

Todd D. Murphey

Electrical and Computer Engineering
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EDUCATION

California Institute of Technology

Pasadena, CA

- Ph.D. in Control and Dynamical Systems, 2002
- Thesis: *Control of Multiple Model Systems*

University of Arizona

Tucson, AZ

- B.S. in Mathematics, *summa cum laude*, 1997

EMPLOYMENT

University of Colorado at Boulder	<i>Assistant Professor</i>	2004-present	Boulder, CO
Aerospace Corporation	<i>Senior Technical Staff</i>	2003-2004	El Segundo, CA
Northwestern University	<i>Postdoctoral Scholar</i>	2002-2003	Evanston, IL

AWARDS AND HONORS

- Bruce Holland Excellence in Teaching award (2007)
(awarded by ECE Department at CU Boulder)
- National Science Foundation CAREER award (2006)
- Hertz Foundation Research Fellowship Grant (1999)
- National Science Foundation Japan Summer Program Fellowship (1999)

PUBLICATIONS¹ AND INVITED TALKS

Articles In Preparation

- [2] T. D. Murphey, "Intrinsic operators on Riemannian graphs," *To be submitted to IEEE Transactions on Automatic Control*, 2007. In Preparation.
- [1] T. Caldwell and T. D. Murphey, "Experimental slip-steering control using hybrid estimation and control," *To be submitted to International Journal of Field Robotics*, 2007. In Preparation.

Journal Articles

- [9] E. Johnson and T. D. Murphey, "Scalable variational integrators for constrained mechanical systems in generalized coordinates," *IEEE Transactions on Robotics*, Submitted

¹Reprints of many of these can be found at <http://ece.colorado.edu/~murphey>

- [8] B. Shucker, T. D. Murphey, and J. Bennett, “Convergence preserving switching for topology dependent decentralized systems,” *IEEE Transactions on Robotics*, Accepted for Publication.
- [7] T. D. Murphey and J. Falcon, “Programming from the ground up in controls laboratories using graphical programming,” *International Journal of Engineering Education*, Accepted for Publication.
- [6] T. D. Murphey and K. M. Lynch, “Experiments in parts feeding and self-assembly by limit set shaping,” *International Journal of Robotics Research*, Accepted for Publication.
- [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 for distributed manipulation with changing contacts,” *International Journal of Robotics Research*, vol. 23, pp. 763–782, July 2004.

Refereed Book Chapters

- [5] T. D. Murphey, *Algorithmic Foundations of Robotics VII*, ch. Manipulation Using Reduced Representations of Uncertainty. Springer-Verlag, To be published in 2007. Eds. S Akella, N. Amato, W. Huang, B. Mishra.
- [4] M. Egerstedt, T. D. Murphey, and J. Ludwig, *Hybrid Systems: Computation and Control*, vol. TBD of *Lecture Notes in Computer Science*, ch. Motion Programs for Puppet Choreography and Control, pp. 190–202. Springer-Verlag, 2007. Eds. A. Bemporad, A. Bicchi, and G. C. Buttazzo.
- [3] 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.
- [2] 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.
- [1] K. M. Lynch and T. D. Murphey, *Control Problems in Robotics and Automation*, ch. Control Issues in Nonprehensile Manipulation, pp. 39–57. Springer-Verlag, 2003. Eds. A. Bicchi and H. Christensen.

Refereed Conference Papers

- [27] T. D. Murphey, “Filtering of interaction rules in cooperation,” in *American Controls Conference (ACC)*, 2008.
- [26] M. Travers, T. D. Murphey, and L. Pao, “Data association with ambiguous targets,” in *American Controls Conference (ACC)*, 2008.
- [25] E. Johnson and T. D. Murphey, “Discrete and continuous mechanics for tree representations of mechanical systems,” in *IEEE Int. Conf. on Robotics and Automation*, 2008.

