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EDUCATION

California Institute of Technology <i>Ph.D. in Control and Dynamical Systems</i>	Pasadena, CA 2002
University of Arizona <i>B.S. in Mathematics</i>	Tucson, AZ 1997

EMPLOYMENT

Northwestern University <i>Professor</i>	2009-present
<i>Associate Professor</i>	2017 - present
<i>Assistant Professor</i>	2009-2011
University of Colorado at Boulder <i>Assistant Professor</i>	2004-2008
Aerospace Corporation <i>Senior Technical Staff</i>	2003-2004
Northwestern University <i>Postdoctoral Scholar</i>	2002-2003

PUBLICATIONS¹ AND SOFTWARE

Journal Articles

- [61] J. F. Yang, A. T. Liu, T. Berrueta, G. Zhang, A. Brooks, V. B. Koman, S. Yang, X. Gong, T. D. Murphey, and M. S. Strano, "Memristor circuits for colloidal robotics: Temporal access to memory, sensing, and actuation," *Advanced Intelligent Systems*, Conditionally Accepted.
- [60] W. Jin, T. D. Murphey, D. Kulic, N. Ezer, and S. Mou, "Learning from sparse demonstrations," *IEEE Transactions on Robotics*, Conditionally Accepted.
- [59] N. O. Zweifel, N. E. Bush, I. Abraham, T. D. Murphey, and M. J. Hartmann, "WHISKiT Physics: simulating the dynamics of active sensing behavior in the rat," *Proceedings of the National Academy of Sciences*, 2021.
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¹Reprints of many of these can be found at <http://nrx.northwestern.edu/people/todd-murphey>

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- [53] A. Pervan and T. D. Murphey, “Algorithmic design for embodied intelligence in synthetic cells,” *IEEE Transactions on Automation Science and Engineering*, vol. 18, no. 3, pp. 864–875, 2021.
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- [51] C. Chen, T. D. Murphey, and M. A. MacIver, “Tuning movement for sensing in an uncertain world,” *eLife*, vol. 9, p. e52371, 2020.
- [50] K. Fitzsimons, O. Kalinowska, J. Dewald, and T. Murphey, “Task-based hybrid shared control for training through forceful interaction,” *International Journal of Robotics Research*, vol. 39, no. 9, pp. 1138–1154, 2020.
- [49] T. Fan, H. Wang, M. Rubenstein, and T. D. Murphey, “CPL-SLAM: Efficient and certifiably correct planar graph-based SLAM using the complex number representation,” *IEEE Transactions on Robotics*, vol. 36, no. 6, pp. 1719–1737, 2020.
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- [43] T. Berrueta, A. Pervan, K. Fitzsimons, and T. Murphey, “Dynamical system segmentation for information measures in motion,” *IEEE Robotics and Automation Letters*, vol. 4, no. 1, pp. 169–176, 2019.
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Peer Reviewed Conference Papers

- [140] T. Fan, K. V. Alwala, D. Xiang, W. Xu, , T. Murphey, and M. Mukadam, “Revitalizing optimization for 3d human pose and shape estimation: A sparse constrained formulation,” in *International Conference on Computer Vision (ICCV)*, 2021.
- [139] M. Rahme, I. Abraham, M. Elwin, and T. Murphey, “Linear policies are sufficient to enable low-cost quadrupedal robots to traverse rough terrain,” in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, 2021.
- [138] M. Sun, F. Baldini, P. Trautman, and T. D. Murphey, “Move beyond trajectories: Distribution space coupling for crowd navigation,” in *Robotics: Science and Systems (RSS)*, 2021.
- [137] A. Kalinowska*, A. Prabhakar*, K. Fitzsimons, and T. D. Murphey, “Ergodic LfD: Learning from what to do and what not to do,” *IEEE Int. Conf. on Robotics and Automation (ICRA)*, 2021.
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- [135] G. Mamakoukas, O. Xherija, and T. D. Murphey, “Learning memory-efficient stable linear dynamical systems for prediction and control,” in *Conference on Neural Information Processing Systems (NeurIPS)*, 2020.
- [134] T. Fan and T. D. Murphey, “Majorization minimization methods to distributed pose graph optimization with convergence guarantees,” in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 5058 – 5065, 2020.
- [133] A. Pervan and T. D. Murphey, “Bayesian particles on cyclic graphs,” in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 3364 – 3370, 2020.
- [132] A. T. Liu, J. F. Yang, L. N. LeMar, G. Zhang, A. Pervan, T. D. Murphey, and M. S. Strano, “Autoperforation of two-dimensional materials to generate colloidal state machines capable of locomotion,” in *Faraday Discussions*, Royal Society of Chemistry, 2020.

