

# Tony Dear

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<b>Employment</b>	<b>Columbia University, Department of Computer Science</b> Lecturer in the Discipline of Computer Science Associate in the Discipline of Computer Science	January 2019 - present July 2018 - December 2018
<b>Education</b>	<b>Carnegie Mellon University, The Robotics Institute</b> Doctor of Philosophy, Robotics - Thesis: Extensions of the Principal Fiber Bundle Model for Locomoting Robots Master of Science, Robotics	August 2018 May 2015
	<b>University of California, Berkeley</b> Bachelor of Science, Electrical Engineering and Computer Science (EECS)	May 2012
<b>Teaching</b>	<b>Columbia University</b> COMS 4701, Artificial Intelligence COMS 4733, Computational Aspects of Robotics COMS 3203, Discrete Mathematics COMS 4701, Artificial Intelligence COMS 3251, Computational Linear Algebra CSOR 4200, Data-Driven Decision Modeling COMS 3203, Discrete Mathematics COMS 4701, Artificial Intelligence COMS 4701, Artificial Intelligence COMS 3251, Computational Linear Algebra COMS 4733, Computational Aspects of Robotics COMS 3251, Computational Linear Algebra COMS 4701, Artificial Intelligence COMS 4733, Computational Aspects of Robotics COMS 3251, Computational Linear Algebra COMS 4701, Artificial Intelligence COMS 3251, Computational Linear Algebra COMS 4701, Artificial Intelligence COMS 4733, Computational Aspects of Robotics COMS 3203, Discrete Mathematics COMS 4701, Artificial Intelligence	Spring 2024 Fall 2023 Spring 2023 Fall 2022 Summer 2022 Spring 2022 Fall 2021 Summer 2021 Spring 2021 Fall 2020 Spring 2020 Fall 2019 Spring 2019 Fall 2018
	<b>Coursera</b> Decision Making and Reinforcement Learning (instructor)	Spring 2023 to present
	<b>Carnegie Mellon University</b> 16-384, Robot Kinematics and Dynamics (online course developer)	Fall 2013 - Summer 2018
<b>Leadership</b>	Columbia Online Artificial Intelligence Executive Education Program Director CS@CU MS Bridge Program Director	
<b>Grants</b>	<b>Collaboratory Fellows Fund</b> Received \$100,000 with Prof. Yi Zhang (Columbia IEOR) for the development of an interdisciplinary, data-driven decision-making course. The course covers ideas and examples from artificial intelligence and business analytics to give students a solid foundation in decision theory, dynamic programming, reinforcement learning, and model estimation. Applications include practice with real data sets for business analytics and a capstone project.	Aug 2020 - Aug 2023
	<b>Provost's Teaching and Learning Grant for MOOCs</b> Received support and funding to develop a massive open online course (MOOC) on the subject of <i>Decision Making and Reinforcement Learning</i> with Columbia Video Network (CVN). This course teaches sequential decision making and reinforcement learning with an emphasis on theory and algorithms. Assessments include self-check questions, quizzes, and coding implementations.	June 2021 - Aug 2022

## Research

### Columbia University

August 2018 - present

Collaborators: Prof. Scott David Kelly (University of North Carolina, Charlotte). Geometric mechanics, deep reinforcement learning (RL), and robot locomotion. We are interested in applying ideas from mechanics to simplify the modeling and application of RL to physical robots and systems. Our ultimate goal is to develop algorithms and systems that can effectively learn in real time and in real life.

### 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.

## Journal Publications

**T. Dear**, B. Buchanan, R. Abajian-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* 39(5), 598-616, 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

A. Pujari, H. Lin, W. L. Neal, **T. Dear**, and S. D. Kelly. “Detecting and Exploiting Symmetry to Accelerate Reinforcement Learning”. 2023 Proceedings of the Conference on Control and its Applications. July 2023.

J. Shi, **T. Dear**, and S. D. Kelly. “Deep Reinforcement Learning for Snake Robot Locomotion”. Proceedings of the 21st IFAC World Congress (virtual), July 2020.

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 IEEE Conference on Decision and Control. Las Vegas, NV, December 2016.

H. Salman, **T. Dear**, S. Babikian, E. Shammass, and H. Choset. “A Physical Parameter-Based Skidding Model for the Snakeboard”. Proceedings of the 55th IEEE 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. Daejeon, 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.

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

**Service** Helped organize the inaugural Columbia Undergraduate Computer and Data Science Research Fair in Fall 2022

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 MDPI Robotics, 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.

<b>Professional Affiliations</b>	<b>Tau Beta Pi</b> , Initiated CA-Alpha Chapter, Fall 2009
	<b>IEEE-Eta Kappa Nu</b> , Initiated CA-Alpha Chapter, Spring 2009