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EDUCATION

California Institute of Technology Pasadena, CA
Ph.D. in Control and Dynamical Systems 2002

University of Arizona Tucson, AZ
B.S. in Mathematics 1997

EMPLOYMENT

Northwestern University 2009-present
Professor 2017 - present
Associate Professor 2011-2017
Assistant Professor 2009-2011

University of Colorado at Boulder 2004-2008
Assistant Professor

Aerospace Corporation 2003-2004
Senior Technical Staff

Northwestern University 2002-2003
Postdoctoral Scholar

PUBLICATIONS[1] AND SOFTWARE

Journal Articles

[69] J. F. Yang, T. A. Berrueta, A. M. Brooks, A. T. Liu, G. Zhang, D. Gonzalez-Medrano, S. Yang, V. B. Koman, P. Chvykov, L. N. LeMar, M. Z. Miskin, T. D. Murphey, and M. S. Strano, "Emergent microrobotic oscillators via asymmetry-induced order," *Nature Communications*, Accepted.

[68] A. Kalinowska, P. M. Pilarski, and T. D. Murphey, "Embodied communication: How robots and people communicate through physical interaction," *Annual Review of Control, Robotics, and Autonomous Systems*, Accepted.

[67] G. Mamakoukas, I. Abraham, and T. D. Murphey, "Learning stable models for prediction and control," *IEEE Transactions on Robotics*, Conditionally Accepted.

[66] T. Fan and T. D. Murphey, "Majorization minimization methods for distributed pose graph optimization," *IEEE Transactions on Robotics*, Conditionally Accepted.

[65] W. Jin, T. D. Murphey, D. Kulic, N. Ezer, and S. Mou, "Learning from sparse demonstrations," *IEEE Transactions on Robotics*, 2022.

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[1]Reprints of many of these can be found at *murpheylab.github.io*

[64] W. Jin, T. D. Murphey, Z. Lu, and S. Mou, "Learning from human directional corrections," *IEEE Transactions on Robotics*, 2022.

[63] A. Prabhakar and T. D. Murphey, "Mechanical intelligence for learning embodied sensor-object relationships," *Nature Communications*, vol. 13, p. 4108, 2022.

[62] A. Pinosky, I. Abraham, A. Broad, B. Argall, and T. D. Murphey, "Hybrid control for combining model-based and model-free reinforcement learning," *International Journal of Robotics Research*, 2022.

[61] K. Fitzsimons and T. D. Murphey, "Ergodic shared control: Closing the loop on pHRI based on information encoded in motion," *ACM Transactions on Human-Robot Interaction*, vol. 11, no. 4, 2022.

[60] 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*, vol. 4, p. 2100205, 2022.

[59] N. O. Zweifel, N. E. Bush, I. Abraham, T. D. Murphey, and M. J. Hartmann, "A dynamical model for generating synthetic data to quantify active tactile sensing behavior in the rat," *Proceedings of the National Academy of Sciences*, vol. 118, no. 27, p. e2011905118, 2021.

[58] H. Yasuda, P. R. Buskohl, A. Gillman, T. D. Murphey, S. Stepney, R. A. Vaia, and J. R. Raney, "Mechanical computing," *Nature*, vol. 598, pp. 39–48, 2021.

[57] A. Taylor, T. Berrueta, and T. D. Murphey, "Active learning in robotics: A review of control principles," *Mechatronics*, vol. 77, p. 102576, 2021.

[56] G. Mamakoukas, M. Castano, X. Tan, and T. D. Murphey, "Derivative-based Koopman operators for real-time control of robotic systems," *IEEE Transactions on Robotics*, vol. 37, no. 6, pp. 2173–2192, 2021.

[55] H. Kress-Gazit, K. Eder, G. Hoffman, H. Admoni, B. Argall, R. Ehlers, C. Heckman, N. Jansen, R. Knepper, J. Kretinsky, S. Levy-Tzedek, J. Li, T. Murphey, L. Riek, and D. Sadigh, "Formalizing and guaranteeing human-robot interaction," *Communications of the ACM*, vol. 64, no. 9, pp. 78–84, 2021.

[54] P. Chvykov, T. Berrueta, A. Vardhan, W. Savoie, A. Samland, T. D. Murphey, K. Wiesenfeld, D. I. Goldman, and J. L. England, "Predictive principle for self-organization in active collectives," *Science*, vol. 371, no. 6524, pp. 90–95, 2021.

[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.

[52] I. Abraham, A. Prabhakar, and T. D. Murphey, "An ergodic measure for active learning from equilibrium," *IEEE Transactions on Automation Science and Engineering*, vol. 18, no. 3, pp. 917–931, 2021.

[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.

[48] A. Broad, I. Abraham, T. Murphey, and B. Argall, "Data-driven Koopman operators for model-based shared control of human-machine systems," *International Journal of Robotics Research*, vol. 39, no. 9, pp. 1178–1195, 2020.

[47] I. Abraham, A. Handa, N. Ratliff, K. Lowrey, T. Murphey, and D. Fox, "Model-based generalization under parameter uncertainty using path integral control," *IEEE Robotics and Automation Letters*, vol. 5, no. 2, pp. 2864–2871, 2020.

[46] W. Savoie, T. A. Berrueta, Z. Jackson, A. Pervan, R. Warkentin, S. Li, T. D. Murphey, K. Wiesenfeld, and D. I. Goldman, "A robot made of robots: emergent transport and control of a smarticle ensemble," *Science Robotics*, vol. 4, no. 34, p. eaax4316, 2019.

