

## CURRICULUM VITAE

### Dale A. Lawrence

January, 2024

**CURRENT DATA** Professor  
University of Colorado  
Department of Aerospace Engineering Sciences  
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#### EDUCATION

**PhD 1985** Electrical Engineering, Cornell University. Course work centered on system theory, including nonlinear and adaptive systems. Minor in mathematics. Advisor: C. Richard Johnson, Jr. Dissertation Title: "Adaptive System Stability Analysis via Energy Exchange".

**MS 1982** Electrical Engineering, Cornell University. Thesis Title: "Stability Analysis of a Generalized Discrete-Time Parameter Estimation Algorithm".

**BS 1980** Electrical Engineering (With Distinction) Colorado State University, 1980.

#### RESEARCH INTERESTS

Basic research in dynamics and control, particularly in the areas of adaptive and nonlinear systems. Theoretical methods for analysis and design in practical applications. Recent activity has focused on unmanned aerial vehicles for atmospheric measurements.

#### EMPLOYMENT HISTORY

**2010 – present** Professor, University of Colorado, Aerospace Engineering Sciences

**1995 - 2010** Associate Professor, University of Colorado, Aerospace Engineering Sciences

**1991---1995** Assistant Professor, University of Colorado, Aerospace Engineering Sciences

**1988---1991** Assistant Professor, University of Cincinnati, Electrical and Computer Engineering

**1985---1988** Staff Engineer, Martin Marietta Astronautics Group, Denver, CO, robotics research and development for space applications

**1981---1985** Graduate Research Assistant, Cornell University, research in adaptive systems

**1982 (summer)** Member of Technical Staff, Technicare Corporation, Englewood, CO, control system design and development for precision actuators

**1980---1981** Graduate Research Assistant, Virginia Polytechnic Institute, Blacksburg, VA, research in large space structure control

**1980 (summer)** Member of Technical Staff, ADR Ultrasound, Inc., Tempe, AZ, control system design and evaluation for ultrasonic imaging systems

