Tony Dear

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Employment

Columbia University, Department of Computer Science
Lecturer in Discipline — January 2019 - present
Associate in Discipline — July 2018 - December 2018

Education

Carnegie Mellon University, The Robotics Institute
Doctor of Philosophy, Robotics — August 2018
Master of Science, Robotics — May 2015
- Thesis: Extensions of the Principal Fiber Bundle Model for Locomoting Robots
- Completed Future Faculty Program at the Eberly Center for Teaching Excellence

University of California, Berkeley
Bachelor of Science, Electrical Engineering and Computer Science (EECS) — May 2012
- Graduated with highest honors (*summa cum laude*)
- Completed EECS Honors Program, minor program in Physics

Teaching

Columbia University
COMS 3251, Computational Linear Algebra — Spring 2020
Total enrollment 127.
COMS 4701, Artificial Intelligence — Fall 2019
Total enrollment 358. Course evaluation 4.25/5, instructor evaluation 4.45/5.
COMS 4733, Computational Aspects of Robotics — Spring 2019
Total enrollment 80. Course evaluation 4.09/5, instructor evaluation 4.41/5.
COMS 3203, Discrete Mathematics — Spring 2019
Total enrollment 102. Course evaluation 3.89/5, instructor evaluation 4.28/5.
COMS 4701, Artificial Intelligence — Fall 2018
Total enrollment 301. Course evaluation 4.06/5, instructor evaluation 4.21/5.

We have streamlined the math requirement to include discrete math (3203) and linear algebra (3251) for CS undergraduates in all schools. The two courses include programming instruction in Python, which provides students with formal practice in the language prior to taking courses that assume such background. I am simultaneously developing the curriculum for and teaching 3251 with these goals in mind by interleaving traditional paper-and-pencil problems and larger programming "lab" assignments that investigate applications of linear algebra.

Carnegie Mellon University
16-384, Robot Kinematics and Dynamics — Fall 2013 - Summer 2018
Course developer and TA with Prof. Howie Choset. Produced a package of online course materials in the form of lecture videos and curriculum hosted on CMU's Open Learning Initiative (OLI). Short, navigable lecture videos are hosted on Panopto and interleaved with interactive practice problems. The problems, both quantitative and qualitative, are designed with targeted hints and feedback in order to accommodate individual student submissions. www.robotkinematics.org

16-742, Geometry of Locomotion — Fall 2015
TA for Prof. Howie Choset. Developed and maintained course materials; advised 10 separate course projects, comprised of original research, a presentation, and a paper writeup. Continued to work with several groups post-course to submit project results as conference publications.

Future Faculty Program, Eberly Center for Teaching Excellence — Fall 2015
Completed graduate student program focusing on teaching skills and strategies. Milestones included attendance of interactive seminars on a variety of pedagogical topics, two teaching feedback consultations following lecture observations, a course and syllabus design project, and an individualized project. The latter included development of materials for a flipped version of 16-384, as well as a report on the approach and experience of the implementation.

Research

Columbia University August 2018 - present

Currently pursuing several directions of research related to robot locomotion and motion planning. We are investigating ways to incorporate traditional planning and estimation tools, such as SLAM and RRTs, with robots that can be modeled using geometric mechanics. At the same time, we are also interested in learning such models without prior knowledge, through methods such as deep reinforcement learning.

Carnegie Mellon University September 2012 - August 2018

Advisor: Prof. Howie Choset. Expanded applicability of geometric methods for modeling and controlling locomoting systems, including wheeled, snake, and swimming robots. We applied intuitive motion planning techniques to systems that deviate from ideal conditions, such as those with passive joints or those that have to coordinate their degrees of freedom with environmental interactions. We also validated the newly established theory through experiments on simple but representative robots, such as a multi-link wheeled snake robot with compliant joints.

University of California, Berkeley February 2011 - February 2012

Advisor: Prof. Stuart Russell. Developed and tested a seismic inference system in accordance with the Comprehensive Test Ban Treaty Organization (CTBTO) to detect nuclear explosions and seismic events worldwide; first system of its kind to use Bayesian inference. Implemented algorithms and computation through parallel and distributed computing on Amazon EC2, with results of up to 30 times speedup.

Space Sciences Lab (UC Berkeley) June 2009 - August 2010

Advisor: Dr. James McFadden. Project: Mars Atmosphere and Volatile EvolutioN (MAVEN) mission. Assisted with PCB design, layout, and verification of modules in the Particles and Field package of a Mars orbiter designed to measure solar and magnetic properties of the atmosphere.

Journal Publications

T. Dear, B. Buchanan, R. Abrajan-Guerrero, S. D. Kelly, M. Travers, and H. Choset. "Locomotion of a multi-link non-holonomic snake robot with passive joints". The International Journal of Robotics Research, 2020. https://doi.org/10.1177/0278364919898503

R. L. Hatton, **T. Dear**, and H. Choset. "Kinematic Cartography and the Efficiency of Viscous Swimming". IEEE Transactions on Robotics 33(3), 523-535, 2017.

Conference Publications

J. Grover, J. Zimmer, **T. Dear**, M. Travers, H. Choset, and S. D. Kelly. "Geometric Motion Planning for a Three-Link Swimmer in a Three-Dimensional Low Reynolds-Number Regime". Proceedings of the 2018 American Control Conference. Milwaukee, WI, June 2018.

T. Dear, S. D. Kelly, M. Travers, and H. Choset. "Locomotion of a Multi-link Nonholonomic Snake Robot". Proceedings of the ASME 2017 Dynamic Systems and Control Conference. Tysons Corner, VA, October 2017.

T. Dear, S. D. Kelly, and H. Choset. "Control and Locomotion of Hydrodynamically Coupled Rigid Spheres". Proceedings of the 2017 American Control Conference. Seattle, WA, May 2017.