[45] K. Fitzsimons, A. M. Acosta, J. Dewald, and T. D. Murphey, "Ergodicity reveals assistance and learning in physical human robot interaction," *Science Robotics*, vol. 4, no. 29, p. eaav6079, 2019.

[44] I. Abraham and T. D. Murphey, "Active learning of dynamics for data-driven control using Koopman operators," *IEEE Transactions on Robotics*, vol. 35, no. 5, pp. 1071–1083, 2019. **2019 King-Sun Fu IEEE Transactions on Robotics Best Paper**

[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.

[42] K. Flaßkamp and T. D. Murphey, "Structure-preserving local optimal control of mechanical systems," *Optimal Control, Applications and Methods*, vol. 40, no. 2, pp. 310–329, 2019.

[41] E. Tzorakoleftherakis and T. D. Murphey, "Iterative sequential action control for stable, model-based control of nonlinear systems," *IEEE Transactions on Automatic Control*, vol. 64, no. 8, pp. 3170–3183, 2019.

[40] G. Mamakoukas, M. Maciver, and T. D. Murphey, "Feedback synthesis for underactuated systems using sequential second-order needle variations," *International Journal of Robotics Research*, vol. 37, no. 13-14, pp. 1826–1853, 2019.

[39] I. Abraham and T. Murphey, "Decentralized ergodic control: Distribution-driven sensing and exploration for multi-agent systems," *IEEE Robotics and Automation Letters*, vol. 3, no. 4, pp. 2987–2994, 2018.

[38] A. Mavrommati, E. Tzorakoleftherakis, I. Abraham, and T. D. Murphey, "Real-time area coverage and target localization using receding-horizon ergodic exploration," *IEEE Transactions on Robotics*, vol. 34, no. 1, pp. 62–80, 2018.

[37] M. A. MacIver, L. Schmitz, U. Mugan, T. D. Murphey, and C. D. Mobley, "A massive increase in visual range preceded the origin of terrestrial vertebrates," *Proceedings of the National Academy of Science (PNAS)*, vol. 114, no. 12, pp. E2375–E2384, 2017.

[36] I. Abraham, A. Prabhakar, M. Hartmann, and T. Murphey, "Ergodic exploration using binary sensing for non-parametric shape estimation," *IEEE Robotics and Automation Letters*, vol. 2, no. 2, pp. 827–834, 2017.

[35] A. D. Wilson, J. A. Schultz, A. Ansari, and T. D. Murphey, "Dynamic task execution using active parameter identification with the Baxter research robot," *IEEE Transactions on Automation Science and Engineering*, vol. 14, no. 1, pp. 391–397, 2017.

[34] K. Flaßkamp, A. Ansari, and T. D. Murphey, "Hybrid control for tracking of invariant manifolds," *Nonlinear Analysis: Hybrid Systems*, vol. 25, pp. 298–311, 2017.

[33] J. Schultz, K. Flaßkamp, and T. D. Murphey, "Variational integrators for structure-preserving filtering," *ASME Journal of Computational and Nonlinear Dynamics*, vol. 12, no. 2, pp. 021005:1–021005:10, 2016.

[32] A. Broad, M. Derry, J. Schultz, T. Murphey, and B. Argall, "Trust adaptation leads to lower control effort in shared control of crane automation," *IEEE Robotics and Automation Letters*, vol. 2, no. 1, pp. 239–246, 2016.

[31] A. Ansari and T. D. Murphey, "Sequential Action Control: Closed-form optimal control for nonlinear and nonsmooth systems," *IEEE Transactions on Robotics*, vol. 32, no. 5, pp. 1196–1214, 2016.

[30] A. Farshchiansadegh, A. Melendez-Calderon, R. Ranganathan, T. D. Murphey, and F. Mussa-Ivaldi, "Sensory agreement guides energy optimization in human movements," *PLOS Computational Biology*, vol. 12, no. 4, p. e1004861, 2016.

[29] A. Mavrommati, J. Schultz, and T. D. Murphey, "Real-time mode scheduling using single-integration hybrid optimization for linear time-varying systems," *IEEE Transactions on Automation Science and Engineering*, vol. 13, no. 3, pp. 1385–1398, 2016.

[28] E. Tzorakoleftherakis, T. D. Murphey, and R. A. Scheidt, "Augmenting sensorimotor control using goal-aware vibrotactile stimulation during reaching and manipulation behaviors," *Experimental Brain Research*, vol. 234, no. 8, pp. 2403–2414, 2016.

[27] A. Ansari and T. D. Murphey, "Minimum sensitivity control for planning with parametric and hybrid uncertainty," *International Journal of Robotics Research*, vol. 35, no. 7, pp. 823–839, 2016.

[26] E. Tzorakoleftherakis, A. Ansari, A. Wilson, J. Schultz, and T. D. Murphey, "Model-based reactive control for hybrid and high-dimensional robotic systems," *IEEE Robotics and Automation Letters*, vol. 1, no. 1, pp. 431–438, 2016.

[25] T. Caldwell and T. D. Murphey, "Projection-based iterative mode scheduling for switched systems," *Nonlinear Analysis: Hybrid Systems*, vol. 21, pp. 59–83, 2016.

[24] L. Miller, Y. Silverman, M. A. MacIver, and T. Murphey, "Ergodic exploration of distributed information," *IEEE Transactions on Robotics*, vol. 32, no. 1, pp. 36–52, 2016.

[23] D. Pekarek and T. D. Murphey, "Discrete Lagrangian mechanics for nonsmooth nonseparable systems," *International Journal for Numerical Methods in Engineering*, vol. 105, pp. 440–463, 2016.

