

Taeyoung Lee: Curriculum Vitae

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Education

Ph. D	Department of Aerospace Engineering UNIVERSITY OF MICHIGAN, Ann Arbor, MI <i>Thesis: Computational Geometric Mechanics and Control of Rigid Bodies</i> <i>Advisors: N. Harris McClamroch, Melvin Leok (Mathematics)</i> <i>Committee: Daniel Scheeres, Anthony Bloch, Jessy Grizzle</i>	Sep 2004-Apr 2008
M. S	Department of Mathematics UNIVERSITY OF MICHIGAN, Ann Arbor, MI	Sep 2007-Apr 2008
M. S	Department of Aerospace Engineering SEOUL NATIONAL UNIVERSITY, Korea <i>Thesis: Nonlinear Adaptive and Robust Flight Control Using the Backstepping Algorithm</i> <i>Advisor: Youdan Kim</i>	1998-2000
B. S	Department of Aerospace Engineering SEOUL NATIONAL UNIVERSITY, Korea	1994-1998

Professional Experience

Associate Professor	Department of Mechanical and Aerospace Engineering THE GEORGE WASHINGTON UNIVERSITY, Washington DC	Aug 2015-present
Assistant Professor	Department of Mechanical and Aerospace Engineering THE GEORGE WASHINGTON UNIVERSITY, Washington DC	Aug 2011-Jul 2015
Assistant Professor	Department of Mechanical and Aerospace Engineering FLORIDA INSTITUTE OF TECHNOLOGY, Melbourne FL	Aug 2008-Aug 2011
Military Service	Second Lieutenant, Tactical Control Officer The 3rd Air Defense Artillery Division, Republic of Korea Air Force	2001-2004

Research Interests

- Computational Geometric Mechanics:** Construction of structure-preserving numerical integration algorithms for complex dynamic systems to obtain long-term structural stability, reliability, and high fidelity in computational results
- Geometric Nonlinear Control:** Developing control nonlinear systems for dynamic systems evolving on nonlinear configuration manifolds to achieve global stability properties in a unified way
- Computational Geometric Uncertainty Propagation and Estimation:** Developing computational techniques to propagate uncertainties through complex dynamics on a manifold, and designing coordinate-free estimation schemes
- Complex Aerospace Systems:** Applying computational geometric techniques to the development of nonlinear control algorithms and exact computational approaches for nontrivial dynamics of complex aerospace systems
- Unmanned Aerial Vehicle (UAV) Experiments:** Developing hardware systems and flight software for multirotor unmanned aerial vehicles, such as quadrotors, to illustrate aggressive autonomous flight maneuvers
- Robotics:** Autonomous exploration algorithm for cooperating heterogeneous aerial vehicles to construct a three-dimensional map of an unknown area

Research Grants (total award: over \$1.8M)

Office of Naval Research (ONR) Grant #N00014-15-1-2043 (\$655K, co-PI) <i>Analysis of Ship Air Wakes</i>	2015-2018
Naval Research Laboratory (NRL) Contract #N00173-14-F-0584 (\$326K, PI) <i>Collaborative Autonomous Aerial Exploration</i>	2015-2017
NSF CMMI Control Systems #1335008 (\$220K, PI) <i>Stochastic Motion Planning and Estimation with Non-Gaussian Uncertainty Distributions on a Lie Group</i>	2013-2017
NSF CNS Major Research Instrumentation #1337722 (\$500K, co-PI) <i>Development of Large-Scale Dense Scene Capture and Tracking Instrument</i>	2013-2017
NSF CMMI Dynamic Systems #1029551 (\$150K, PI) <i>Computational Geometric Uncertainty Propagation for Hamiltonian Systems on a Lie Group</i>	2010-2014
GWU Institute For Biomedical Engineering Interdisciplinary Research Grant (PI) <i>Optimal Control of Anti-Tachycardia Pacing Therapy</i>	2011-2012
FIT Faculty Professional Development Grant (PI) <i>Development of an Autonomous Quadrotor UAV for Educational Research</i>	2010-2011

Honor & Awards

<i>Air Force Summer Faculty Fellowship</i> , Air Force Office of Scientific Research, Kirtland AFB, Albuquerque NM <i>Vision-Based Spacecraft Formation Control and Estimation Network</i>	2013
<i>Air Force Summer Faculty Fellowship</i> , Air Force Office of Scientific Research, Kirtland AFB, Albuquerque NM <i>Vision-Based Spacecraft Relative Attitude Control and Estimation</i>	2012
<i>Best Student Course Evaluation</i> , Mechanical and Aerospace Engineering, Florida Institute of Technology	2010
<i>Distinguished Dissertation Award, honorable mention</i> , University of Michigan	2009
<i>Distinguished Achievement Award</i> , College of Engineering, University of Michigan	2008
<i>Ivor K. McIvor Award</i> , College of Engineering, University of Michigan (outstanding research in applied mechanics)	2008
<i>SIAM Conference on Computational Science and Engineering, BGCE Student Paper Prize, finalist</i>	2007
<i>Rackham Predoctoral Fellowship</i> , University of Michigan	2006-2007
<i>Rackham International Students Fellowship</i> , University of Michigan	2006
<i>Rackham Travel Grant</i> , University of Michigan	Feb, Aug 2006
<i>International Scholarship</i> , Ministry of Education & Human Resources Development, Korea	2004

Publications

(Available for download at <http://fdcl.seas.gwu.edu/>)

Category	Published (or accepted)	Submitted	Total
Book	1	0	1
Journal	28	10	38
Peer-reviewed Conference	72	3	75
Total			114

Book

- *[1] T. Lee, M. Leok, and N.H. McClamroch. *Global Formulation of Lagrangian and Hamiltonian Dynamics on Manifolds*, volume I. Springer, 2017. to appear.