T. Dear, S. D. Kelly, M. Travers, and H. Choset. "Locomotive Analysis of a Single-Input Three-Link Snake Robot". Proceedings of the 55th IEE Conference on Decision and Control. Las Vegas, NV, December 2016.

H. Salman, **T. Dear**, S. Babikian, E. Shammas, and H. Choset. "A Physical Parameter-Based Skidding Model for the Snakeboard". Proceedings of the 55th IEE Conference on Decision and Control. Las Vegas, NV, December 2016.

A. Agrawal, H. Zaini, **T. Dear**, and H. Choset. "Experimental Gait Analysis of Waveboard Locomotion". Proceedings of the ASME 2016 Dynamic Systems and Control Conference. Minneapolis, MN, October 2016.

T. Dear, S. D. Kelly, and H. Choset. "Variations on the Role of Principal Connections in Robotic Locomotion". Proceedings of the ASME 2016 Dynamic Systems and Control Conference. Minneapolis, MN, October 2016.

R. Shu, A. Siravuru, A. Rai, **T. Dear**, K. Sreenath, and H. Choset. "Optimal Control for Geometric Motion Planning of a Robot Diver". Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems. Daejon, South Korea, October 2016.

T. Dear, S. D. Kelly, M. Travers, and H. Choset. "The Three-Link Nonholonomic Snake as a Hybrid Kinodynamic System". Proceedings of the American Control Conference. Boston, MA, July 2016.

T. Dear, S. D. Kelly, M. Travers, and H. Choset. "Motion Planning and Differential Flatness of Mechanical Systems on Principal Bundles". Proceedings of the ASME 2015 Dynamic Systems and Control Conference. Columbus, OH, October 2015.

J. Dai, M. Travers, **T. Dear**, C. Gong, H. C. Astley, D. I. Goldman, and H. Choset. "Robot-Inspired Biology: The Compound-Wave Control Template". Proceedings of the IEEE International Conference on Robotics and Automation. Seattle, WA, May 2015.

T. Dear, S. D. Kelly, M. Travers, and H. Choset. "Snakeboard Motion Planning with Viscous Friction and Skidding". Proceedings of the IEEE International Conference on Robotics and Automation. Seattle, WA, May 2015.

T. Dear, S. D. Kelly, M. Travers, and H. Choset. "Dissipation-Induced Self-Recovery in Systems on Principal Bundles". Proceedings of the ASME 2014 Dynamic Systems and Control Conference. San Antonio, TX, October 2014.

T. Dear, R. L. Hatton, and H. Choset. "Nonlinear Dimensionality Reduction for Kinematic Cartography with an Application toward Robot Locomotion". Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems. Chicago, IL, September 2014.

T. Dear, R. L. Hatton, M. Travers, and H. Choset. "Snakeboard Motion Planning with Local Trajectory Information". Proceedings of the ASME 2013 Dynamic Systems and Control Conference. Stanford, CA, October 2013. Nominated for Best Student Paper.

T. Dear, S. D. Kelly, M. Travers, and H. Choset. "Mechanics and Control of a Terrestrial Vehicle Exploiting a Nonholonomic Constraint for Fishlike Locomotion". Proceedings of the ASME 2013 Dynamic Systems and Control Conference. Stanford, CA, October 2013.

Presentations

T. Dear, S. D. Kelly, and H. Choset. "Locomotion and Coordination of Underactuated Bodies in An Ideal Fluid". SIAM Annual Meeting, Pittsburgh, PA, July 2017.

T. Dear, S. D. Kelly, and H. Choset. "Compliant Joints and Locomotion of Wheeled Robotic Systems". SIAM Conference on Applications of Dynamic Systems, Snowbird, UT, May 2017.

J. A. Adams, H. Choset, and **T. Dear**. "Biologically Inspired Human Supervision and Control of Agent Teams". ONR Science of Autonomy Meeting, Arlington, VA, August 2014.

H. Choset, **T. Dear**, and R. L. Hatton. "Mapping Effort: Cartographically Inspired Methods for Representing the Energetic Cost of Locomotion". SIAM Annual Meeting, Chicago, IL, July 2014.

Fellowships

National Defense Science and Engineering Graduate (NDSEG) Fellowship	2014 - 2017
Jim & Donna Gray Endowment Award (UC Berkeley)	2011 - 2012

Service

Director of the CS@CU Bridge to MS Program in Computer Science, 2019 - present

Advisor for Columbia undergraduate student groups, including Application Development Initiative (ADI) Labs and Columbia Space Robotics, as well as undergraduate and MS students on independent research projects

Reviewer for refereed journals, including IEEE T-ASE and NODY, and refereed conferences, including ICRA, IROS, CDC, ACC, DSCC, among others.

Mentor for undergraduate students (including international) participating in the Robotics Institute Summer Scholars (RISS) program to perform research in the laboratory.

Organized tour groups of Robotics Institute labs, including for K-12 students of the Big Brothers Big Sisters of Greater Pittsburgh program.

Language interpreter for international student finalists in the Intel International Science and Engineering Fair (ISEF), Pittsburgh, PA, May 2015.

IT lead and staff member for Pioneers in Engineering at UC Berkeley, 2011-2012. Organized robotics competitions and other STEM mentoring opportunities for local high school students.

Professional Affiliations

Tau Beta Pi, Initiated CA-Alpha Chapter, Fall 2009
IEEE-Eta Kappa Nu, Initiated CA-Alpha Chapter, Spring 2009

Skills

Programming/Tools: Python, Java, C, Mathematica, MatLab, LaTeX
Languages: English, Mandarin, Cantonese, conversational Spanish