- [24] T. D. Murphey and M. Horowitz, "Adaptive cooperative manipulation with intermittent contact," in *IEEE Int. Conf. on Robotics and Automation*, 2008.
- [23] T. D. Murphey and M. E. Egerstedt, "Choreography for marionettes: Imitation, planning, and control," in *IEEE Int. Conf. on Intelligent Robots and Systems Workshop on Art and Robotics*, p. 6 pages, 2007.
- [22] 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.
- [21] 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*, pp. 330–335, 2007.
- [20] T. D. Murphey, "Teaching rigid body mechanics using student-created virtual environments," in *American Controls Conference (ACC)*, pp. 2503–2508, 2007.
- [19] B. Shucker, T. D. Murphey, and J. Bennett, "Switching rules for decentralized control with simple control laws," in *American Controls Conference (ACC)*, pp. 1485–1492, 2007.
- [18] 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.
- [17] T. D. Murphey, "Modeling and control of multiple-contact manipulation without modeling friction," in *Proc. American Controls Conference (ACC)*, pp. 3227–3234, 2006.
- [16] B. Shucker, T. D. Murphey, and J. Bennett, "Switching control without nearest neighbor rules," in *Proc. American Controls Conference (ACC)*, pp. 5959–5965, 2006.
- [15] T. D. Murphey, "Motion planning for kinematically overconstrained vehicles using feedback primitives," in *Proc. IEEE Int. Conf. on Robotics and Automation*, pp. 1643–1648, 2006.
- [14] B. Shucker, T. D. Murphey, and J. Bennett, "Cooperative control using occasional non-local interactions," in *Proc. IEEE Int. Conf. on Robotics and Automation*, pp. 1324–1329, 2006.
- [13] T. D. Murphey, J. Bernheisel, D. Choi, and K. M. Lynch, "An example of parts handling and self-assembly using stable limit sets," in *Proc. of International Conference on Intelligent Robots and Systems (IROS)*, pp. 1624–1629, 2005.
- [12] T. D. Murphey, "Application of supervisory control methods to uncertain multiple model systems," in *Proc. American Controls Conference (ACC)*, vol. 2, pp. 774–780, 2005.
- [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)*, (Banff, Canada), pp. 218–224, 2004.
- [10] T. D. Murphey and J. W. Burdick, "Kinematic reducibility for multiple model systems," in *Proc. IEEE Conf. on Decision and Control (CDC)*, vol. 5, (Maui, Hawaii), 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*, 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*, pp. 3619–3623, 2003.

- [7] T. D. Murphey and J. W. Burdick, “Nonsmooth controllability theory and an example,” in *Proc. IEEE Conf. on Decision and Control (CDC)*, (Las Vegas), pp. 370–376, 2002.
- [6] T. D. Murphey and J. W. Burdick, “Global exponential stabilizability for distributed manipulation,” in *Proc. IEEE Int. Conf. on Robotics and Automation*, (Washington D.C.), pp. 1210–1216, 2002.
- [5] T. D. Murphey and J. W. Burdick, “A local controllability test for nonlinear multiple model systems,” in *Proc. American Controls Conference (ACC)*, vol. 6, (Anchorage, Alaska), pp. 4657–4661, 2002.
- [4] T. D. Murphey and J. W. Burdick, “Global stability for distributed systems with changing contact states,” in *Proc. IEEE Int. Conf. on Intelligent Robots and Systems*, (Hawaii), pp. 214–219, 2001.
- [3] T. D. Murphey and J. W. Burdick, “A controllability test and motion planning primitives for overconstrained vehicles,” in *Proc. IEEE Int. Conf. on Robotics and Automation*, (Seoul, Korea), pp. 2716–2722, 2001.
- [2] T. D. Murphey and J. W. Burdick, “On the stability and design of distributed systems,” in *Proc. IEEE Int. Conf. on Robotics and Automation*, (Seoul, Korea), 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)*, (Perpignan, France), p. 8 pages, 2000.