Computational Geometric Control and Optimization

- *[1] G. Cruz, A. Goel, T. Lee, and D. Bernstein. Attitude control of a dual rigid-body spacecraft with nonminimum-phase dynamics. In *Proceedings of the American Control Conference*, July 2017. submitted.

- *[2] T. Lee, D. Chang, and Y. Eun. Attitude control strategies overcoming the topological obstruction on $SO(3)$. In *Proceedings of the American Control Conference*, July 2017. submitted.
- [3] T. Lee. Optimal hybrid controls for global exponential tracking on the two-sphere. In *Proceedings of the IEEE Conference on Decision and Control*, December 2016. accepted.
- [4] S. Kulumani and T. Lee. Low-thrust trajectory design using reachability sets near asteroid 4769 Castalia. In *Proceedings of the AIAA/AAS Astrodynamics Specialist Conference*, September 2016. AIAA 2016-5376.
- [5] S. Kulumani, C. Poole, and T. Lee. Geometric adaptive control of attitude dynamics on $SO(3)$ with state inequality constraint. In *Proceedings of the American Control Conference*, pages 4936–4941, Boston, MA, July 2016.
- [6] K. Lee, C. Park, T. Lee, and S. Park. Spacecraft formation keeping via discrete-time Hamilton-Jacobi theory. In *Proceedings of the AIAA Guidance, Navigation and Control Conference*, January 2016. AIAA 2016-0874.
- *[7] S. Kulumani and T. Lee. Constrained geometric attitude control on $SO(3)$. *Journal of Control, Automation and Systems Engineering*, 2016. submitted.
- *[8] T. Lee. Geometric adaptive control for aerial transportation of a rigid body. *IEEE Transactions on Control Systems Technology*, 2016. submitted.
- [9] T. Lee. Geometric controls for a tethered quadrotor UAV. In *Proceedings of the IEEE Conference on Decision and Control*, pages 2749–2754, Osaka, Japan, December 2015.
- [10] F. Goodarzi, D. Lee, and T. Lee. Geometric control of a quadrotor UAV transporting a payload connected to a quadrotor UAV via flexible cable. *International Journal of Control, Automation, and Systems*, 13(6):1–13, December 2015. doi:10.1007/s12555-014-0304-0.
- [11] T. Lee. Global exponential attitude tracking controls on $SO(3)$. *IEEE Transactions on Automatic Control*, 60(10):2837–2842, October 2015. doi:10.1109/TAC.2015.2407452.
- [12] T. Lee. Geometric adaptive control for aerial transportation of a rigid body. In *Proceedings of the IMA Conference on Mathematics of Robotics*, September 2015.
- [13] F. Goodarzi, D. Lee, and T. Lee. Geometric adaptive tracking control of a quadrotor unmanned aerial vehicle on $SE(3)$. *ASME Journal of Dynamic Systems, Measurement, and Control*, 137(9), September 2015. doi:10.1115/1.4030419.
- [14] S. Kulumani and T. Lee. Systematic design of optimal low-thrust transfers for the three-body problem. In *Proceedings of the AIAA/AAS Astrodynamics Specialist Conference*, August 2015. AAS 15-757.
- [15] F. Goodarzi and T. Lee. Dynamics and control of quadrotor UAVs transporting a rigid body connected via flexible cables. In *Proceedings of the American Control Conference*, pages 4677–4682, July 2015.
- [16] T. Lee. Collision avoidance via Voronoi tessellation for quadrotor UAVs transporting a payload. In *Proceedings of the American Control Conference*, pages 1842–1848, July 2015.
- [17] E. Kaufman and T. Lee. Geometric adaptive control for aerial transportation of a rigid body. Presented at International Conference on Robotics and Automation, May 2015.
- [18] T. Wu and T. Lee. Spacecraft attitude formation stabilization using lines-of-sight without angular velocity measurements. In *Proceedings of the AAS/AIAA Space Flight Mechanics Meeting*, February 2015. AAS 15-441.
- *[19] S. Kulumani and T. Lee. Systematic design of optimal low-thrust transfers for the three-body problem. *Acta Astronautica*, 2015. submitted.
- *[20] F. Goodarzi and T. Lee. Stabilization of a rigid body payload with multiple cooperative quadrotors. *ASME Journal of Dynamic Systems, Measurement, and Control*, 2015. submitted.
- *[21] T. Wu, B. Flewelling, F. Leve, and T. Lee. Spacecraft attitude formation tracking using line-of-sight measurements. *AIAA Journal of Guidance, Control, and Dynamics*, 2015. submitted.

