

M. K. Stephen Yeung

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Education

Ph.D., Theoretical & Applied Mechanics, Cornell University (1999). Thesis Advisor: Steven Strogatz.
Thesis Title: Time Delay in the Kuramoto Model of Coupled Phase Oscillators. Minors in Mathematics and Applied Mathematics.

B. Sc., First Class Honours, Physics, Chinese University of Hong Kong (1994). Minor in Mathematics.

Employment

Jul. 2003 – present: Assistant Professor, Dept. of Mathematics & Statistics, Utah State University.

Jun. 1999 – Jun. 2003: Research Associate, Dept. of Biomedical Engineering and Center for BioDynamics, Boston University.

May – Aug. 1994: Research Assistant, Dept. of Physics, Chinese University of Hong Kong.

Research Interests

Dynamical systems and network structures, and their applications in physics, engineering, and biology
Applied probability and game theory, and their applications in social sciences.

Research Projects

Applied probability and game theory

- Characterized an anomaly in the probability distribution governing the sum of random variables
- Constructed a non-traditional game without an equilibrium point.
- Studied their implications in sports and elections.

Reverse engineering gene networks

- Developed efficient algorithms to reconstruct gene networks from microarray data.
- Reduced sampling complexity to $O(\log N)$.
- Reduced computational complexity to $O(N^4)$.

Delta-sigma data converters

- Developed robust high-bandwidth noise-shaping A/D and D/A data converters in digital audio and multimedia systems.
- Reduced complexity from $O(N \log N)$ to $O(N)$, lowering power consumption and chip area.
- Modified network to allow number of elements to be arbitrary integer, not necessarily of the form $N = 2^k$ as in earlier designs, resulting in greater flexibility in design to meet specifications.

Kuramoto model with time delay

- Studied networks of coupled oscillators with global, time-delayed coupling.
- Generalized a theorem due to Hayes (1959), which governs the distribution of zeros of exponential polynomials and the stability of delay differential equations.
- Stated conditions for synchronization and incoherence for oscillators interacting with time delay.

Coupled arrays of Josephson junctions

- Studied interactions of two inductively coupled discrete Josephson rings.

Lasers with injection

- Analyzed dynamics of a solid-state laser driven by injected sinusoidal field.
- Discovered a novel global codimension-2 bifurcation underlying the unlocking mechanism.
- Established conditions for stable phase-locking of injection lasers.

Publications

- M. K. S. Yeung, "A two-player multi-game match without optimal strategies", manuscript in preparation (2005).
- M. K. S. Yeung, "Reverse engineering gene networks using perturbations with unknown effects", manuscript in preparation (2005).
- M. K. S. Yeung, "Inferring local structures of gene networks", manuscript in preparation (2005).
- M. K. S. Yeung, "Some anomalies in the probabilities of various outcomes in a sequence of paired comparisons", manuscript in preparation (2005).
- M. K. S. Yeung, "Winning the battles but losing the war", submitted for publication (2005).
- J. J. Collins, D. di Bernardo, T. S. Gardner, J. Tegnér and M. K. S. Yeung, "Systems and Methods for Reverse Engineering Models of Biological Networks", U.S. Patent Application Serial No. 10/506,734 (filed in 2004).
- R. W. Adams, D. J. Mar and M. K. S. Yeung, "Efficient data-directed scrambler for noise-shaping mixed-signal converters with an arbitrary number of discretization levels with arbitrary weights", U.S. Patent Application No. 20030197633 (filed in 2003).
- M. K. S. Yeung, Book review of "When Least is Best", by F. J. Nalin, *UMAP J.*, 25(4): 439-440 (2004).
- R. W. Adams, D. J. Mar and M. K. S. Yeung, "Data-directed scrambler for noise-shaping mixed-signal converters with an arbitrary number of discretization levels" U.S. Patent No. 6,614,377 (2003). Cited 5 times.
- M. K. S. Yeung, Book review of "An Introduction to Mathematical Modeling in Physiology, Cell Biology, and Immunology", edited by J. Sneyd, *SIAM Review*, 45(3): 621-624 (2003).
- J. Tegnér, M. K. S. Yeung, J. Hasty and J. J. Collins, "Reverse engineering gene networks: Integrating genetic perturbations with dynamical modeling", *Proc. Natl. Acad. Sci. USA* 100, 5944-5949 (2003). Cited 30 times.
- M. K. S. Yeung, J. Tegnér and J. J. Collins, "Reverse engineering gene networks using singular value decomposition and robust regression", *Proc. Natl. Acad. Sci. USA* 99, 6163-6168 (2002). Cited 57 times.
- M. K. S. Yeung and S. H. Strogatz, "Time delay in the Kuramoto model of coupled oscillators", *Phys. Rev. Lett.* 82, 648-651 (1999). Cited 56 times.
- M. K. S. Yeung and S. H. Strogatz, "Nonlinear dynamics of a solid-state laser with injection", *Phys. Rev. E* 58, 4421-4435 (1998); with erratum, *Phys. Rev. E* 61, 2154 (2000). Cited 18 times.
- A. E. Duwel, C. F. Heij, J. C. Weisenfeld, M. K. S. Yeung, E. Trias, S. J. K. Várdy, H. S. J. van der Zant, S. H. Strogatz and T. F. Orlando, "Interactions of topological kinks in two coupled rings of nonlinear oscillators", *Phys. Rev. B* 58, 8749-8754 (1998). Cited 1 time.