**1978---1980** Laboratory Technician, Colorado State University, Ft. Collins, CO, instrumentation development

#### AWARDS

**2015** Best Paper, *AIAA Spacecraft Structures Conference*

**2008** Associate Fellow, AIAA

**2005** Best Paper, *World Haptics Symposium*, Pisa Italy

**2004** Best Commercial Potential Award, *IEEE Symposium on Haptic Interfaces*

**2000** Best Paper, *AIAA Guidance Navigation and Control Conference*

**1991** Eta Kappa Nu Teaching Award, Electrical and Computer Engineering, University of Cincinnati

**1990** Teaching Excellence Award, Electrical and Computer Engineering, University of Cincinnati

**1988** Distinguished Publication Award, Martin Marietta Astronautics, Denver, CO

**Refereed Journal Publications** (My students indicated by bold font)

- [J-63] J. Pointer, **C. Roseman**, B. Argrow, and D. Lawrence, "Apparatus for calibration of fine-wire sensors at stratospheric conditions." *Exp. Thermal and Fluid Sci.*, Vol. 149, 2023, <https://doi.org/10.1016/j.expthermflusci.2023.111016>
- [J-62] R. Calmer, G. de Boer, **J. Hamilton**, D. Lawrence, M. Webster, N. Wright, M. Shupe, C. Cox, and J. Cassano, "Relationships between summertime surface albedo and melt pond fraction in the central Arctic Ocean: The aggregate scale of albedo obtained on the MOSAiC floe." *Elementa-Science of the Anthropocene*, Vo. 11, No. 1, 2023, <https://doi.org/10.1525/elementa.2023.00001>.
- [J-61] U. Egerer, J. Cassano, M. Shupe, G. de Boer, D. Lawrence, **A. Doddi**, H. Siebert, G. Jozef, R. Calmer, **J. Hamilton**, C. Pilz, and M. Lonardi, "Estimating turbulent energy flux vertical profiles from uncrewed aircraft system measurements: exemplary results for the MOSAiC campaign", *Atmos. Meas. Tech.*, Vol. 16, pp. 2297–2317, 2023, <https://doi.org/10.5194/amt-16-2297-2023>.
- [J-60] H. Luce, L. Kantha, H. Hashiguchi, D. Lawrence, **A. Doddi**, T. Mixa, and M. Yabuki, "Turbulence Kinetic Energy dissipation rate: Assessment of radar models from comparisons between 1.3 GHz WPR and DataHawk UAV measurements", *Atmos. Meas. Tech.*, Vol. 16, pp. 3561–3580, 2023, <https://doi.org/10.5194/amt-16-3561-2023>.
- [J-59] **J. Hamilton**, G. de Boer, **A. Doddi**, and D. Lawrence, "The DataHawk2 uncrewed aircraft system for atmospheric research", *Atmos. Meas. Tech.*, 15, 6789–6806, 2022, <https://doi.org/10.5194/amt-15-6789-2022>.
- [J-58] A. Jensen, J. Pinto, S. Bailey, R. Sobash, G. Romine, G. de Boer, A. Houston, S. Smith, D. Lawrence, C. Dixon, J. Lundquist, J. Jacob, J. Elston, S. Waugh, D. Brus, and M. Steiner, "Assimilation of a Coordinated Fleet of Uncrewed Aircraft System Observations in Complex Terrain: Observing System Experiments", *AMS Monthly Weather Review*, 150:2737-2763, Oct., 2022, DOI: 10.1175/MWR-D-22-0090.1
- [J-57] de Boer, G., Calmer, R., Jozef, G., Cassano, J., **Hamilton, J.**, Lawrence, D., Borenstein, S., **Doddi, A.**, Cox, C., Schmale, J., Preußner, A., and Argrow, B.: Observing the Central Arctic Atmosphere and Surface with University of Colorado Uncrewed Aircraft Systems, *Nature Sci. Data*, 9:439, 2022, <https://doi.org/10.1038/s41597-022-01526-9>.
- [J-56] **Doddi, A.**, Lawrence, D., Fritts, D., Wang, L., Lund, T., Brown, W., Zajic, D., and Kantha, L.: Instabilities, Dynamics, and Energetics accompanying Atmospheric Layering (IDEAL) Campaign: High-Resolution in situ Observations above the Nocturnal Boundary Layer, *Atmos. Meas. Tech.*, 15, 4023–4045, 2022, <https://doi.org/10.5194/amt-15-4023-2022>.
- [J-55] Shupe, M.D., Rex, M., Blomquist, B., Persson, P. O. G., Schmale, J., Uttal, T., Althausen, D., Angot, H., Archer, S., Bariteau, L., Beck, I., Bilberry, J., Bucci, S., Buck, C., Boyer, M., Brasseur, Z., Brooks, I. M., Calmer, R., Cassano, J., Castro, V., Chu, D., Costa, D., Cox, C. J., Creamean, J., Crewell, S., Dahlke, S., Damm, E., de Boer, G., Deckelmann, H., Dethloff, K., Dütsch, M., Ebell, K., Ehrlich, A., Ellis, J., Engelmann, R., Fong, A. A., Frey, M. M., Gallagher, M. R., Ganzeveld, L., Gradinger, R., Graeser, J., Greenamyre, V., Grieshe, H., Griffiths, S., **Hamilton, J.**, Heinemann, G., Helmig, D., Herber, A., Heuzé, C., Hofer, J., Houchens, T., Howard, D., Inoue, J., Hans-Werner, J., Jaiser, R., Jokinen, T., Jourdan, O., Jozef, G., King, W., Kirchgassner, A., Klingebiel, M., Krassovski, M., Krumpfen, T., Lampert, A., Landing, W., Laurila, T., Lawrence, D., Lonardi, M., Loose, B., Lüpkes, C., Maahn, M., Macke, A., Maslowski, W., Marsay, C., Maturilli, M., Mech, M., Morris, S., Moser, M., Nicolaus, M., Ortega, P., Osborn, J., Pätzold, F., Perovich, D. K., Petäjä, T., Pilz, C., Pirazzini, R., Posman, K., Powers, H., Pratt, K. A., Preußner, A., Quéléver, L., Radenz, M., Rabe, B., Rinke, A., Sachs, T., Schulz, A., Siebert, H., Silva, T., Solomon, A., Sommerfeld, A., Spreen, G., Stephens, M., Stohl, A., Svensson, G., Uin, J., Viegas, J., Voigt, C., von der Gathen, P., Wehner, B.,

Welker, J. M., Wendisch, M., Werner, M., Xie, Z., and Yue, F.: Overview of the MOSAiC Expedition – Atmosphere, *Elementa Sci Anth*, 10: 1, 2022, DOI: <https://doi.org/10.1525/elementa.2021.00060>.

[J-54] Cleary, P. A., de Boer, G., Hupy, J. P., Borenstein, S., Hamilton, J., Kies, B., Lawrence, D., Pierce, R. B., Tirado, J., Voon, A., and Wagner, T. J.: “Observations of the Lower Atmosphere From the 2021 WiscoDISCO Campaign”, *Earth Syst. Sci. Data*, 14, 2129–2145, 2022, <https://doi.org/10.5194/essd-14-2129-2022>.