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Editor Reviewed Book Chapters

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- [7] A. Pervan and T. D. Murphey, *Robotic Systems and Autonomous Platforms: Advances in Materials and Manufacturing*, ch. Algorithmic Materials: Embedding Computation within Material Properties for Autonomy. Elsevier, 2018. Eds. M. Strano and S. Walsh.
- [6] A. Mavrommati, A. Ansari, and T. D. Murphey, *Trends in Control and Decision-Making for Human-Robot Collaboration Systems*, ch. Assistive Optimal Control-on-Request with Application in Standing Balance Therapy and Reinforcement, pp. 131–156. Springer, 2017. Eds. Y. Wang and F. Zhang.
- [5] J. Schultz, E. Johnson, and T. D. Murphey, *Differential-Geometric Methods in Computational Multibody System Dynamics*, ch. Trajectory Optimization in Discrete Mechanics. CISM, 2015. Eds. Z. Terze and A. Mueller.
- [4] E. Jochum, J. Schultz, E. Johnson, and T. D. Murphey, *Art and Control*, ch. Robotic Puppets and the Engineering of Autonomous Theater. Springer-Verlag, 2013. Eds. A. LaViers and M. Egerstedt.
- [3] E. Jochum and T. D. Murphey, *New Scholarship on Puppetry and Performing Objects*, ch. Programming Play: Puppets, Robots, and Engineering. Springer-Verlag, 2012. Eds. D. Posner, J. Bell, and C. Orenstein.
- [2] T. D. Murphey, *Multi-point Interaction with Real and Virtual Objects*, ch. On Observing Contact States in Overconstrained Manipulation, pp. 151–164. Springer-Verlag, 2005. Eds. F. Barbagli, D. Prattichizzo, and K. Salisbury.
- [1] K. M. Lynch and T. D. Murphey, *Control Problems in Robotics and Automation*, ch. Control of Nonprehensile Manipulation, pp. 39–57. Springer-Verlag, 2003. Eds. A. Bicchi and H. Christensen.

FUNDING

- Todd Murphey (PI). Office of Naval Research: *Active Learning Sensor-Object Models in Highly Variable Environments*, \$380,000, 06/2021-05/2024.