[22] R. Abbott, A. Pedler, M. Sterling, J. Hides, T. D. Murphey, M. Hoggarth, and J. Elliott, "The geography of fatty infiltrates within the cervical multifidus and semispinalis cervicis in individuals with chronic whiplash-associated disorders," *Journal of Orthopaedic and Sports Physical Therapy*, vol. 45, no. 4, pp. 281–288, 2015.

[21] E. Johnson, J. Schultz, and T. D. Murphey, "Linearizations of variational integrators for analysis and optimization," *IEEE Transactions on Automation Science and Engineering*, vol. 12, no. 1, pp. 140–152, 2015.

[20] A. Wilson, J. Schultz, and T. D. Murphey, "Trajectory optimization for well-conditioned parameter estimation," *IEEE Transactions on Automation Science and Engineering*, vol. 12, no. 1, pp. 28–36, 2015.

[19] A. Wilson, J. Schultz, and T. D. Murphey, "Trajectory synthesis for Fisher information maximization," *IEEE Transactions on Robotics*, vol. 30, no. 6, pp. 1358–1370, 2014.

[18] B. Quist, V. Seghete, L. Huet, T. D. Murphey, and M. J. Z. Hartmann, "Modeling forces and moments at the base of a rat vibrissa during non contact whisking and whisking against an object," *Journal of Neuroscience*, vol. 34, pp. 9828–9844, July 2014.

[17] V. Seghete and T. D. Murphey, "A propagative model of simultaneous impact: existence, uniqueness, and design consequences," *IEEE Transactions on Automation Science and Engineering*, vol. 11, no. 1, pp. 154–168, 2014.

[16] L. Miller and T. D. Murphey, "Simultaneous optimal estimation of mode transition times and parameters applied to simple traction models," *IEEE Transactions on Robotics*, vol. 29, no. 6, pp. 1496–1503, 2013.

[15] 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.

[14] T. Caldwell and T. D. Murphey, "Single integration optimization of linear time-varying switched systems," *IEEE Transactions on Automatic Control*, vol. 57, no. 6, pp. 1592–1597, 2012.

[13] E. Johnson and T. D. Murphey, "Second-order switching time optimization for nonlinear time-varying dynamic systems," *IEEE Transactions on Automatic Control*, vol. 56, no. 8, pp. 1953–1957, 2011.

[12] P. Martin, E. Johnson, T. D. Murphey, and M. Egerstedt, "Constructing and implementing motion programs for robotic marionettes," *IEEE Transactions on Automatic Control*, vol. 56, no. 4, pp. 902–907, 2011.

[11] T. Caldwell and T. D. Murphey, "Switching mode generation and optimal estimation with application to skid-steering," *Automatica*, vol. 47, no. 1, pp. 50–64, 2011.

[10] T. D. Murphey and J. Falcon, "Programming from the ground up in controls laboratories," *International Journal of Engineering Education*, vol. 26, no. 5, pp. 1241–1248, 2010.

[9] E. Jochum and T. D. Murphey, "A Robotic Pygmalion: Choreography for an automated marionette play," *Puppetry International*, vol. 27, pp. 22–24, 2010.

[8] E. Johnson and T. D. Murphey, "Scalable variational integrators for constrained mechanical systems in generalized coordinates," *IEEE Transactions on Robotics*, vol. 25, no. 6, pp. 1249–1261, 2009.

[7] B. Shucker, T. D. Murphey, and J. Bennett, "Convergence preserving switching for topology-dependent decentralized systems," *IEEE Transactions on Robotics*, vol. 24, no. 6, pp. 1405–1415, 2008.

[6] T. D. Murphey and K. M. Lynch, "Case studies in planar part feeding and assembly based on design of limit sets," *International Journal of Robotics Research*, vol. 27, pp. 693–708, June 2008.

[5] T. D. Murphey, "Teaching rigid body mechanics using student-created virtual environments," *IEEE Transactions on Education*, vol. 51, no. 1, pp. 45–52, 2008.

[4] T. D. Murphey, "On multiple model control for multiple contact systems," *Automatica*, vol. 44, pp. 451–458, 2008.

[3] T. D. Murphey, "Kinematic reductions for uncertain mechanical contact," *Robotica*, vol. 25, pp. 751–764, Nov 2007.

[2] T. D. Murphey and J. W. Burdick, "The power dissipation method and kinematic reducibility of multiple model robotic systems," *IEEE Transactions on Robotics*, vol. 22, pp. 694–710, August 2006.

[1] T. D. Murphey and J. W. Burdick, "Feedback control methods for distributed manipulation systems that involve mechanical contacts," *International Journal of Robotics Research*, vol. 23, pp. 763–782, July 2004.

Peer Reviewed Conference Papers

[145] M. Sun, A. Pinosky, I. Abraham, and T. D. Murphey, "Scale-invariant fast functional registration," in *International Symposium on Robotics Research (ISRR)*, 2022.

[144] A. Kalinowska, E. Davoodi, K. W. Mathewson, T. Murphey, and P. M. Pilarski, "Communication emergence in a goal-oriented environment: Towards situated communication in multi-step interactions," in *Conference on Reinforcement Learning and Decision Making (RLDM)*, 2022.

[143] A. Kalinowska, E. Davoodi, K. W. Mathewson, T. Murphey, and P. M. Pilarski, "Towards situated communication in multi-step interactions: Time is a key pressure in communication emergence," in *Annual Meeting of the Cognitive Science Society*, 2022.