Conference Presentations

On gene networks:

- Poster, Gordon Research Conference on Theoretical Biology & Biomathematics, Hilton School, NH (2002).
- Poster, First SIAM Conference on the Life Sciences, Boston, MA (2002).

On data converters:

- Sixth SIAM Conference on Applications of Dynamical Systems, Snowbird, UT (2001)
- APS March Meeting, Seattle, WA (2001).
- AFS March Meeting, Minneapolis MN (2000)

On the Kuramoto Model:

- Fifth SIAM Conference on Applications of Dynamical Systems, Snowbird, UT (1999).

On dynamics of laser:

- Poster, Gordon Research Conference on Nonlinear Science, South Hadley MA (2001).

Invited Lectures

On applied probability:

- MIT Sloan School of Management (2005).

On gene networks:

- Third Annual Intermountain/Southwest Conference on Industrial and Interdisciplinary Mathematics Arizona State University (2004).
- Department of Mathematics, University of Arizona (2003).
- Department of Mathematics and Statistics, Utah State University (2003).
- Department of Mathematics, University of Massachusetts, Boston (2003).
- Department of Mathematics, University of Georgia, Athens (2003).
- Center for Bioinformatics, University of Pennsylvania (2003).
- Department of Mathematics, University of California, Davis (2003).
- Department of Applied Mathematics, University of Washington (2002).
- SIAM 50th Anniversary and 2002 Annual Meeting, Philadelphia, PA (2002).

On data converters:

- Industrial and Interdisciplinary Math Colloquium, Utah State University (2003).
- Center for BioDynamics, Boston University (2001).

On the Kuramoto Model:

- Center for BioDynamics, Boston University (2000).
- Neurogroup, Boston University (2000).
- Centre for Nonlinear Dynamics in Physiology and Medicine, McGill University (1998).

On dynamics of laser:

- Department of Physics, Utah State University (2003).
- International Conference on Dynamics of Continuous, Discrete and Impulsive Systems, London, Ontario, Canada (2001).
- Department of Mathematics, Boston University (1999).

Teaching and Other Pedagogical Experience

Instructor, Utah State University, Fall 2003 – present. Courses taught:

Course	Semester	Evaluation [†]
Math 1210: Calculus I	Fall 05	—
Math 2250: Linear Algebra & Differential Equations	Fall 05	—
Math 5460: Theory & Application of Nonlinear Dynamical Systems	Spring 05	6.0/6.0
Math 2250H: Linear Algebra & Differential Equations (Honors)	Fall 04	5.5/6.0
Math 5610: Computational Linear Algebra & Solution of Equations	Fall 04	5.4/6.0
Math 2250: Linear Algebra & Differential Equations (2 sections)	Spring 04	5.6 & 5.1/6.0
Math 5910: Directed Reading: Mathematical Biology	Spring 04	—
Math 5610: Computational Linear Algebra & Solution of Equations	Fall 03	5.2/6.0
Phyx 5810: Physics Colloquium, as guest lecturer	Fall 03	—

†: Department average: 4.8/6.0 (Fall 03), 4.9/6.0 (Spring 04), 5.0/6.0 (Fall 04, Spring 05).

College average: 4.8/6.0 (Fall 03), 4.9/6.0 (Spring 04, Fall 04, Spring 05).

Major advisor of Marty Garlick; minor advisor of 8 students: Fiya Chootinan, Alia Ciddle, Justin Heavilin, Agnieszka Jach, Inga Maslova (M. Sc., 2005), Kady Schreiber (Ph.D., 2004), Laura Watkins (Ph.D., 2005), Brian Yurk.

Co-facilitator, Graduate Teaching Development Workshops, Center for Learning and Teaching, Cornell University, Spring 1999.

Member, Organizing Committee, Office of Instructional Support, Cornell University, Spring & Fall 1996, Spring 1997.