

Yoke Peng Leong

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EDUCATION

- Ph.D. **California Institute of Technology** (Caltech)
Control and Dynamical Systems (CDS), Expected Dec 2017
- M.S. **Northwestern University**
Mechanical Engineering (Robotics & Control), 2012

Surface Feature Detection Based on Proprioception of a Robotic Finger during Haptic Exploration (Adviser: Dr. Todd Murphey)
- B.S. **Northwestern University**
Mechanical Engineering (Mechatronics), *Summa cum Laude*, 2012
Minor: Economics

GRADUATE RESEARCH EXPERIENCES

Nonlinear Optimal Control

Adviser: Dr. Joel Burdick (Caltech)

- Constructed a novel optimal controller synthesis technique based on convex optimization (Sum of Squares program) for stochastic nonlinear systems with performance guarantees
- Solved the high dimensional ($> 3D$) linear Hamilton Jacobi Bellman equation, a PDE, using tensor decomposition in MATLAB on a laptop

L_1 Optimal Control

Adviser: Dr. John Doyle (Caltech)

- Derived performance bound of L_1 optimal control for linear systems with unstable poles, unstable zeros, and delay based on technique in optimization
- Analyzed the waterbed effects in time domain

Control Engineering in Neuroscience

Adviser: Dr. Joel Burdick, Dr. John Doyle (Caltech)

- Discovered a novel, important relationship in human sensorimotor control that were neglected in previous studies using robust control analysis
- Conducted human subject experiments to verify theoretical analysis that includes building a 3D motion tracking platform using commercial motion tracking cameras, designing experimental protocols to collect data, and analyzing motion capture data using Bash and MATLAB

Formal Methods for Controller Synthesis

Adviser: Dr. Pavithra Prabhakar (Kansas State University)

- Combined techniques from abstraction-based controller synthesis and finite quantitative games to synthesize optimal controller for hybrid systems with formal specifications
- Created a tool in Python that implements the approach

PUBLICATIONS/TALKS

Journal Articles

- [1] Y. P. Leong and J. C. Doyle, “Effects of delays, poles, and zeros on time domain waterbed tradeoffs and oscillations,” *IEEE Control Systems Letters*, vol. 1, no. 1, pp. 122–127, 2017.
- [2] Y. P. Leong, M. B. Horowitz, and J. W. Burdick, “Linearly solvable stochastic control lyapunov functions,” *SIAM Journal on Control and Optimization*, vol. 54, no. 6, pp. 3106–3125, 2016.
- [3] Y. P. Leong and T. D. Murphey, “Feature localization using kinematics and impulsive hybrid optimization,” *IEEE Transactions on Automation Science and Engineering*, vol. 10, no. 4, pp. 957–968, 2013.

Refereed Conference Papers

- [1] J. Doyle, Y. Nakahira, Y. P. Leong, E. Jenson, A. Dai, D. Ho, and N. Matni, “Teaching control theory in high school,” in *IEEE Int. Conf. on Decision and Control (CDC)*, Tutorial Session, 2016, pp. 5925–5949.
- [2] Y. P. Leong and J. C. Doyle, “Understanding robust control theory via stick balancing,” in *IEEE Int. Conf. on Decision and Control (CDC)*, 2016, pp. 1508–1514.
- [3] Y. P. Leong and P. Prabhakar, “Optimal control with regular objectives using an abstraction-refinement approach,” in *American Controls Conf. (ACC)*, 2016, pp. 5161–5168.
- [4] E. Stefansson and Y. P. Leong, “Sequential alternating least squares for solving high dimensional linear Hamilton-Jacobi-Bellman equation,” in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, 2016, pp. 3757–3764.
- [5] Y. P. Leong, M. B. Horowitz, and J. W. Burdick, “Suboptimal stabilizing controllers for linearly solvable system,” in *IEEE Int. Conf. on Decision and Control (CDC)*, 2015, pp. 7157–7164.
- [6] N. Matni, Y. P. Leong, Y.-S. Wang, S. You, M. B. Horowitz, and J. Doyle, “Resilience in large scale distributed systems,” in *Conference on Systems Engineering Research*, 2014, pp. 285–293.
- [7] Y. P. Leong and T. D. Murphey, “Second order switching time and magnitude optimization for impulsive hybrid systems,” in *American Controls Conf. (ACC)*, 2013, pp. 6213–6218.

Master’s Thesis

- [1] Y. P. Leong, “Surface feature detection based on proprioception of a robotic finger during haptic exploration,” M. S. Thesis, Northwestern University, Jun. 2012.