[142] A. Kalinowska, E. Davoodi, F. Strub, K. Mathewson, T. Murphey, and P. Pilarski, "Situated communication: A solution to over-communication between artificial agents," in *Emergent Communication Workshop at ICLR 2022*, 2022.

[141] J. Meyer, A. Pinosky, T. Trzpit, J. E. Colgate, and T. Murphey, "A game benchmark for real-time human-swarm control," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, 2022.

[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 *IEEE/CVF International Conference on Computer Vision (ICCV)*, pp. 11457–11466, 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)*, pp. 8469–8476, 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)*, pp. 3648–3654, 2021.

[136] W. Edwards, G. Tang, G. Mamakoukas, T. D. Murphey, and K. Hauser, "Automatic tuning for data-driven model predictive control," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 7379–7385, 2021.

[135] 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*, vol. 227, pp. 213–232, Royal Society of Chemistry, 2021.

[134] G. Mamakoukas, O. Xherija, and T. D. Murphey, "Memory-efficient learning of stable linear dynamical systems for prediction and control," in *Advances in Neural Information Processing Systems (NeurIPS)*, vol. 33, pp. 13527–13538, 2020.

[133] 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.

[132] 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.

[131] A. Kalinowska, K. Rudy, M. Schlafly, K. Fitzsimons, J. Dewald, and T. D. Murphey, "Shoulder abduction loading affects motor coordination in individuals with chronic stroke, informing targeted rehabilitation," in *IEEE RAS/EMBS International Conference on Biomedical Robotics and Biomechatronics(BioRob)*, pp. 1010–1017, 2020.

[130] A. Prabhakar, I. Abraham, M. Schlafly, A. Taylor, K. Popovic, G. Diniz, B. Teich, B. Simidchieva, S. Clark, and T. Murphey, "Ergodic specifications for flexible swarm control: From user commands to persistent adaptation," in *Robotics: Science and Systems (RSS)*, 2020.

[129] I. Abraham, A. Broad, A. Pinosky, B. Argall, and T. D. Murphey, "Hybrid control for learning motor skills," in *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, 2020.

[128] A. Nilles, A. Pervan, T. Berrueta, T. D. Murphey, and S. LaValle, "Information requirements of collision-based micromanipulation," in *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, 2020.

[127] M. Castano, A. Hess, G. Mamakoukas, T. Gao, T. Murphey, and X. Tan, "Control-oriented modeling of soft robotic swimmer with Koopman operators," in *IEEE/ASME International Conference on Advanced Intelligent Mechatronics (AIM)*, pp. 1679 – 1685, 2020.

[126] T. Fan and T. D. Murphey, "Generalized proximal methods for pose graph optimization," in *International Symposium on Robotics Research (ISRR)*, 2019.

[125] T. Fan, H. Wang, M. Rubenstein, and T. D. Murphey, "CPL-Sync: Efficient and guaranteed planar pose graph optimization using the complex number representation," in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 1904 – 1911, 2019. **ABB Best Student Paper Award.**

[124] A. Broad, T. Murphey, and B. Argall, "Highly parallelized data-driven MPC for minimal intervention shared control," in *Robotics: Science and Systems (RSS)*, 2019.

[123] G. Mamakoukas, M. Castano, X. Tan, and T. D. Murphey, "Local Koopman operators for data-driven control of robotic systems," in *Robotics: Science and Systems (RSS)*, 2019.

[122] O. Ennasr, G. Mamakoukas, M. Castano, D. Coleman, T. D. Murphey, and X. Tan, "Adaptive single action control policies for linearly parameterized systems," in *ASME Dynamic Systems and Control Conference (DSCC)*, 2019.

[121] A. Kalinowska, T. Berrueta, A. Zoss, and T. D. Murphey, "Data-driven gait segmentation for walking assistance in a lower-limb assistive device," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 1390 – 1396, 2019.

[120] A. Broad, T. Murphey, and B. Argall, "Operation and imitation under safety-aware shared control," in *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, pp. 905 – 920, 2018.

[119] I. Abraham, A. Prabhakar, and T. D. Murphey, "Active area coverage from equilibrium," in *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, pp. 284 – 300, 2018.

[118] T. Fan, J. Schultz, and T. D. Murphey, "Efficient computation of higher-order variational integrators in robotic simulation and trajectory optimization," in *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, pp. 689 – 706, 2018.

[117] A. Pervan and T. D. Murphey, "Low complexity control policy synthesis for embodied computation in synthetic cells," in *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, pp. 602 –618, 2018.

[116] G. Mamakoukas, M. MacIver, and T. D. Murphey, "Superlinear convergence using controls based on second-order needle variations," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 4301–4308, 2018.

[115] I. Abraham, A. Mavrommati, and T. D. Murphey, "Data-driven measurement models for active localization in sparse environments," in *Robotics: Science and Systems (RSS)*, 2018.

[114] A. Kalinowska, K. Fitzsimons, J. Dewald, and T. D. Murphey, "Online user assessment for minimal intervention during task-based robotic assistance," in *Robotics: Science and Systems (RSS)*, 2018.

[113] A. Broad, I. Abraham, B. Argall, and T. D. Murphey, "Structured neural networks for model-based control," in *Robotics: Science and Systems (RSS) Workshop on Learning and Inference in Robotics*, 2018.

[112] A. Broad, T. D. Murphey, and B. Argall, "Demonstration and imitation of novel behaviors under safety aware control," in *Robotics: Science and Systems (RSS) Workshop on Causal Imitation in Robotics*, 2018.