- Dana Randall (PI), Jeremy England, Daniel Goldman, Todd Murphey, Andrea Richi, Michael Strano, Army Research Office: *MURI: Formal Foundations of Algorithmic Matter and Emergent Computation*, \$6,000,000, 07/2019-06/2026.
- Todd D. Murphey (PI, 50%), Brenna Argall (Co-PI, 50%). National Science Foundation–Cyber-Physical Systems: *CPS: Medium: Information based Control of Cyber-Physical Systems operating in uncertain environments*. \$896,000, 09/2018-08/2021.
- Todd Murphey (PI, 55%), Anant Mishra (Co-I, Siemens, 45%). DARPA-TTO: *Complete Fog-of-Force Control Using Swarms*, \$450,000, 03/2020-03/2021.
- Todd Murphey (PI, 55%), Anant Mishra (Co-I, Siemens, 45%). DARPA-TTO: *Interaction & Perception: Multi-Source Spectral Framework for Human-Swarm Collaboration*, \$450,000, 05/2019-01/2020.
- Todd D. Murphey (PI) and Xiaobo Tan. National Science Foundation–Information and Intelligent Systems: *RI: Small: Collaborative Research: Information-driven Autonomous Exploration in Uncertain Underwater Environments*. \$500,000, 09/2017-08/2021.
- Todd D. Murphey (PI). National Science Foundation–Civil and Mechanical Systems: *Stability and Optimality Properties of Sequential Action Control for Nonlinear and Hybrid Systems*. \$375,000, 08/2017-07/2021.
- Todd D. Murphey (PI). National Science Foundation–National Robotics Initiative: *Task-Based Assistance for Software-Enabled Biomedical Devices*. \$430,000, 09/2021-08/2021.
- Mitra Hartmann (PI), Todd Murphey, John Rudnicki, Sara Solla. National Institutes of Health: *Coding properties of Vibrissal-Responsive Trigeminal Ganglion Neurons*. \$1,800,000, 07/2015-06/2021.
- Todd D. Murphey (PI), Eva Kanso, Yasamin Mostofi, Evangelos Theodorou. Army Research Office: *Study Proposal: Transforming Terrestrial Agility At All Scales*. \$60,000.
- Todd D. Murphey. Army Research Office: *Ergodic Control for Optimal Information Acquisition*. \$360,000.
- Todd D. Murphey (PI, 50%), J. Edward Colgate (Co-PI, 50%). National Science Foundation–National Robotics Initiative: *Autonomous Synthesis of Haptic Languages*. \$585,000.
- Malcolm A. MacIver (PI, 40%), Michael Peshkin (Co-PI, 30%), Todd D. Murphey (Co-PI, 30%). Office of Naval Research: *A Bio-Inspired Underwater Robot for Station Keeping with Omnidirectional Disturbances*. \$1,000,000.
- Todd D. Murphey (PI, 35%), Brenna Argall (Co-PI, 35%), and Magnus Egerstedt (Co-PI, 30%). National Science Foundation–Cyber-Physical Systems: *Collaborative Research: Mutually stabilized correction in physical demonstration*. \$1,000,000.
- Todd D. Murphey (PI, 50%) and Melvin Leok (Co-PI, 50%). National Science Foundation–Civil and Mechanical Systems: *Ergodic Trajectories in Discrete Mechanics*. \$430,000.
- Todd D. Murphey. National Institute of Health–R24: *Exoskeleton Evaluation for Hemiplegia Therapy*. \$50,000.
- Todd D. Murphey. National Science Foundation–Civil and Mechanical Systems: *Physical Design and Feedback Control of Hybrid Mechanical Systems*. \$350,000.
- Kevin Lynch (PI), Brenna Argall, J. Edward Colgate, Todd D. Murphey, and Ying Wu (Co-PIs). National Science Foundation: *MRI: Equipment Development: Bimanual Robotic Manipulation and Sensory Workspace*. \$400,000.

- Todd D. Murphey (PI, 50%) and Kevin Lynch (Co-PI, 50%). National Science Foundation–Robust Intelligence: *Hierarchical Planning, Estimation, and Control for Hybrid Mechanical Systems*. \$450,000.
- W. Murray (PI, 50%), T. D. Murphey (Co-PI, 50%), National Institutes of Health: *Prosthesis Control by Forward Simulation of the Intact Biomedical System*. (Northwestern portion) \$550,000.
- Todd D. Murphey (Consultant to Kinea, 10%) DARPA: *SBIR Phase I: Tactile Detection Robotic Hand System*. Murphey’s portion is \$10,000
- Todd D. Murphey (PI, 50%) and Magnus Egerstedt (Co-PI, 50%). National Science Foundation–CreativeIT: *Collaborative Research: Major: Puppet Choreography and Automated Marionettes*. \$800,000.
- Magnus Egerstedt (Co-PI, 50%) and Todd D. Murphey (PI, 50%). National Science Foundation–Software for Real-World Systems: *Collaborative Proposal: Abstraction-Based Motion Programs for Complex, Interconnected Systems*. \$450,000.
- Lucy Y. Pao (PI, 50%) and Todd D. Murphey (Co-PI, 50%). Air Force Research Laboratory: *Data Association and Sensor Management Algorithms for Tracking Applications*. \$250,000.
- Todd D. Murphey. National Science Foundation–Advanced Learning Technology: *Assessment of Controls Laboratory*. \$24,591.
- Todd D. Murphey. National Science Foundation–Civil and Mechanical Systems: *CAREER: Planning and Control for Overconstrained Mechanisms*. \$400,000.