- [22] S. Dai, T. Lee, and D. Bernstein. Adaptive control of a quadrotor UAV transporting a cable-suspended load with unknown mass. In *Proceedings of the IEEE Conference on Decision and Control*, pages 6149–6154, December 2014.
- [23] T. Wu and T. Lee. Spacecraft position and attitude formation control using line-of-sight observations. In *Proceedings of the IEEE Conference on Decision and Control*, pages 970–975, December 2014.
- [24] T. Lee. Geometric control of multiple quadrotor UAVs transporting a cable-suspended rigid body. In *Proceedings of the IEEE Conference on Decision and Control*, pages 6155–6160, December 2014.
- [25] T. Lee. Optimal control of partitioned hybrid systems via discrete-time Hamilton-Jacobi theory. *Automatica*, 50(8):2062–2069, August 2014. doi:10.1016/j.automatica.2014.05.024.
- [26] F. Goodarzi, D. Lee, and T. Lee. Geometric stabilization of a quadrotor UAV with a payload connected by flexible cable. In *Proceedings of the American Control Conference*, pages 4925–4930, June 2014.
- [27] J. Dougherty, D. Lee, and T. Lee. Laser-based guidance of a quadrotor UAV for precise landing on an inclined surface. In *Proceedings of the American Control Conference*, pages 1210–1215, June 2014.
- [28] E. Kaufman, K. Caldwell, D. Lee, and T. Lee. Design and development of a free-floating hexrotor UAV for 6-dof maneuvers. In *Proceedings of the IEEE Aerospace Conference*, March 2014.
- [29] T. Lee, K. Sreenath, and V. Kumar. Geometric control of cooperating multiple quadrotor UAVs with a suspended load. In *Proceedings of the IEEE Conference on Decision and Control*, volume 5510–5515, Florence, Italy, December 2013.
- [30] K. Sreenath, T. Lee, and V. Kumar. Geometric control and differential flatness of a quadrotor UAV with a cable-suspended load. In *Proceedings of the IEEE Conference on Decision and Control*, pages 2269–2274, Florence, Italy, December 2013.
- [31] T. Wu, T. Lee, and M. Keidar. Low-thrust attitude control for nano-satellite with micro-cathode thrusters. In *Proceedings of the International Electric Propulsion Conference*, Washington, DC, October 2013. IEPC-2013-366.
- [32] T. Lee. Robust adaptive tracking on $SO(3)$ with an application to the attitude dynamics of a quadrotor UAV. *IEEE Transactions on Control Systems Technology*, 21(5):1924–1930, September 2013. doi:10.1109/TCST.2012.2209887.
- [33] M. Camblor, A. Xie, G. Cruz, S. Esteban, T. Lee, and D. Bernstein. A numerical comparison of inertia-free attitude control laws for a spacecraft with a discrete flexible mode. In *Proceedings of the AIAA Guidance, Navigation and Control Conference*, Boston, MA, August 2013. AIAA 2013-4562.
- [34] F. Goodarzi, D. Lee, and T. Lee. Geometric nonlinear PID control of a quadrotor UAV on $SE(3)$. In *Proceedings of the European Control Conference*, pages 3845–3850, Zurich, July 2013.
- [35] T. Lee. Robust global exponential attitude tracking controls on $SO(3)$. In *Proceedings of the American Control Conference*, pages 2103–2108, Washington, DC, June 2013.
- [36] T. Wu, B. Flewelling, F. Leve, and T. Lee. Spacecraft relative attitude formation tracking on $SO(3)$ based on line-of-sight measurements. In *Proceedings of the American Control Conference*, pages 4827–4832, Washington, DC, June 2013.
- [37] T. Lee, M. Leok, and N.H. McClamroch. Nonlinear robust tracking control of a quadrotor UAV on $SE(3)$. *Asian Journal of Control*, 15(2):391–408, March 2013. doi:10.1002/asjc.567.
- [38] T. Lee, M. Leok, and N.H. McClamroch. Dynamics and control of a chain pendulum on a cart. In *Proceedings of the IEEE Conference on Decision and Control*, pages 2502–2508, Maui, HI, December 2012.
- [39] T. Lee. Discrete-time optimal feedback control via the discrete Hamilton-Jacobi theory with applications to hybrid systems. In *Proceedings of the IEEE Conference on Decision and Control*, pages 7055–7062, Maui, HI, December 2012.
- [40] T. Lee, M. Leok, and N.H. McClamroch. Nonlinear robust tracking control of a quadrotor UAV on $SE(3)$. In *Proceedings of the American Control Conference*, pages 4649–4654, Montreal, Canada, June 2012.
- [41] T. Lee. Relative attitude control of two spacecraft on $SO(3)$ using line-of-sight observations. In *Proceedings of the American Control Conference*, pages 167–172, Montreal, Canada, June 2012.