[111] O. Ennasr, G. Mamakoukas, T. D. Murphey, and X. Tan, "Ergodic exploration for adaptive sampling of water columns using gliding robotic fish," in *ASME Dynamic Systems and Control Conference (DSCC)*, p. V003T32A016 (9 pages), 2018.

[110] T. Fan, H. Weng, and T. D. Murphey, "Decentralized and recursive identification for cooperative manipulation of unknown rigid body with local measurements," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 2842–2849, 2017.

[109] I. Abraham, G. de la Torre, and T. Murphey, "Model-based control using Koopman operators," in *Robotics: Science and Systems (RSS)*, 2017.

[108] G. Mamakoukas, M. MacIver, and T. Murphey, "Feedback synthesis for controllable underactuated systems using sequential second order actions," in *Robotics: Science and Systems (RSS)*, 2017.

[107] A. Broad, T. Murphey, and B. Argall, "Learning models for shared control of human-machine systems with unknown dynamics," in *Robotics: Science and Systems (RSS)*, pp. 1092 – 1099, 2017.

[106] M. Castano, A. Mavrommati, T. D. Murphey, and X. Tan, "Trajectory planning and tracking of robotic fish using ergodic exploration," in *American Controls Conf. (ACC)*, pp. 5476 – 5481, 2017.

[105] A. Prabhakar, A. Mavrommati, J. Schultz, and T. D. Murphey, "Autonomous visual rendering using physical motion," in *Workshop on the Algorithmic Foundations of Robotics (WAFR)*, pp. 80–95, 2016.

[104] J. Schultz and T. D. Murphey, "Low-infrastructure real-time embedded control via variational integrators," *PAMM*, vol. 16, no. 1, pp. 949–952, 2016.

[103] G. De La Torre and T. D. Murphey, "On the benefits of surrogate Lagrangians in optimal control and planning algorithms," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 7384–7391, 2016.

[102] A. Mavrommati and T. D. Murphey, "Automatic synthesis of control alphabet policies," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, pp. 313 – 320, 2016.

[101] T. Fan and T. D. Murphey, "Online feedback control for input-saturated robotic systems on Lie groups," in *Robotics: Science and Systems (RSS)*, 2016.

[100] G. Mamakoukas, M. MacIver, and T. D. Murphey, "Controlling simulated underactuated underwater vehicles with added mass and velocity drift using sequential action control," in *American Controls Conf. (ACC)*, pp. 4500 – 4506, 2016.

[99] G. De La Torre, K. Flaßkamp, A. Prabhakar, and T. D. Murphey, "Ergodic exploration with stochastic sensor dynamics," in *American Controls Conf. (ACC)*, pp. 2971 – 2976, 2016.

[98] K. Fitzsimons, E. Tzorakoleftherakis, and T. D. Murphey, "Optimal human-in-the-loop interfaces based on Maxwell's demon," in *American Controls Conf. (ACC)*, pp. 4397 – 4402, 2016.

[97] T. Fan and T. D. Murphey, "Structured linearization of discrete mechanical systems on Lie groups: a synthesis of analysis and control," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 1092 – 1099, 2015.

[96] A. Prabhakar, K. Flaßkamp, and T. D. Murphey, "Symplectic integration for optimal ergodic control," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 2594 – 2600, 2015.

[95] E. Tzorakoleftherakis and T. D. Murphey, "Controllers as filters: Noise-driven swing-up control based on Maxwell's demon," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 4368 – 4374, 2015.

[94] A. Wilson, J. Schultz, A. Ansari, and T. D. Murphey, "Real-time trajectory synthesis for information maximization using Sequential Action Control and least-squares estimation," in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 4935–4940, 2015.

[93] T. Caldwell and T. D. Murphey, "Power network regulation benchmark for switched-mode optimal control," in *Analysis and Design of Hybrid Systems (ADHS)*, pp. 280–285, 2015.

[92] A. Ansari, K. Flaßkamp, and T. D. Murphey, "Sequential action control for tracking of free invariant manifolds," in *Analysis and Design of Hybrid Systems (ADHS)*, pp. 335–342, 2015.

[91] L. Miller and T. D. Murphey, "Optimal planning for target localization and coverage using range sensing," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, pp. 501–508, 2015.

[90] A. Mavrommati, A. Ansari, and T. D. Murphey, "Optimal control-on-request: An application in real-time assistive balance control," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 5928 – 5934, 2015.

[89] E. Tzorakoleftherakis, M. C. Bengtson, F. A. Mussa-Ivaldi, R. A. Scheidt, and T. D. Murphey, "Tactile proprioceptive input in robotic rehabilitation after stroke," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 6475 – 6481, 2015.

[88] A. D. Wilson and T. D. Murphey, "Maximizing Fisher information in discrete-time mechanical systems using projection-based trajectory optimization," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 2403 – 2409, 2015.

[87] A. Ansari and T. D. Murphey, "Control-on-request: Short-burst assistive control for long time horizon improvement," in *American Controls Conf. (ACC)*, pp. 1173 – 1180, 2015.

[86] A. Ansari and T. D. Murphey, "A variational derivation of LQR for piecewise time-varying systems," in *American Controls Conf. (ACC)*, pp. 2260 – 2265, 2015.

[85] K. Flaßkamp and T. D. Murphey, "Variational integrators in linear optimal control and filtering," in *American Controls Conf. (ACC)*, pp. 5140 – 5145, 2015.

[84] T. Murphey and B. Argall, "Towards software-enabled rehabilitation," in *IROS Workshop on Workshop on Rehabilitation & Assistive Robotics*, 2014.

[83] I. D. Neveln, L. M. Miller, M. A. MacIver, and T. Murphey, "Improving object tracking through distributed exploration of an information map," in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 3441 – 3447, 2014.