TEACHING

Teaching Highlights

- Northwestern University Cole-Higgins Award for Excellence in Teaching (2015)
- Northwestern University Charles Deering McCormick Professor of Teaching Excellence (2014)
- Northwestern University Cole-Higgins Award for Excellence in Advising (2013)
- Participant in National Academy of Engineering Frontiers of Engineering Education Symposium (2009)

Coursera

2013-2014, www.coursera.org

- Created and taught course: *Everything Is The Same: Modeling Engineered Systems*; available at <http://www.coursera.org/course/modelsystems>.

International Centre for Mechanical Sciences (CISM)

2013, Udine, Italy

- Lecturer for *Differential-Geometric Methods in Computational Multibody Systems*. (My portion of the lectures focused on engineering applications of structured integration and optimal control in the context of structured integration.)

Northwestern University

2009-present, Evanston, IL

- Created and taught course: *Theory of Machines: Dynamics ME 314* (2009-present)
- Created and taught course: *Active Learning in Robotics, EA-3* (2018-present)
- Taught course: *Systems Dynamics, EA-3* (2009-2019)
- Created and taught course: *Introduction to Optimal Control, ME 454* (2009-2017)
- Created and taught course: *Stochastic Systems in Robotics* (Spring, 2011)

PROFESSIONAL ACTIVITIES

Service Highlights

- Member: Air Force Scientific Advisory Board (2019-2021)
 - Chair for FY21 AFRL Autonomy and Artificial Intelligence review
 - Vice-Chair for FY20 AFRL-RH review
 - Co-Vice-Chair for FY20 study *21st Century Training and Education Technologies*
- IEEE service
 - Member: IEEE RAS Education Committee (2021-present)
 - Member: IEEE RAS Section Chapter of the Year Award committee (2021)
 - Member: IEEE RAS ad hoc Committee to Explore Synergies in Automation and Robotics (CESAR) (2021-present)
 - Senior Editor for *IEEE Transactions on Robotics* (2014-2018)
 - Associate Editor for *IEEE Transactions on Automation Science and Engineering* (2010-2014)
 - Associate Editor for *IEEE Transactions on Robotics* (2008-2012)
- Member: National Academies / National Research Council Committee on Counter-Unmanned Aircraft System (CUAS) Capability for Battalion-and-Below Operations (2016-2018)
- Presenter for Coalition for the National Science Foundation (CNSF) Capitol Hill Exhibition (2017)
- Member: Northwestern University Task Force on the Undergraduate Academic Experience (2015)
- Defense Science Study Group (DSSG)—one of fifteen scientists/engineers nationwide selected to participate in the DARPA/IDA DSSG for the two year program in 2014-2015
- Invited speaker on Massive Open Online Courses (MOOCs) in universities for National Academy of Engineering Frontiers of Engineering Education Symposium in 2013

University Service

- Segal Fellow
- Member: RAC Retail Robotics Advisory Board
- Chair: Northwestern University Faculty Distance Learning Workgroup (2015 - 2018)
- Director and Co-Founder of Master of Science in Robotics Program (2013-present)
- Member: Northwestern University Segal Design Institute Research Council
- Member: Feinberg School of Medicine DPT/PhD T32 Steering Committee
- Participant in Kellogg School of Management Executive Education 2013 Program *Management Skills for Innovative University Leaders*.

External Service

- Associate Editor for *Robotica* (2007-2011)
- Conference Organization
 - Local Arrangements Chair for the 2014 *IEEE International Conference on Intelligent Robots and Systems (IROS)*
 - Publication Chair for the 2010 *IEEE International Conference on Automation Science and Engineering (CASE)*
 - Co-Organizer (with Greg Chirikjian, Howie Choset, and Marco Morales) of 2008 *Workshop on the Algorithmic Foundations of Robotics (WAFR)*
- Workshop Organization