[J-53] G. de Boer, S. Borenstein, R. Calmer, C. Cox, M. Rhodes, C. Choate, **J. Hamilton**, J. Osborn, D. Lawrence, B. Argrow, and J. Intrieri, “Measurements from the University of Colorado RAAVEN Uncrewed Aircraft System during ATOMIC”, *Earth Syst. Sci. Data*, Vol. 14, pp. 19–31, Jan, 2022, <https://doi.org/10.5194/essd-14-19-2022>.

[J-52] Jensen, A.A., Pinto, J.O., Bailey, S.C.C., Sobash, R.A., de Boer, G., Houston, A.L., Chilson, P.B., Bell, T., Romine, G., Smith, S.W., Lawrence, D.A., Dixon, C., Lundquist, J.K., Jacob, J.D., Elston, J., Waugh, S., and Steiner, M.: Assimilation of a Coordinated Fleet of Uncrewed Aircraft System Observations in Complex Terrain: EnKF System Design and Preliminary Assessment, *Monthly Weather Review*, 149, 1459–1480, <https://doi.org/10.1175/mwr-d-20-0359.1>, May, 2021.

[J-51] G. de Boer, Dixon, C., Borenstein, S., Lawrence, D. A., Elston, J., Hesselius, D., Stachura, M., Laurence III, R., Swenson, S., Choate, C. M., Doddi, A., Sesnic, A., Glasheen, K., Laouar, Z., Quinby, F., Frew, E., and Argrow, B. M.: University of Colorado and Black Swift Technologies RPAS-based measurements of the lower atmosphere during LAPSE-RATE, *Earth Syst. Sci. Data*, 13, 2515–2528, <https://doi.org/10.5194/essd-13-2515-2021>, 2021.

[J-50] **S. M. Cook** and D. A. Lawrence, “Sensitivity of a physically realizable heliogyro root pitch control system to inherent damping models”, *Advances in Space Research*, Vol. 67, No. 9, May, 2021, pp. 2696-2705 <https://doi.org/10.1016/j.asr.2020.09.008>.

[J-49] G. de Boer, A. Houston, J. Jacob, P. Chilson, S. Smith, B. Argrow, D. Lawrence, J. Elston, D. Brus, O. Kemppinen, P. Klein, J. Lundquist, S. Waugh, S. Bailey, A. Frazier, M. Sama, C. Crick, D. Schmale III, J. Pinto, E. Pillar-Little, V. Natalie, and A. Jensen, “Data generated during the 2018 LAPSE-RATE campaign: an introduction and overview”, *Earth System Science Data*, Vol. 12, pp. 3357–3366, 2020. [doi.org/10.5194/essd-12-3357-2020](https://doi.org/10.5194/essd-12-3357-2020)

[J-48] G. de Boer, C. Diehl, J. Jacob, A. Houston, S. Smith, P. Chilson, D. Schmale III, J. Intrieri, J. Pinto, J. Elston, D. Brus, O. Kemppinen, A. Clark, D. Lawrence, S. Bailey, M. Sama, A. Frazier, C. Crick, V. Natalie, E. Pillar-Little, P. Klein, S. Waugh, J. Lundquist, L. Barbieri, S. Kral, A. Jensen, C. Dixon, S. Borenstein, D. Hesselius, K. Human, P. Hall, B. Argrow, T. Thornberry, R. Wright, and J. Kelly, “Development of Community, Capabilities, and Understanding through Unmanned Aircraft-Based Atmospheric Research: The LAPSE-RATE Campaign”, *Bull. Amer. Meteor. Soc.*, Vol. 101, No. 5, 2020. [doi.org/10.1175/BAMS-D-19-0050.1](https://doi.org/10.1175/BAMS-D-19-0050.1)

[J-47] **S. M. Cook**, D. A. Lawrence, J. E. Warren, and W. K. Wilkie, “Improved Modal Damping Characterization for Small-Scale Heliogyro Blades”, *AIAA J. Spacecraft and Rockets*, Vol. 57, No. 4, 2020. DOI: 10.2514/1.A34518.