- [42] T. Lee. Exponential stability of an attitude tracking control system on $SO(3)$ for large-angle rotational maneuvers. *Systems and Control Letters*, 61(1):231–237, January 2012. doi:10.1016/j.sysconle.2011.10.017.
- [43] T. Fernando, J. Chandiramani, T. Lee, and H. Gutierrez. Robust adaptive geometric tracking controls on $SO(3)$ with an application to the attitude dynamics of a quadrotor UAV. In *Proceedings of the IEEE Conference on Decision and Control*, pages 7380–7385, Orlando, FL, December 2011.
- [44] T. Lee, M. Leok, and N.H. McClamroch. Geometric tracking control of a quadrotor UAV for extreme maneuverability. In *Proceedings of the World Congress of the International Federation of Automatic Control*, pages 6337–6342, Milano, Italy, August 2011.
- [45] T. Lee. Geometric tracking control of the attitude dynamics of a rigid body on $SO(3)$. In *Proceedings of the American Control Conference*, pages 1200–1205, San Francisco, CA, June 2011.
- [46] T. Lee, M. Leok, and N.H. McClamroch. Geometric tracking control of a quadrotor aerial vehicle on $SE(3)$. In *Proceedings of the IEEE Conference on Decision and Control*, pages 5420–5425, Atlanta, GA, December 2010. (**Google citation: 240+**).
- [47] T. Lee, M. Leok, and N.H. McClamroch. Computational geometric optimal control of connected rigid bodies in a perfect fluid. In *Proceedings of the American Control Conference*, pages 5985–5990, Baltimore, MD, June 2010. url:<http://arxiv.org/abs/0705.3868>.
- [48] T. Lee, M. Leok, and N.H. McClamroch. Discrete control systems. In *the Encyclopedia of Complexity and System Science*, pages 2002–2019. Springer, 2009.
- [49] T. Lee, M. Leok, and N.H. McClamroch. Optimal attitude control of a rigid body using geometrically exact computations on $SO(3)$. *Journal of Dynamical and Control Systems*, 14(4):465–487, October 2008. doi:10.1007/s10883-008-9047-7.
- [50] T. Lee, M. Leok, and N.H. McClamroch. Time optimal attitude control for a rigid body. In *Proceedings of the American Control Conference*, pages 5210–5215, Seattle, WA, June 2008. url:<http://arxiv.org/abs/0709.2514>.
- [51] T. Lee, M. Leok, and N.H. McClamroch. Computational geometric optimal control of rigid bodies. *Communications in Information and Systems, special issue dedicated to R. W. Brockett*, 8(4):445–472, 2008.
- [52] T. Lee, M. Leok, and N.H. McClamroch. A combinatorial optimal control problem for spacecraft formation reconfiguration. In *Proceedings of the IEEE Conference on Decision and Control*, pages 5370–5375, New Orleans, LA, December 2007. url:<http://arxiv.org/abs/math.OA/0702738>.
- [53] T. Lee, M. Leok, and N.H. McClamroch. Optimal attitude control for a rigid body with symmetry. In *Proceedings of the American Control Conference*, pages 1073–1078, New York, NY, July 2007. url:<http://arxiv.org/abs/math.OA/06009482>.
- [54] T. Lee, M. Leok, and N.H. McClamroch. Optimal control of a rigid body using geometrically exact computations on $SE(3)$. In *Proceedings of the IEEE Conference on Decision and Control*, pages 2170–2175, San Diego, CA, December 2006. url:<http://arxiv.org/abs/math.OA/0602588>.
- [55] T. Lee, M. Leok, and N.H. McClamroch. Attitude maneuvers of a rigid spacecraft in a circular orbit. In *Proceedings of the American Control Conference*, pages 1742–1747, Minneapolis, MN, June 2006. url:<http://arxiv.org/abs/math.NA/0509299>.

Computational Geometric Mechanics

- [1] T. Lee, M. Leok, and N.H. McClamroch. Geometric formulations of Furuta pendulum control problems. *Mathematics in engineering, science and aerospace*, 7(1):69–81, 2016.
- [2] T. Lee, M. Leok, and N.H. McClamroch. Global formulations of Lagrangian and Hamiltonian mechanics on two-spheres. In *Proceedings of the IEEE Conference on Decision and Control*, pages 6010–6015, Osaka, Japan, December 2015.
- [3] T. Lee, M. Leok, and N.H. McClamroch. Global formulations of Lagrangian and Hamiltonian dynamics on embedded manifolds. In *Proceedings of the IMA Conference on Mathematics of Robotics*, September 2015.

- [4] T. Lee, F. Leve, M. Leok, and N.H. McClamroch. Lie group variational integrators for spacecraft with variable speed control moment gyros. In *Proceedings of the U.S. National Congress on Computational Mechanics*, July 2015.
- [5] T. Lee and F. Leve. Lagrangian mechanics and Lie group variational integrators for spacecraft with imbalanced reaction wheels. In *Proceedings of the American Control Conference*, pages 3122–3127, June 2014.
- [6] T. Lee, M. Leok, and N.H. McClamroch. High-fidelity numerical simulation of complex dynamics of tethered spacecraft. *Acta Astronautica*, 99(1):215–230, June 2014. doi:10.1016/j.actaastro.2014.02.021.
- [7] T. Lee and M. Keidar. Low-thrust orbital maneuver analysis for Cubesat with micro-cathode thruster. In *Proceedings of the International Electric Propulsion Conference*, Washington, DC, October 2013. IEPC-2013-365.
- [8] T. Lee, M. Leok, and N.H. McClamroch. Stable manifolds of saddle points for pendulum dynamics on S^2 and $SO(3)$. In *Proceedings of the IEEE Conference on Decision and Control*, pages 3915–3921, Orlando, FL, December 2011.
- [9] T. Lee, M. Leok, and N.H. McClamroch. Geometric numerical integration for complex dynamics of tethered spacecraft. In *Proceedings of the American Control Conference*, pages 1885–1891, San Francisco, CA, June 2011.
- [10] T. Lee, M. Leok, and N.H. McClamroch. Computational dynamics of a 3D elastic string pendulum attached to a rigid body and an inertially fixed reel mechanism. *Nonlinear Dynamics*, 64(1-2):97–115, April 2011. doi:10.1007/s11071-010-9849-5.
- [11] N. Chaturvedi, T. Lee, M. Leok, and N.H. McClamroch. Nonlinear dynamics of the 3D pendulum. *Journal of Nonlinear Science*, 21(1):3–32, February 2011. doi:10.1007/s00332-010-9078-6.
- [12] T. Lee, M. Leok, and N.H. McClamroch. Dynamics of a 3D elastic string pendulum. In *Proceedings of IEEE Conference on Decision and Control*, pages 3347–3352, Shanghai, China, December 2009.
- [13] T. Lee, M. Leok, and N.H. McClamroch. Lagrangian mechanics and variational integrators on two-spheres. *International Journal for Numerical Methods in Engineering*, 79(9):1147–1174, August 2009. doi:10.1002/nme.2603.
- [14] T. Lee, M. Leok, and N.H. McClamroch. Dynamics of connected rigid bodies in a perfect fluid. In *Proceedings of the American Control Conference*, pages 408–413, St. Louis, MO, June 2009. url:<http://arxiv.org/abs/0809.1488>.
- [15] T. Lee. *Computational Geometric Mechanics and Control of Rigid Bodies*. PhD thesis, University of Michigan, 2008.
- [16] T. Lee, M. Leok, and N.H. McClamroch. Lie group variational integrators for the full body problem in orbital mechanics. *Celestial Mechanics and Dynamical Astronomy*, 98(2):121–144, June 2007. doi:10.1007/s10569-007-9073-x.
- [17] T. Lee, M. Leok, and N.H. McClamroch. Lie group variational integrators for the full body problem. *Computer Methods in Applied Mechanics and Engineering*, 196:2907–2924, May 2007. doi:10.1016/j.cma.2007.01.017.
- [18] E. Fahnestock, T. Lee, M. Leok, N.H. McClamroch, and D. Scheeres. Polyhedral potential and variational integrator computation of the full two body problem. In *Proceedings of the AIAA/AAS Astrodynamics Specialist Conference and Exhibit*, Keystone, CO, August 2006. AIAA 2006-6289. url:<http://arxiv.org/abs/math.OC/0601424>.
- [19] T. Lee, M. Leok, and N.H. McClamroch. A Lie group variational integrator for the attitude dynamics of a rigid body with application to the 3D pendulum. In *Proceedings of the IEEE Conference on Control Application*, pages 962–967, Toronto, Canada, August 2005.