[82] A. Mavrommati and T. D. Murphey, "Single-integration mode scheduling for linear time-varying switched systems," in *American Controls Conf. (ACC)*, pp. 430 – 436, 2014.

[81] E. Tzorakoleftherakis, F. Mussa-Ivaldi, R. Scheidt, and T. D. Murphey, "Effects of optimal tactile feedback in balancing tasks: a pilot study," in *American Controls Conf. (ACC)*, pp. 778 – 783, 2014.

[80] V. Seghete and T. D. Murphey, "Continuous-time optimal control of impacting mechanical systems via a projected Hamilton's principle," in *American Controls Conf. (ACC)*, pp. 2438 – 2444, 2014.

[79] J. Schultz and T. D. Murphey, "Extending filter performance through structured integration," in *American Controls Conf. (ACC)*, pp. 261 – 270, 2014.

[78] A. Wilson and T. D. Murphey, "Local E-optimality conditions for trajectory design to estimate parameters in nonlinear systems," in *American Controls Conf. (ACC)*, pp. 443 – 450, 2014.

[77] E. Jochum, J. Schultz, and T. Murphey, "Engineering autonomous theatre: The impact of culture on mobile robots and automated systems," in *AAMAS Workshop on Culture Aware Robotics*, 2014.

[76] E. Jochum, G. Borggreen, and T. Murphey, "INTERACT: Applying theory and methods from the visual and performing arts to robots," in *HRI-Workshop on Culture Aware Robotics*, 2014.

[75] K. Flaßkamp, T. D. Murphey, and S. Ober-Blöbaum, "Optimization for discretized switched systems," *PAMM*, vol. 13, no. 1, pp. 401–402, 2013.

[74] T. Caldwell and T. D. Murphey, "Projection-based optimal mode scheduling," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 5307 – 5314, 2013.

[73] L. Miller and T. D. Murphey, "Trajectory optimization for continuous ergodic exploration on the motion group $SE(2)$," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 4517 – 4522, 2013.

[72] D. Pekarek and T. D. Murphey, "A projected Lagrange-d'Alembert principle for forced nonsmooth mechanics and optimal control," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 7777 – 7784, 2013.

[71] A. Ansari and T. Murphey, "Minimal sensitivity control for hybrid environments," in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 3023 – 3028, 2013.

[70] Y. Silverman, L. Miller, M. MacIver, and T. D. Murphey, "Optimal planning for information acquisition," in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 5974 – 5980, 2013.

[69] A. D. Wilson and T. D. Murphey, "Optimal trajectory design for well-conditioned parameter estimation," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, pp. 13–19, 2013. **Finalist for ABB Best Conference Paper Award.**

[68] K. Flaßkamp, T. D. Murphey, and S. Ober-Blöbaum, "Discretized switching time optimization problems," in *European Control Conference (ECC)*, pp. 3179–3184, 2013.

[67] Y. P. Leong and T. D. Murphey, "Second-order switching time and magnitude optimization for impulsive hybrid systems," in *American Controls Conf. (ACC)*, pp. 6213–6218, 2013.

[66] L. M. Miller and T. D. Murphey, "Trajectory optimization for continuous ergodic exploration," in *American Controls Conf. (ACC)*, pp. 4196–4201, 2013.

[65] J. Schultz and T. D. Murphey, "Embedded control synthesis using one-step methods in discrete mechanics," in *American Controls Conf. (ACC)*, pp. 5293–5298, 2013.

[64 A. Ansari and T. D. Murphey, "Minimal parametric sensitivity trajectories for nonlinear systems," in *American Controls Conf. (ACC)*, pp. 5011–5016, 2013.

[63] D. Pekarek and T. D. Murphey, "Global projections for variational nonsmooth mechanics," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 5572–5579, 2012.

[62] L. Miller and T. D. Murphey, "Optimal contact decisions for ergodic exploration," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 5091–5097, 2012.

[61] T. Caldwell and T. D. Murphey, "Projection-based switching system optimization: Absolute continuity of the line search," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 699–706, 2012.

[60] K. Flaßkamp, T. D. Murphey, and S. Ober-Blöbaum, "Switching time optimization in discretized hybrid dynamical systems," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 707–712, 2012.

[59] L. Miller and T. D. Murphey, "Simultaneous optimal parameter and mode transition estimation," in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 719–724, 2012.

[58] D. Pekarek and T. D. Murphey, "Varational nonsmooth mechanics via a projected Hamilton's principle," in *American Controls Conf. (ACC)*, pp. 1040–1046, 2012.

[57] M. Travers, T. D. Murphey, and L. Y. Pao, "Linear time-varying impulse optimization for data association," in *American Controls Conf. (ACC)*, pp. 1047–1052, 2012.

[56] T. Caldwell and T. D. Murphey, "Projection-based switching time optimization," in *American Controls Conf. (ACC)*, pp. 4552–4557, 2012.

[55] T. D. Murphey and B. Argall, "Making robotic marionettes perform," in *ICRA Workshop on Robotics and Performance Arts: Reciprocal Influences*, 2012.

[54] B. Tovar and T. D. Murphey, "Trajectory tracking among landmarks and binary sensor beams," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 2121–2127, 2012.

[53] V. Seghete and T. D. Murphey, "Conditions for uniqueness in simultaneous impact with application to mechanical design," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 5006–5011, 2012.

[52] J. Schultz and T. D. Murphey, "Trajectory generation for underactuated control of a suspended mass," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 123–129, 2012.