- Co-Organizer (with Aleksandra Kalinowska, Deepak Gopinath, Mahdieh Nejati, Katarina Popovic, and Brenna Argall) of 2020 RSS workshop: *AI and Its Alternatives in Assistive and Collaborative Robotics*
- Co-Organizer (with Aleksandra Kalinowska, Alexander Broad, Brenna Argall, and Adam Zoss) of 2019 RSS workshop: *AI and Its Alternatives for Shared Autonomy in Assistive and Collaborative Robotics*.
- Member of advisory committee for 2017 *Midwest Workshop on Controls and Game Theory*
- Co-Organizer (with Ken Goldberg, Vijay Kumar, and Frank van der Stappen) of 2009 RSS *Workshop on Algorithmic Automation*
- Co-Chair (with Ken Goldberg, Jean-Paul Laumond, and Vijay Kumar) of CASE 2008 workshop: *Workshop on Algorithmic Automation*
- Co-Organizer (with Vijay Kumar) of ICRA 2008 workshop: *Contact Models for Manipulation and Locomotion*
- Co-Organizer (with Francisco Valero-Cuevas and Yoky Matsuoka) of ICRA 2008 workshop: *Is human-like dextrous manipulation within our robotic grasp?*
- Participant in the National Science Foundation and Computing Community Consortium (CCC) *Workshop on Robotics in Manufacturing and Automation*
- Conference Program committees
 - 2020 *Int. Conference for Biomedical Robotics and Biomechanics*: Editor
 - 2020 *Workshop on the Algorithmic Foundations of Robotics*
 - 2020 *Robotics: Science and Systems*
 - 2017 *Robotics: Science and Systems*: Area Chair
 - 2016 *Robotics: Science and Systems*: Area Chair
 - 2016 *Workshop on the Algorithmic Foundations of Robotics*
 - 2015 *IFAC Conference on Analysis and Design of Hybrid Systems*
 - 2012 *Workshop on the Algorithmic Foundations of Robotics*
 - 2009 *Robotics: Science and Systems*
 - 2008 *Hybrid Systems: Computation and Control*
 - 2008 *Robotics: Science and Systems*
 - 2008 *IEEE International Conference on Robotics and Automation*
 - 2008 *IEEE Conference on Automation Science and Engineering*
 - 2007 *IEEE/RSJ International Conference on Intelligent Robots and Systems*
 - 2007 *International Conference on Advanced Robotics*
 - 2007 *International Conference on Networked Robots*
 - 2007 *IEEE International Conference on Robotics and Automation*
 - 2006 *IEEE/RSJ International Conference on Intelligent Robots and Systems*
 - 2006 *IEEE International Conference on Robotics and Automation*
 - 2005 *Robotics: Science and Systems*
 - 2005 *IEEE/RSJ International Conference on Intelligent Robots and Systems*
 - 2001 *IEEE/RSJ International Conference on Intelligent Robots and Systems*
- Other Conference Committees (primarily IEEE conference committees for best paper awards over the years)
- National Science Foundation Panelist for programs ranging from control, education, robotics, cyberphysical systems, and others 2006-2017
- Member, IEEE, ASME, and AAAS