Invited Talks

- [17] Reducing Complexity in Grasping Descriptions
ICRA Workshop on Dexterous Human Grasping, Pasadena, California, May 2008.
- [16] Variational Integrators for Mechanical Contact
ICRA Workshop on Modeling Contact in Manipulation and Locomotion, Pasadena, California, May 2008.
- [15] Numerical Optimization in Part Design
ICRA Workshop on Automated Assembly, Pasadena, California, May 2008.
- [14] Geometric Methods for Dynamically Complex Manipulation Planning and Control
Carnegie Mellon University, Pittsburgh, PA, Spring 2008
- [13] Simple Representations of Contact for Manipulation
University of Southern California, Los Angeles, California, Nov 2007.
- [12] Marionettes as Complex Mechanical Systems
IROS Workshop on Art and Robots, San Diego, California, Nov 2007.
- [11] Automatic Synthesis of Motion Imitation In Marionettes
Northwestern University, Evanston, Illinois, May 2007.
- [10] Reduction of Information Requirements in Mechanical Systems
University of Illinois, Urbana-Champaign, Urbana-Champaign, Illinois, October 2006.
- [9] Hybrid Control in Manipulation and Coordination
Rice University, Houston, Texas, August 2006.
- [8] Innovative Teaching Methods with LabVIEW in Dynamic Systems and Controls
(with Raul Longoria) *NI Week, Austin, Texas, August 2006.*
- [7] Abstraction and Uncertainty in Manipulation with Frictional Interfaces
Georgia Institute of Technology, Atlanta, Georgia, February 2006.
- [6] Manipulation, Puppets, and Forums and
Programming from the Ground Up in Control Classes Using LabVIEW
National Instruments Headquarters, Austin, Texas, January 2006.

- [5] Geometric Modeling and Control of Friction-Dominated Mechanical Systems
The University of Colorado, Boulder, Applied Mathematics Seminar, October 2005.
- [4] Modeling and Control of Friction-Dominated Mechanical Systems
The University of Pisa, Italy, April 2005.
- [3] On Observing Contact States in Overconstrained Manipulation
Workshop on Multi-point Interaction in Robotics, New Orleans, April 2004.
- [2] Kinematic Reducibility for Multiple Model Systems
Courant Institute - New York University, November 2003.
- [1] Controllability and Reducibility for Nonsmooth Mechanical Systems
Louisiana Conference on Mathematical Control Theory, April 2003.

FUNDING

- Todd D. Murphey. National Science Foundation—Alternative 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.
- Todd D. Murphey. National Instruments Foundation. *Embedded Systems and Control Development*. \$32,000.
- Todd D. Murphey, Lucy Y. Pao, Dale A. Lawrence, John Hauser, David Meyer. Engineering Excellence Fund proposal: *Development of Hardware Control Experiments*. Support from the University of Colorado in the amount of \$35,000 and external support in the amount of roughly \$50,000 from National Instruments.

TEACHING

University of Colorado

2004-present, Boulder, CO

- Created and taught course: *Engineering Freshman Honors Colloquium: Everything and More—A History of Limits and the Development of Modern Calculus* (Spring 2008)
- Created and taught course: *Engineering Freshman Projects: Algorithms in Robotics, GEEN 1400* (Fall 2007)
- Created and taught course: *Introduction to Geometric Mechanics and Control ECEN 4028/5028* (Spring 2006)
- Created and taught course: *Robot Dynamics and Motion Planning ECEN 4028/5028* (Spring 2006)
- Taught course: *Control Systems Analysis ECEN 4138* (Fall 2005, 2006)
- Created and taught laboratory: *Control Systems Lab ECEN 4638* (Fall 2005, 2006)
- Created and taught course: *Robot Control ECEN 5438* (Spring 2005, 2007)

Northwestern University

2002-2003, Evanston, IL

- Co-taught course: *Geometry in Robotics* (Spring 2003)
- Taught seminar course: *Introduction to Hybrid Dynamical Systems* (Autumn 2002)

PROFESSIONAL ACTIVITIES

- Associate Editor for the journal *Robotica* (2007-present)
- Co-Organizer (with Greg Chirikjian, Howie Choset, and Marco Morales) of 2008 *Workshop on the Algorithmic Foundations of Robotics (WAFR)*
- 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?*
- Program committees
 - 2008 *Robotics: Science and Systems*
 - 2008 *Hybrid Systems: Computation and Control Workshop*
 - 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*
- Member of IEEE Robotics and Automation Society chapter award committee
- National Science Foundation Panelist in 2006
- Member of IEEE Robotics and Automation Society Conference Review board in 2004
- Reviewer for several journals (*International Journal of Robotics Research*, *IEEE Transactions on Automatic Control*, *IEEE Transactions on Robotics*, *Robotica*, *ASME Journal of Dynamic Systems, Measurement, and Control*) and conferences (*IEEE International Conference on Robotics and Automation*, *IEEE/RSJ International Conference on Intelligent Robots and Systems*, *IEEE Conference on Decision and Control*, *American Controls Conference*)
- Member, IEEE and SIAM