Uncertainty Propagation / Estimation

- *[1] M. Bisheban and T. Lee. Computational geometric system identification for the attitude dynamics on $SO(3)$. In *Proceedings of the American Control Conference*, July 2017. submitted.
- [2] S. Kulumani and T. Lee. Bayesian attitude estimation on $SO(3)$ with matrix Fisher mixtures. In *Proceedings of the AIAA/AAS Spaceflight Mechanics Meeting*, February 2017. accepted.
- [3] C. Mallon, B. Muthig, K. Gamagedara, K. Patil, C. Friedman, T. Lee, and M. Snyder. Measurements of ship air wake using airborne anemometers. In *Proceedings of AIAA Aerospace Sciences Meeting*, January 2017. accepted.

- [4] E. Kaufman, Z. Ai, and T. Lee. Autonomous exploration by expected information gain from probabilistic occupancy grid mapping. In *Proceedings of the IEEE Conference on Simulation, Modeling, and Programming for Autonomous Robots*, December 2016.
- [5] E. Kaufman, T. Lovell, and T. Lee. Minimum uncertainty JPDA filters and coalescence avoidance for multiple object tracking. *Journal of the Astronautical Sciences*, 63(4):308–334, December 2016. doi:10.1007/s40295-016-0092-2.
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- [8] T. Lee. Global unscented attitude estimation via the matrix Fisher distributions on $SO(3)$. In *Proceedings of the American Control Conference*, pages 4942–4947, Boston, MA, July 2016.
- [9] F. Goodarzi and T. Lee. Extended Kalman filter on $SE(3)$ for geometric control of a quadrotor UAV. In *Proceedings of the IEEE International Conference on Unmanned Aircraft Systems*, pages 1371–1380, Washington, DC, June 2016.
- [10] E. Kaufman, T. Lovell, and T. Lee. Nonlinear observability for relative orbit determination with angles-only measurements. *Journal of the Astronautical Sciences*, 63(1):60–80, March 2016. doi:10.1007/s40295-015-0082-9.
- *[11] F. Goodarzi and T. Lee. Global formulation of an extended Kalman filter on $SE(3)$ for geometric control of a quadrotor UAV. *Journal of Intelligent and Robotic Systems*, 2016. submitted.
- *[12] M. Bisheban and T. Lee. Computational geometric system identification for the attitude dynamics on $SO(3)$. *Journal of Control, Automation and Systems Engineering*, 2016. submitted.
- *[13] E. Kaufman, K. Takami, T. Lee, and Z. Ai. Autonomous exploration with exact inverse sensor models. *Journal of Intelligent and Robotic Systems*, 2016. submitted.
- *[14] T. Wu, E. Kaufman, and T. Lee. Hybrid attitude observer on $SO(3)$ with global asymptotic stability. *AIAA Journal of Guidance, Control, and Dynamics*, 2016. submitted.
- [15] J. Dougherty and T. Lee. Monocular estimation of ground orientation for autonomous landing of a quadrotor. *AIAA Journal of Guidance, Control, and Dynamics*, 39(6):1407–1416, 2016. doi:10.2514/1.G001229.
- [16] T. Wu, E. Kaufman, and T. Lee. Globally asymptotically stable attitude observer on $SO(3)$. In *Proceedings of the IEEE Conference on Decision and Control*, pages 2164–2168, Osaka, Japan, December 2015.
- [17] T. Wu and T. Lee. Angular velocity observer on the special orthogonal group for velocity-free rigid-body attitude tracking control. In *Proceedings of the European Control Conference*, pages 1824–1829, Linz, Austria, July 2015.
- [18] T. Lee. Stochastic optimal motion planning for the attitude kinematics of a rigid body with non-gaussian uncertainties. *ASME Journal of Dynamic Systems, Measurement, and Control*, 137(3):034502, March 2015. doi:10.1115/1.4027950.
- [19] E. Kaufman, A. Lovell, and T. Lee. Nonlinear observability measure for relative orbit determination with angles-only measurements. In *Proceedings of the AAS/AIAA Space Flight Mechanics Meeting*, February 2015. AAS 15-451.
- [20] E. Kaufman, A. Lovell, and T. Lee. Minimum uncertainty JPDA filter and coalescence avoidance performance evaluations. In *Proceedings of the AAS/AIAA Space Flight Mechanics Meeting*, February 2015. AAS 15-451.
- [21] E. Kaufman and T. Lee. Optimal joint probabilistic data association filter avoiding coalescence in close proximity. In *Proceedings of the European Control Conference*, pages 2709–2714, June 2014.
- [22] T. Lovell and T. Lee. Nonlinear observability for relative satellite orbits with angles-only measurements. In *Proceedings of the International Symposium on Space Flight Dynamics*, May 2014.
- [23] T. Lee. Stochastic optimal motion planning and global estimation for the attitude kinematics on $SO(3)$. In *Proceedings of the IEEE Conference on Decision and Control*, volume 588–593, Florence, Italy, December 2013.

