing and Addressing the Implications of Complexity and Emergence</i> S\$1,667,000 Singapore Ministry of Defense
2015 – 2019	Co-PI on consortium grant, <i>ASPIRE: Advancing Security of Public Infrastructure using Resilience and Economics</i> S\$544,000 (of S\$6M total) Singapore National Research Foundation

2015 – 2018	Co-PI on consortium grant, <i>DManD: Digital Manufacturing and Design Centre</i> S\$345,600 (of S\$25M total) Singapore National Research Foundation
2015	J. Ruths, D. Ruths. <i>ICCS Workshop: Paradigms for Control in Social Systems</i> S\$15,120 International Design Center (IDC21500101)
2014 – 2017	E. Kyoseva, J. Ruths, <i>Modular Design Principles for Quantum Devices</i> S\$259,200 International Design Center (IDG31300102)
2014 – 2015	J. Ruths, A. Mathur, G. Sabaliauskaite, <i>Empirical Assessment of Techniques for Detecting and Responding to Sensor Attacks in Cyber Physical System</i> S\$48,514 iTrust (IGDS S14 05011)
2013 – 2015	J. Ruths, <i>Design Principles for Robustly Controllable Networks</i> S\$287,400 International Design Center (IDG31300103)
2011 – 2014	J. Ruths, <i>Computational Methods for Optimal Control of Quantum Systems</i> S\$100,000 Singapore Ministry of Education (SRG 2011010)

## Teaching

[Instructor Evaluation]

SUTD 40.570	(Graduate) Linear Control Systems	[4.88/5]
SUTD 40.006	(Undergraduate) Network Modeling	[4.6/5]
SUTD 10.007	(Undergraduate) Modeling the Systems World, Differential Equations	[4.2/5]
SUTD 10.004	(Undergraduate) Advanced Math II, Linear Algebra & Multivariable Calculus	[4.3/5]
SUTD 10.001	(Undergraduate) Advanced Math I, Single Variable Calculus	[4.2/5]

## Active Collaborators

Selin Damla Ahipasaoglu	SUTD, Engineering Systems Design (Optimization)
Reka Albert	Pennsylvania State University, Physics
Roland Bouffanais	SUTD, Engineering Product Development (Complex Systems)
Alvaro Cardenas	University Texas at Dallas, Computer Science
Justin Dauwels	Nanyang Technological University, Electrical and Electronic Engineering
Magnus Egerstedt	Georgia Tech University, Electrical and Computer Engineering
Stefano Galelli	SUTD, Engineering Systems Design (Water Resource Management)
Bijoy Ghosh	Texas Tech University, Mathematics and Statistics
Elica Kyoseva	SUTD, Engineering Product Development (Physics)
Jr-Shin Li	Washington University in Saint Louis, Electrical and Computer Engineering
Man-Ngai Cheung	SUTD, Information Systems Technology and Design (Machine Learning)
Aditya Mathur	SUTD (previously Purdue University), Computer Science
Derek Ruths	McGill University, Computer Science
Peter Taylor	Newcastle University, Neuroscience
Laura Wynter	IBM Research, Singapore (Network Science & Traffic)
Anders Yeo	SUTD, Engineering Systems Design (Graph Theory)