- Postdocs
 - Dr. Gerardo de la Torre, now at Northrop Grumman
 - Dr. Kathrin Flaßkamp, was a Postdoctoral Researcher at the University of Bremen, now a professor at Saarbrücken University
 - Dr. David Pekarek, now a senior scientist at Data Tactics
 - Dr. Benjamin Tovar, now a Research Software Engineer at Notre Dame
- Ph.D. Students
 - Brian Shucker (CS at University of Colorado), 2006 Ph.D. thesis: *Control of Distributed Robotic Macrosensors*, was at MIT Lincoln Laboratories, now at TALOS robotics.
 - Matt Travers, 2011 Ph.D. thesis: *Impulse Smoothing for Data Association*, now a Systems Scientist at Carnegie Mellon University.
 - Elliot Johnson, 2012 Ph.D. thesis: *Trajectory Optimization and Regulation for Constrained Discrete Mechanical Systems*, now at the Southwester Research Institute.
 - Elizabeth Jochum (Performance Studies at the University of Colorado), 2013 Ph.D. thesis: *Deux Ex Machina: Towards an Aesthetics of Autonomous and Semi-Autonomous Machines*, now an Associate Professor at Aalborg University.
 - Tim Caldwell, 2013 Ph.D. thesis: *Iterative Methods in Switched System Optimal Control*, postdoc at the University of Colorado at Boulder 2013-2015, Zoox 2015-present.
 - Vlad Seghete, 2014 Ph.D. thesis: *Numerical Methods for Simulation and Control of Impacting Mechanical Systems*. IDEO after DataScope Analytics 2014-present.
 - Jarvis Schultz, 2014 Ph.D. thesis: *Discrete Mechanics Computation for Real-Time Embedded Control*, Northwestern University 2014-2019, AZEVTEC 2019-present.
 - Andrew Wilson 2015 Ph.D. thesis: *Information-based Trajectory Optimization for Active Estimation in Mechanical Systems*, Intuitive Surgical 2015-present.
 - Alex Ansari, 2015 Ph.D. thesis: *Sequential Action Control: Closed-Form Optimal Feedback for Nonlinear and Hybrid Systems*. Postdoc at Carnegie Mellon University 2015-2017, Uber ATG 2017-2021, Cruise 2021-present.
 - Lauren Miller, 2015 Ph.D. thesis: *Optimal Ergodic Control for Active Search and Information Acquisition*. Postdoc at UC Berkeley 2015-2016. Now at Boston Dynamics, after Marble, after HERE.
 - Anastasia Mavrommati, 2017 Ph.D. thesis: *Real-Time Algorithms for Symbol-Based Automation*. Schlumberger-Doll Research 2017-2020; Mathworks 2020-present.
 - Emmanouil Tzorakoleftherakis, 2017 Ph.D. thesis: *Stable Control Synthesis for Human-in-the-Loop Systems*. Mathworks 2017-present.
 - Ian Abraham, 2020 Ph.D. thesis: *Optimal Experimental Learning and Infinite Linear Embeddings*. Belytschko Outstanding Research Award in Mechanical Engineering, Northwestern University (2021); Postdoctoral fellow at Carnegie Mellon University (2020-2021); Assistant Professor of Mechanical Engineering at Yale University (2022-present).

- Ahalya Prabhakar, 2020 Ph.D. thesis: *Communicating and Modeling Information through Motion*. Postdoctoral fellow at EPFL, Switzerland, 2020-present.
- Kathleen Fitzsimons, 2020 Ph.D. thesis: *Motion as an Information Signal in Physical Human-Robot Interaction*. Assistant Professor, Pennsylvania State University 2020-present.
- Rebecca Abbott (ME/Physical Therapy at Northwestern University, co-advised with Prof. James Elliot.) 2021 Ph.D. thesis: *Active Model-Based Inference for Muscle Strength Diagnostics*.
- Giorgos Mamakoukas, 2021 Ph.D. thesis: *Real-Time Safe Control for Model-Based and Data-Driven Robotics*. Motional 2021-present.
- Ana Pervan, 2021 Ph.D. thesis: *Co-Design of Bodies and Strategies*. Wayve 2021-present.
- Taosha Fan
- Aleksandra (Ola) Kalinowska
- Thomas Berrueta
- Millicent Schlafly
- Annalisa Taylor
- Katarina Popovic
- Kyra Rudy
- Allison Pinosky
- Muchen Sun
- Jake Ketchum
- Joel Meyer
- Jonathan Bosnich
- Undergraduate and MS Students
 - Kirk Nichols (ECE at University of Colorado)
 - Corrina Gibson (Aerospace at University of Colorado)
 - Matanya Horowitz (ECE at University of Colorado)
 - Yoke Peng Leong
 - Katy Powers
 - Henry Hung
 - Camaria Lehman (BME at Northwestern University)
 - Elliot Hevel
 - Scott Beck
 - Vismaya Walawalker
 - Samuel Donis
 - Alex Samland
 - Christopher Kim
 - Andrew Kim

- Won Hee Jenny Kim
- Karalyn Baird
- Muchen Sun
- Wu Di
- Maurice Rahme (MSR at Northwestern University)
- Joshua Cohen (MSR at Northwestern University)
- Visiting Students
 - Amy LaViers (Georgia Institute of Technology, USA)
 - Rowland O’Flaherty (Georgia Institute of Technology, USA)
 - Kathrin Flasskamp (Univ. of Paderborn, Germany)
 - Peter Kingston (Georgia Institute of Technology, USA)

EXTERNAL ACTIVITIES

- Consultant for HDT for SOCOM TALOS exoskeleton project (2016-2017)
- Member of Nousot Scientific Advisory Board (2017-2021)