- [24] T. Lee and M. Leok. Computational geometric uncertainty propagation and global estimation for Hamiltonian systems on a Lie group. Proceedings of the NSF CMMI Research and Innovation Conference, July 2012.
- [25] T. Lee and M. Leok. Computational geometric uncertainty propagation for Hamiltonian systems on a Lie group. Proceedings of the NSF CMMI Research and Innovation Conference, February 2011.
- [26] T. Lee, M. Leok, and N.H. McClamroch. Global symplectic uncertainty propagation on $SO(3)$. In *Proceedings of the IEEE Conference on Decision and Control*, pages 61–66, Cancun, Mexico, December 2008. url:<http://arxiv.org/abs/0803.1515>.
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- [29] T. Lee, M. Leok, N.H. McClamroch, and A. Sanyal. Global attitude estimation using single direction measurements. In *Proceedings of the American Control Conference*, pages 3659–3664, New York, NY, July 2007. url:<http://arxiv.org/abs/math.OC/06009>.
- [30] T. Lee, A. Sanyal, M. Leok, and N.H. McClamroch. Deterministic global attitude estimation. In *Proceedings of the IEEE Conference on Decision and Control*, pages 3174–3179, San Diego, CA, December 2006. url:<http://arxiv.org/abs/math.OC/0602589>.

Nonlinear Flight Control

- [1] N.H. McClamroch and T. Lee. Optimal flight planning for a jet aircraft mission. In K. Murty, editor, *Case Studies in Operations Research*, volume 212 of *International Series in Operations Research and Management Science*, , pages 355–390. Springer, 2015.
- [2] T. Lee and Y. Kim. Nonlinear adaptive flight control using backstepping and neural networks controller. *AIAA Journal of Guidance, Control, and Dynamics*, 24(4):675–682, July 2001. doi:10.2514/2.4794.
- [3] T. Lee, Y. Kim, and D. Kim. Stability analysis of nonlinear flight control using neural networks. In *Proceedings of the 3rd Asian Control Conference*, Shanghai, China, July 2000.
- [4] T. Lee and Y. Kim. Nonlinear adaptive flight control using neural networks and backstepping. *Journal of Control, Automation and Systems Engineering*, 6(12):1070–1078, 2000.
- [5] T. Lee and Y. Kim. Robust nonlinear control of flight dynamics using backstepping controller. In *Proceedings of the Korean Society for Aeronautical and Space Sciences Fall Conference*, Kyoungki, Korea, November 1999.
- [6] T. Lee and Y. Kim. Nonlinear adaptive control of flight dynamics using backstepping and neural networks controller. In *Proceedings of the Institute of Control, Automation, and System Engineering 5th Conference*, Yongin, Korea, October 1999.
- [7] J. Ahn, T. Lee, and Y. Kim. Real-time missile trajectory optimization using parameter optimization. In *Proceedings of the Japan Society for Aeronautical and Space Sciences (JSASS) 13th International Sessions in 37th Aircraft Symposium*, Tokyo, Japan, October 1999.
- [8] J. Ahn, T. Lee, and Y. Kim. Real time formulation of missile trajectory optimization using a parameter optimization technique. *Journal of Korean Society for Aeronautical and Space Sciences*, 27(4):94–103, 1999.

Invited Talks

<i>Geometric Mechanics and Control on Nonlinear Manifolds for Complex Aerospace Systems</i> University of Michigan, Ann Arbor, MI	Mar 2016
<i>Geometric Mechanics and Control on Nonlinear Manifolds for Complex Aerospace Systems</i> MAE Seminar Series, Syracuse University, Syracuse, NY	Mar 2016
<i>Global Formulations of Stochastic Analysis on Manifolds</i> NSF Workshop on Learning, Perception and Control in Robots and Humans, Arlington VA	Aug 2015
<i>Geometric Mechanics and Control on Nonlinear Manifolds for Complex Aerospace Systems</i> MAE Seminar Series, Seoul National University, South Korea	Sep 2014
<i>Geometric Mechanics and Control on Nonlinear Manifolds for Complex Aerospace Systems</i> Department Seminar Series, Yonsei University, South Korea	Sep 2014
<i>Stochastic Optimal Motion Planning and Estimation for the Attitude Kinematics on $SO(3)$</i> AMS Eastern Sectional Meeting, Special Session on Mechanics and Control, Baltimore MD	Mar 2014
<i>Geometric Mechanics and Control on Nonlinear Manifolds for Complex Aerospace Systems</i> AFRL Seminar Series, Kirtland AFB, Albuquerque NM	Jul 2013
<i>Computational Geometric Mechanics and Controls for Complex Aerospace Systems</i> ECE Seminar Series, University of Virginia	Mar 2013
<i>Computational Geometric Mechanics and Control on Nonlinear Manifolds</i> Mathematics Colloquium Series, University of Maryland Baltimore County	Nov 2011
<i>Geometric Control on Nonlinear Manifolds for Complex Aerospace Systems</i> Physical Sciences Department Colloquium Series, Embry-Riddle Aeronautical University	Apr 2011
<i>Geometric Control on Nonlinear Manifolds for Complex Aerospace Systems</i> MAE Seminar, George Washington University	Mar 2011
<i>Discrete Geometric Mechanics</i> Young Researchers Workshop on Geometry, Mechanics and Control, University of La Laguna, Spain	Dec 2010
<i>Computational Geometric Mechanics and Control of Multibody Systems</i> University of Michigan	May 2010
<i>Lie Group Variational Integrator for Dynamics and Control of Multibody Systems</i> Structured Integrators Workshop, University of California, San Diego	Apr 2010
<i>Computational Geometric Mechanics and Control of Rigid Bodies</i> Florida Institute of Technology, Melbourne, Florida	Feb 2008
<i>Computational Geometric Mechanics, Control, and Estimation of Rigid Bodies on Lie Groups</i> SIAM Conference on Computational Science and Engineering, Costa Mesa, California	Feb 2007
<i>Optimal Control of a Rigid Body using Geometrically Exact Computations on Lie Groups</i> Flight Dynamics and Control Seminar, University of Michigan	Oct 2006
<i>Attitude Maneuvers of a Rigid Spacecraft in a Circular Orbit</i> Flight Dynamics and Control Seminar, University of Michigan	Nov 2005
<i>Lie Group Variational Integrator for the Attitude dynamics of a Rigid body</i> Flight Dynamics and Control Seminar, University of Michigan	Feb 2005

