Karena X. Cai

kcai@caltech.edu | karenacai.com

EDUCATION

09/15-present **California Institute of Technology,** Pasadena, CA, Expected June 2020
PhD Candidate in Control and Dynamical Systems, GPA: 3.9
Advisors: Richard M. Murray and Soon-Jo Chung

09/11-06/15 **Princeton University,** Princeton, NJ
B.S.E. in Mechanical and Aerospace Engineering, Magna Cum Laude, Dept. GPA: 3.8
Minors in the Applications of Computing and Robotics and Intelligent Systems

HONORS AND AWARDS

10/18 **Simoudis Discovery Grant Recipient**, awarded funding to an outstanding student working on emerging projects at the intersection of big data, machine learning, and autonomy.

3/16-3/17 **National Science Foundation Honorable Mention**

06/15 **George Bienkowski Memorial Prize,** awarded to a senior student of sound academic standing and who has contributed to the department and engineering through their service during their career at Princeton.

06/15 **Morgan McKinzie 93 Senior Thesis Prize Honorable Mention**

CURRENT RESEARCH

05/17-present **Bayesian Estimation with Semantic Data**

- Augmenting Bayesian estimation algorithms with data from computer-vision based object classification algorithms.
- Experimentally validating algorithms on aerial vehicle platforms.

06/18-present **Embedding Semantic Data Into Learning Algorithms for Multi-Agent Prediction**

- Using semantic data to enhance computer-vision based machine-learning algorithms that predict the behaviors of agents in complex urban environments.

RESEARCH EXPERIENCE

09/14-06/15 **Senior Thesis:** The Modeling, Simulation, and Analysis of the Central Pattern Generator Involved in Cockroach Locomotion, Prof. Philip Holmes.

- Investigated the linearized Central Pattern Generator model to analyze the system's stability.
- Linked mathematical analysis with experimental data on cockroach response to perturbations.

06/14-09/14 **ETH Zurich,** *Researcher,* Prof. Raffaello D'Andrea, Zurich, Switzerland

- Improved model for Blind Juggler Machine by rewriting the program in C to increase simulation speed by 4000.
- Optimized chaos in model to improve control strategy by 35 percent.

06/13-09/13 **University of Pennsylvania,** *REU Researcher,* Prof. Daniel Koditschek, Philadelphia, PA

- Independently derived a model to simulate the dynamics of a flexible-spine quadruped.
- Discovered a passive-hybrid limit cycle in the simulated bounding motion of the quadrupedal model.

TECHNICAL PROJECTS

09/13-11/13 **Crane Design Project**

- Designed and fabricated lightweight (2.5-lb) crane structure that withstands a 500-lb load.
- Optimized crane for strength and weight using finite element analysis in Pro/E.
- Won Most Creative Design Award.

02/13-06/13 **Pet-Owner Android Application**

- Developed an Android application allowing pet owners to monitor the physical activity and health of their pet with Arduino, Bluetooth, IMU, and force sensor.

02/13-06/13 **Psychology Roulette Game**

- Designed and programmed web-based roulette game that records data for complex decision-making experiments for Professor Eldar Shafir.

TEACHING/MENTORSHIP EXPERIENCE

04/18-06/18 **CDS 110/CHE 105 Introduction to Feedback Control Systems TA,** Caltech

- Held office hours and graded assignments.

09/16-06/17 **Caltech Rise tutor,** Caltech

- Tutored economically disadvantaged high school students in Caltech afterschool program.

09/12-06/13 **Stuart Country Day School Robotics Mentor,** Robotics Mentor, Princeton, NJ

- Mentored an all-girls team in the design, manufacturing and programming of robots for the FIRST Tech Challenge competition.

09/12-present **Riverside Elementary School,** *Robotics Teacher,* Princeton, NJ

- Mentored elementary school students in designing, building and programming catapults, LEGO smart cars, and LEGO tanks.

LEADERSHIP EXPERIENCE

01/13-present **American Society of Mechanical Engineers,** *President, Student Outreach Chair*

- Organized Regional Engineering Olympics competition for high school students.
- Hosted educational trip to co-generation plant, faculty panels, and guest speakers.

09/13-01/14 **Princeton Innovation Science Magazine,** *Business Chair*

- Acquired funding for magazine by writing grants and selling advertisements.

09/13-present **Princeton University,** *Peer Academic Advisor and B.S.E. Interactor*

- Advised students on engineering major selection and academic resources.
- Facilitated discussions between professors and students about course selection.

TECHNICAL SKILLS

Computer: Python, MATLAB, C/C++, OpenCV, ROS, Arduino, Pro/ENGINEER, and Adobe Illustrator.
Fabrication: Experience with most machining equipment and rapid prototyping tools.

PEER-REVIEWED PUBLICATIONS

K. X. Cai, A. Harvard, R. M. Murray, and S. Chung. *Robust Estimation Framework with Semantic Measurements.* American Control Conference, 2019. *(In Review)*