Posters/Abstracts

- [1] Y. P. Leong, B. Christalin, J. W. Burdick, and J. C. Doyle, *The significance of measurement location in human stick balancing*, Program No. 794.14. Neuroscience Meeting Planner 2015. Society of Neuroscience, 2015. Online.

Technical Notes

- [1] E. Stefansson and Y. P. Leong, *Sequential Alternating Least Squares (SeALS) MATLAB User's Guide*, Online, 2016.

Invited Talks

- [1] *Solving High Dimensional Hamilton-Jacobi-Bellman Equations Using Low Rank Tensor Decomposition*, Special Semester on Computational Methods in Science and Engineering. Workshop 3: Numerical methods for Hamilton-Jacobi equations in optimal control and related fields, Nov. 2016.

HONORS AND AWARDS

Caltech Computing and Mathematical Sciences (CMS) Fellowship, 2012-2013

Tau Beta Pi Engineering Honors Society Fellow, 2012-2013

Northwestern University Mechanical Engineering Academic Achievement Award, 2012

Malaysian Public Service Department Scholarships for Undergraduate Education at USA, 2007-2012

TEACHING EXPERIENCE

Caltech, Department of Computing and Mathematical Sciences, 2014 - 2017

Teaching Assistant

Advanced Robotics: Navigation and Vision, Winter, Spring 2017

Introduction to Feedback Control Systems, Fall 2016

Introduction to Kinematic and Robotics, Spring 2015

Vision: From Computational Theory to Neuronal Mechanisms, Winter 2015

Linear Algebra, Fall 2014

Guest Lecturer

Nonlinear Dynamical Systems, Spring 2016

Introduction to Modern Control, Spring 2015

Students Advised

Hanmin (Emma) Qian, Caltech, Freshman Summer Research Institute, Summer 2017

Elis Stefansson, KTH Institute of Technology, Caltech Summer Undergraduate Research Fellowship, Summer 2015

PREVIOUS RESEARCH EXPERIENCE

IMDEA Software Institute, Madrid Institute for Advanced Studies, May 2014 - July 2014

Research Intern (Adviser: Dr. Pavithra Prabhakar)

- Synthesized optimal control strategy for hybrid dynamical systems using an abstraction-refinement procedure that preserves the transition cost
- Developed the controller synthesis tool in Python

Murphey Lab, Northwestern University, Dec 2010 - Jun 2012

Undergraduate Researcher (Adviser: Dr. Todd Murphey)

- Extended the hybrid system switching time optimization to systems with mixed dynamics and impulses

- Constructed a new smoothing algorithm to detect and localize surface features from noisy proprioceptive measurements of a robotic finger using the impulsive hybrid system optimization technique
- Designed and set up experiments using the PHANToM OMNI haptic device to collect experimental data and test the algorithm

PROFESSIONAL SERVICE

Caltech SURF Program, *Mentor*, Jun 2015 - Sept 2015

- Guided a Swedish undergraduate student to complete research project milestones in a timely manner and develop new results that were presented in a conference

Caltech Graduate Student Council, *CDS Option Representatives, Research Communication Chair (2015-2016)*, Jun 2014 - May 2016

- Managed a team of 3 graduate students to organize the 2016 GSC Poster Session including organizing a pre-event workshop, arranging event logistics, and soliciting judges

Caltech Teaching Conference, *Organizing Committee*, Summer 2014, 2015

- Organized and facilitated a session on teaching and mentoring (2015)
- Facilitated a session on creating an academic career portfolio (2014)

IEEE Conference on Decision and Control, *Reviewer*

American Control Conference, *Reviewer*

PROFESSIONAL MEMBERSHIPS/AFFILIATIONS

Institute of Electrical and Electronics Engineers (IEEE), Control Systems Society

Tau Beta Pi Engineering Honor Society

Pi Tau Sigma Mechanical Engineering Honor Society

LANGUAGE SKILL

English (Fluent), Mandarin (Fluent), Cantonese (Native), Malay (Fluent), Japanese (Basic)

COMPUTER SKILL

Advanced: MATLAB, Python

Intermediate: Mathematica, Javascript, HTML, CSS

Basic: Simulink, C/C++, Bash, NX (Unigraphics), ANSYS

COMMUNITY SERVICE

Caltech RISE Program, *Tutor*, Oct 2013 - June 2016

- Assisted high school students who are under-performing in mathematics and sciences to learn the subjects

Alternative Student Breaks, *Volunteer*, Dec 2008 - June 2013

- Participated in a week-long service learning trip during school breaks
- Volunteered at children hospital, national parks, and various non-profit organizations nationwide