[51] M. Travers, T. D. Murphey, and L. Y. Pao, "Impulsive data association with an unknown number of targets," in *Hybrid Systems: Computation and Control*, pp. 261 – 270, 2011.

[50] D. Pekarek and T. D. Murphey, "A backwards error analysis approach for simulation and control of nonsmooth mechanical systems," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 6942–6949, 2011.

[49] T. Caldwell and T. D. Murphey, "Single integration optimization of linear time-varying switched systems," in *American Controls Conf. (ACC)*, pp. 2024–2030, 2011.

[48] M. Travers, T. D. Murphey, and L. Y. Pao, "Trajectory optimization estimator for impulsive data association," in *American Controls Conf. (ACC)*, pp. 4514–4519, 2011.

[47] T. D. Murphey and E. Johnson, "Control aesthetics in software for automated marionettes," in *American Controls Conf. (ACC)*, pp. 3825 – 3830, 2011.

[46] A. Long, T. D. Murphey, and K. M. Lynch, "Optimal motion planning for a class of hybrid dynamical systems with impacts," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 4220 – 4226, 2011.

[45] E. Johnson, K. Morris, and T. D. Murphey, *Algorithmic Foundations of Robotics VIII*, ch. A Variational Approach to Strand-Based Modeling of the Human Hand, pp. 151–166. Springer-Verlag, 2010. Eds. G. Chirikjian, H. Choset, M. Morales, T. Murphey.

[44] T. Caldwell and T. D. Murphey, "An adjoint method for second-order switching-time optimization," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 2155–2162, 2010.

[43] M. Travers, L. Pao, and T. D. Murphey, "Data association with impulse optimization," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 2204–2209, 2010.

[42] K. Snyder and T. D. Murphey, "Second-order DMOC using projections," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 1872–1878, 2010.

[41] E. Johnson and T. D. Murphey, "Local planning using switching time optimization," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, pp. 828–834, 2010.

[40] C. Gibson and T. D. Murphey, "Geometric integration of impact during an orbital docking procedure," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, pp. 928–932, 2010.

[39] E. Johnson and T. D. Murphey, "Linearizations for mechanical systems in generalized coordinates," in *American Controls Conf. (ACC)*, pp. 629–633, 2010.

[38] M. Travers, T. D. Murphey, and L. Y. Pao, "Stochastic sampling-based data association," in *American Controls Conf. (ACC)*, pp. 1386–1391, 2010.

[37] V. Seghete and T. D. Murphey, "Variational solutions to simultaneous collisions between multiple rigid bodies," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 2731–2738, 2010.

[36] T. Caldwell and T. D. Murphey, "Relaxed optimization for mode estimation in skid steering," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 5423–5428, 2010.

[35] E. Johnson and T. D. Murphey, "Second order switching time optimization for time-varying nonlinear systems," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 5281 – 5286, 2009.

[34] V. Seghete and T. D. Murphey, "Multiple instantaneous collisions in a variational framework," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 5015 – 5020, 2009.

[33] E. Johnson and T. D. Murphey, "Automated trajectory morphing for marionettes using trajectory optimization," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, pp. 274–279, 2009.

[32] T. Caldwell and T. D. Murphey, "Second-order optimal estimation of slip state for a simple slip-steered vehicle," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, pp. 133–139, 2009.

[31] E. Johnson and T. D. Murphey, "Dangers of two-point holonomic constraints for variational integrators," in *American Controls Conf. (ACC)*, pp. 4723–4728, 2009.

[30] T. D. Murphey, *Algorithmic Foundations of Robotics VII*, ch. Mechanical Manipulation Using Reduced Models of Uncertainty, pp. 359–374. Springer-Verlag, 2008. Eds. S Akella, N. Amato, W. Huang, B. Mishra.

[29] K. Nichols and T. D. Murphey, "Variational integrators for constrained cables," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, pp. 802–807, 2008.

[28] T. D. Murphey, "Filtering of interaction rules in cooperation," in *American Controls Conf. (ACC)*, pp. 3733–3739, 2008.

[27] M. Travers, T. D. Murphey, and L. Pao, "Data association with ambiguous measurements," in *American Controls Conf. (ACC)*, pp. 1875–1880, 2008.

[26] E. Johnson and T. D. Murphey, "Discrete and continuous mechanics for tree representations of mechanical systems," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 1106–1111, 2008.

[25] T. D. Murphey and M. Horowitz, "Adaptive cooperative manipulation with intermittent contact," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 1483–1488, 2008.

[24] M. Egerstedt, T. D. Murphey, and J. Ludwig, *Hybrid Systems: Computation and Control*, ch. Motion Programs for Puppet Choreography and Control, pp. 190–202. Lecture Notes in Computer Science, Springer-Verlag, 2007. Eds. A. Bemporad, A. Bicchi, and G. C. Buttazzo.

[23] T. D. Murphey, "Geometric derived information spaces in manipulation with mechanical contact," in *IEEE Int. Conf. on Automation Science and Engineering (CASE)*, pp. 338–345, 2007.

[22] E. Johnson and T. D. Murphey, "Dynamic modeling and motion planning for marionettes: Rigid bodies articulated by massless strings," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 330–335, 2007.

[21] T. D. Murphey, "Teaching rigid body mechanics using student-created virtual environments," in *American Controls Conf. (ACC)*, pp. 2503–2508, 2007.

[20] B. Shucker, T. D. Murphey, and J. Bennett, "Switching rules for decentralized control with simple control laws," in *American Controls Conf. (ACC)*, pp. 1485–1492, 2007.