Editorial Services

- Committee Member:** Technical Program Committee Oct 2014-Jul 2016
2016 American Control Conference
- Committee Member:** Program Committee, Conference Organization Board Oct 2014-Sep 2015
2015 IMA Conference on Mathematics on Robotics
- Associate Editor:** Conference Editorial Board, IEEE Robotics and Automation Society Dec 2014-present
2015, 2016, 2017 IEEE Conference on Robotics and Automation
- Associate Editor:** Conference Editorial Board, IEEE Control System Society Jun 2013-present
2014, 2015, 2016, 2017 American Control Conference
2014, 2015, 2016 IEEE Conference on Decision and Control
- Associate Editor:** Journal on Automation and Control Engineering Mar 2013-present

Conference Organization and Service

- Committee Member:** Local Arrangement Committee, Conference Organization Board Jun 2013
American Control Conference
- Organizer, Chair:** Geometric Control on Nonlinear Manifolds Dec 2010
Invited Session at IEEE Conference on Decision and Control, Atlanta
- Organizer, Chair:** Synergies and Interplay of Nonlinear Dynamics and Control May 2010
Symposium in honor of Dr. Harris McClamroch, University of Michigan
“HarrisFest [Conference Report],” *IEEE Control System Magazine*, vol. 30, no. 5, pp. 81-83, 2010

Professional Service and Review

- Review Panelist:** National Science Foundation (NSF) 2013, 2015
- Reviewer:** National Science Foundation (NSF); IEEE Transactions on Automatic Control; IEEE Transactions on Control Systems Technology; IEEE Transactions on Neural Networks; IEEE Transaction on Plasma Science; IEEE Transactions on Industrial Electronics; IEEE Robotics and Automation Magazine; SIAM Journal on Control and Optimization; ASME Journal of Dynamics, Measurements, and Control; AIAA Journal of Guidance, Control, and Dynamics; International Journal of Aerospace Engineering; International Journal of Adaptive Control and Signal Processing; International Journal of Advanced Robotic Systems; International Journal of Control; International Journal of Control, Automation and Systems; International Journal of Robust and Nonlinear Control; Asian Journal of Control; Acta Astronautica; Aerospace Science & Technology; Automatica; Celestial Mechanics and Dynamical Astronomy; The Astronomical Journal; Control Engineering Practice; Computer Physics Communications; Chinese Journal of Aeronautics; The Astronomical Journal; Journal of Aerospace Engineering; Journal of Nonlinear Science; Transactions of the Japan Society for Aeronautical and Space Sciences, Aerospace Technology; Robotica; Symmetry, Integrability and Geometry: Methods and Applications; Systems and Control Letters; IEEE Conference on Decision and Control; IEEE Multi-conference on Systems and Control; IEEE International Conference on Robotics and Automation; IEEE International Conference on Intelligent Robots and Systems; AIAA Guidance, Navigation and Control Conference; American Control Conference; Applied Mathematical Modelling; European Control Conference; International Conference on Unmanned Aircraft Systems; IMA Conference on Mathematics of Robotics
- Assessment Coordinator:** University coordinator for Southern Association of Colleges and Schools (SACS) accreditation
- Judge:** SSPI Mid-Atlantic Regional Chapter Scholarship Competition Apr 2011
- Judge:** SEAS Research and Development Showcase 2013, 2014

University Service

<i>Committee Member</i> : Research Committee, Faculty Senate, GWU	2013-2014
<i>Committee Member</i> : Graduate Curriculum Committee, Mechanical and Aerospace Engineering, GWU	2013-2015
<i>Faculty secretary</i> : Mechanical and Aerospace Engineering, GWU	2012-2013

Mentoring Experiences

Postdoctoral Scientist	Dr. Kuya Takami: Autonomous aerial exploration	2016-present
	Dr. Daewon Lee: Adaptive control of autonomous load transportation	2012-2014
Graduate Students	Evan Kaufman (Ph.D): Autonomous aerial exploration	2012-present
	Shankar Kulumani (Ph.D): Low thrust optimal orbital maneuvers	2014-present
	Mahdis Bisheban (Ph.D): Geometric control of quadrotors under wind	2015-present
	Kalpesh Patil (MS): Development of telemetry for ship air wakes	2015-present
	Kanishke Gamagedar (MS): Development of telemetry for ship air wakes	2016-present
Former Graduate Students	Dr. Tse-Huai Wu: Geometric control and estimation on SO(3)	2013-2015
	Dr. Farhad Goodarzi (Ph.D): Geometric control of quadrotor UAV	2011-2015
	Kiren Caldwell (MS) : Outdoor flight of quadrotor UAV via differential GPS	2014-2015
	John A. Dougherty (MS): Laser-based guidance of quadrotor UAV	2013-2014
	Tse-Huai Wu (MS): Vision-based spacecraft formation control	2011-2013
Undergraduate Students	Chris Poole : Development of multirotor UAV	2015-present
	Kiren Caldwell : Development of user interface for UAV control	2013-2014
	John Dougherty: Development of i2c interface circuit board	2012-2013
	Ryan Mossbarger: Development of thrust stand	2012-2013
Thesis Committee	Sungrae Kim (MS): Micro-cathode arc thruster	Mar 2016
	Joel Slotten (Ph.D): Investigation of orbital debris	Jan 2016
	Joseph Lukas (Ph.D): Enhancing micro-cathode arc thruster	Jan 2016
	Tse-Huai Wu (Ph. D): Geometric control and estimation on SO(3)	Nov 2015
	Farhad Goodarzi (Ph.D): Geometric control of quadrotor UAV	Jul 2015
	John A. Dougherty (MS): Laser-based guidance of quadrotor UAV	May 2014
	George Teel (MS): Heated-anode cathode arc thruster	May 2014
	Dereck Chiu (MS): Bi-modal micro-cathode arc thruster	May 2014
	Jaime Hervas at ERAU (Ph.D): Higher-order nonholonomic systems	Jul 2013
	Paul Moubarak (Ph.D): Reconfigurable multi-directional manipulation	Mar 2013
	TaiSen Zhuang (Ph.D): Micro-cathode thruster for cube satellite propulsion	Dec 2012
	Tse-Huai Wu (MS): Spacecraft relative attitude formation tracking	Nov 2012
	John Solder (MS): Magnetically enhanced micro-cathode vacuum arc thruster	Jul 2012
	Brenton Duffy (Ph.D): Perturbation for the elliptic restricted three-body problem	Mar 2012
	Lubos Brieda (Ph.D): Multi-scale simulation of hall thrusters	Mar 2012
Therese Suaris (Ph.D): Micro-vacuum arc thrusters and frozen orbits	Aug 2011	

Award by Supervised Students

<i>Student Travel Award:</i> (Evan Kaufman, Shankar Kulumani), American Control Conference	2016
<i>Experimental Research Awards– 1st Place</i> (Shankar Kulumani, Christopher Poole) Geometric adaptive control of attitude dynamics on SO(3) with state inequality constraints SEAS R&D Showcase, George Washington University	2016
<i>Heatherington Family Annual Scholarship:</i> (Shankar Kulumani)	2016
<i>Most Innovative/Creative Project Award:</i> (Shankar Kulumani) Systematic design of optimal low-thrust orbital transfers in the three-body problem The 5th Annual Student Competition, Society for Satellite Professional Internationals (SSPI)	2015
<i>Second Prize:</i> (John Dougherty) Laser-based onboard sensing and estimation for precise landing of a quadrotor UAV on an inclined surface AIAA Region I Student Conference	2014
<i>Second Prize:</i> (Tse-Huai Wu), Vision-based spacecraft attitude formation control GWU Research Day	2014
<i>Student Travel Award:</i> (Farhad Goodarzi, John Dougherty), American Control Conference	2014
<i>Third Place Prize:</i> (Tse-Huai Wu), Vision-Based Spacecraft Formation Control and Estimation Network The 3rd Annual Student Competition, Society for Satellite Professional Internationals (SSPI)	2013
<i>SUPER Fellowship:</i> (Kiren Caldwell), Spacecraft Formation Control Testbed with Free-Floating Aerial Vehicles Summer Undergraduate Program in Engineering Research, The George Washington University	2013

Teaching Experience (average student evaluation: 4.8/5.0)

<i>MAE3145: Orbital Mechanics and Space Dynamics</i>	Fall 2011-2016
<i>MAE6292: Special Topic: Applied Nonlinear Control</i>	Spring 2012,2014,2016
<i>MAE6292: Special Topic: Optimal Control and Estimation</i>	Spring 2015
<i>MAE6277: Spacecraft Attitude Control</i>	Spring 2013, 2017
<i>MAE6246: Electromechanical Control Systems</i>	Spring 2013, Fall 2013-2016
Department of Mechanical and Aerospace Engineering, The George Washington University	
<i>MAE5690: Special Topic: Spacecraft Dynamics and Control</i>	Spring 2011
<i>MAE5690: Special Topic: Nonlinear Systems</i>	Fall 2010
<i>MAE4600: Engineering Astrodynamics</i>	Fall 2009
<i>MAE4242: Aircraft Stability and Control</i>	Fall 2008-2010
<i>MAE4014: Control Systems</i>	Spring 2009-2011
<i>MAE2082: Dynamics</i>	Spring, Summer 2010
Department of Mechanical and Aerospace Engineering, Florida Institute of Technology	

Outreach

<i>Introduction to Control System Engineering</i> Workshop for Robotics Group at Bell Multicultural High School	May 2015
<i>Introduction to Control System Engineering</i> Workshop for Robotics Group at Bell Multicultural High School	May 2014
<i>Introduction to Control System Engineering</i> Engineering Summer Camp for K-12 Students, Florida Institute of Technology	Jul 2010

References

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