[19] T. D. Murphey and J. Falcon, "Programming from the ground up in controls laboratories using graphical programming," in *Proceedings of the IFAC Advances in Control Education (ACE)*, p. 6 pages, 2006.

[18] T. D. Murphey, "Modeling and control of multiple-contact manipulation without modeling friction," in *American Controls Conf. (ACC)*, pp. 3227–3234, 2006.

[17] B. Shucker, T. D. Murphey, and J. Bennett, "An approach to switching control beyond nearest neighbor rules," in *American Controls Conf. (ACC)*, pp. 5959–5965, 2006.

[16] T. D. Murphey, "Motion planning for kinematically overconstrained vehicles using feedback primitives," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 1643–1648, 2006.

[15] B. Shucker, T. D. Murphey, and J. Bennett, "Cooperative control using occasional non-local interactions," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 1324–1329, 2006.

[14] T. D. Murphey, J. Bernheisel, D. Choi, and K. M. Lynch, "An example of parts handling and self-assembly using stable limit sets," in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 1624–1629, 2005.

[13] T. D. Murphey, "Application of supervisory control methods to uncertain multiple model systems," in *American Controls Conf. (ACC)*, pp. 774–780, 2005.

[12] T. D. Murphey and J. W. Burdick, *Algorithmic Foundations of Robotics V*, ch. Feedback Control for Distributed Manipulation, pp. 487–503. Springer-Verlag, 2004. Eds. J. D. Boissonnat, J. Burdick, K. Goldberg, and S. Hutchinson.

[11] T. D. Murphey, D. Choi, J. Bernheisel, and K. M. Lynch, "Experiments in the use of stable limits sets for parts handling," in *Proc. Int. Conf. MEMS, NANO, and Smart Systems (ICMENS)*, pp. 218–224, 2004.

[10] T. D. Murphey and J. W. Burdick, "Kinematic reducibility for multiple model systems," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 5307–5313, 2003.

[9] T. D. Murphey and J. W. Burdick, "Experiments in nonsmooth control of distributed manipulation," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 3600–3606, 2003.

[8] T. D. Murphey and J. W. Burdick, "Smooth feedback control algorithms for fully actuated distributed manipulators," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 3619–3623, 2003.

[7] T. D. Murphey and J. W. Burdick, "Nonsmooth controllability theory and an example," in *IEEE Int. Conf. on Decision and Control (CDC)*, pp. 370–376, 2002.

[6] T. D. Murphey and J. W. Burdick, "Global exponential stabilizability for distributed manipulation," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 1210–1216, 2002.

[5] T. D. Murphey and J. W. Burdick, "A local controllability test for nonlinear multiple model systems," in *American Controls Conf. (ACC)*, pp. 4657–4661, 2002.

[4] T. D. Murphey and J. W. Burdick, "Global stability for distributed systems with changing contact states," in *IEEE Int. Conf. on Intelligent Robots and Systems (IROS)*, pp. 214–219, 2001.

[3] T. D. Murphey and J. W. Burdick, "A controllability test and motion planning primitives for overconstrained vehicles," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 2716–2722, 2001.

[2] T. D. Murphey and J. W. Burdick, "On the stability and design of distributed systems," in *IEEE Int. Conf. on Robotics and Automation (ICRA)*, pp. 2686–2691, 2001.

[1] T. D. Murphey and J. W. Burdick, "Issues in controllability and motion planning for overconstrained wheeled vehicles," in *Proc. Int. Conf. Math. Theory of Networks and Systems (MTNS)*, p. 8 pages, 2000.

Editor Reviewed Book Chapters

[8] T. A. Berrueta, I. Abraham, and T. D. Murphey, *The Koopman Operator in Systems and Control: Theory, Numerics, and Applications*, ch. Experimental Applications of the Koopman Operator in Active Learning for Control, pp. 421–450. Springer, 2020. Eds. I. Mezic, Y. Susuki, and A. Mauroy.

[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, 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*

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, ME 455* (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, Consultant 2022-present)

  - 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

  - Vice President: IEEE RAS Publication Activities Board (2022-present)
  - 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' Board on Army Research and Development: Artificial Intelligence and Justified Confidence: A Workshop (2022)
- Member: US Army Virtual Workshop: "Manned-Unmanned Teaming: Projected Scientific Breakthroughs in 2026-2031" (2022)
- 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
- Memmber: Center for Advancing Safety of Machine Intelligence (CASMI) Governance Advisory Committee (2021-present)
- Segal Fellow (2021-present)
- Member: RAC Retail Robotics Advisory Board (2018-2022)
- 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
  - 2022 *Workshop on the Algorithmic Foundations of Robotics*
  - 2022 *Int. Symposium on Robotics Research*
  - 2020 *Int. Conference for Biomedical Robotics and Biomechatronics*: 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

STUDENTS AND POSTDOCS ADVISED

- 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 Southwestern 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*. Recipient of Martin Outstanding Doctoral Fellowship. 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, 2022 Ph.D. thesis: *Efficient and Guaranteed Geometric Methods for Motion Generation and Perception*. Meta (Facebook) Artificial Intelligence Research 2022-present.

- Aleksandra (Ola) Kalinowska. 2022 Recipient of Terminal Year Fellowship.

- Thomas Berrueta. 2022 Recipient of the Northwestern Presidential Fellowship—the most presigious fellowship awarded to current students by Northwestern University.

- 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)
- Bowen Feng (MSR at Northwestern University)
- Tianyu Li (MSR at Northwestern University)
- Sophia Schiffer
- 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)