[J-46] H. Luce, L. Kantha, H. Hashiguchi, **A. Doddi**, D. Lawrence, and M. Yabuki, “On the Relationship between the TKE Dissipation Rate and the Temperature Structure Function Parameter in the Convective Boundary Layer”, *J. Atmospheric Sciences*, Vol. 77, No. 7, pp. 2311–2326, 2020. DOI: 10.1175/JAS-D-19-0274.1

[J-45] Barbieri L., Kral S., Bailey S., Frazier A., Jacob J., Reuder J., Brus D., Chilson P., Crick C., Detweiler C., **Doddi A.**, Elston J., Foroutan H., González-Rocha J., Greene B., Guzman M., Islam A., Kemppinen O., Lawrence D., Pillar-Little E., Ross S., Sama M., Schmale D., Schuyler T., Shankar A., Smith S., Waugh S., Dixon C., Borenstein S., de Boer G. "Intercomparison of Small Unmanned Aircraft System (sUAS) Measurements for Atmospheric Science during the LAPSE-RATE Campaign." *SENSORS*, 19 (9) (May 01, 2019): ARTN 2179.

[J-44] Gijs de Boer , Darielle Dexheimer , Fan Mei , John Hubbe , Casey Longbottom , Peter J. Carroll , Monty Apple , Lexie Goldberger , David Oaks , Justin Lapierre , Michael Crume , Nathan Bernard , Matthew D. Shupe ,

Amy Solomon, Janet Intrieri, Dale Lawrence, **Abhiram Doddi**, Donna J. Holdridge, Michael Hubbell, Mark D. Ivey, and Beat Schmid, "Atmospheric observations made at Oliktok Point, Alaska, as part of the Profiling at Oliktok Point to Enhance YOPP Experiments (POPEYE) campaign", *Earth Syst. Sci. Data*, Vol. 11, pp. 1349–1362, 2019, <https://doi.org/10.5194/essd-11-1349-2019>.

[J-43] H. Luce, D. Lawrence, Y. Hashiguchi, and L. Kantha, "Estimation of turbulence parameters in the lower troposphere from ShUREX (2016-2017) UAV data", *Atmosphere*, Vol. 10, p. 384-409, doi:10.3390/atmos10070384, July 11, 2019.

[J-42] G. de Boer, M. Ivey, B. Schmid, D. Lawrence, D. Dexheimer, F. Mei, J. Hubbe, A. Bendure, J. Hardesty, M. Shupe, et. al. "A BIRD'S-EYE VIEW Development of an Operational ARM Unmanned Aerial Capability for Atmospheric Research in Arctic Alaska." *Bull. Amer. Meteor. Soc.* 99 (6) (June 01, 2018): 1197-1212.

[J-41] G. de Boer, B. Argrow, J. Cassano, J. Cione, E. Frew, D. Lawrence, G. Wick, and C. Wolff, 2018 "Advancing unmanned aerial capabilities for atmospheric research", *Bull. Amer. Meteor. Soc.*, doi:10.1175/BAMS-D-18-0254.1, published online April 9, 2019.

[J-40] H. Luce, L. Kantha, H. Hashiguchi, D. Lawrence, T. Mixa, M. Yabuki, T. Tsuda, "Vertical structure of the lower troposphere derived from MU radar, unmanned aerial vehicle, and balloon measurements during ShUREX 2015", *Prog Earth Planet Sci*, Vol. 5 No. 29, 2018, <https://doi.org/10.1186/s40645-018-0187-4>.

[J-39] H. Luce, L. Kantha, H. Hashiguchi, D. Lawrence, and **A. Doddi**, "Turbulence Kinetic Energy Dissipation Rates Estimated from Concurrent UAV and MU Radar Measurements", *Earth, Planets and Space*, Vol. 70, No. 207, 2018, DOI 10.1186/s40623-018-0979-1.

[J-38] B. Balsley, D. Lawrence, D. Fritts, L. Wang, K. Wan, and J. Werne, "Fine Structure, Instabilities, and Turbulence in the Lower Atmosphere: High-Resolution In-Situ Slant-Path Measurements with the DataHawk UAV and Comparisons with Numerical Modeling", *J Atm. Ocean. Tech.*, Vol. 35, No. 3, 2018, pp. 619-642, DOI 10.1175/JTECH-D-16-0037.1.

[J-37] H. Luce, H. Hashiguchi, L. Kantha, D. Lawrence, T. Tsuda, T. Mixa and M. Yabuki, "On the performance of the range imaging technique estimated using unmanned aerial vehicles during the ShUREX 2015 campaign", *IEEE Trans. Geosci. Remote Sensing*, 2018, Vol. 56, no. 4, pp. 2033-2042, DOI 10.1109/TGRS.2017.2772351.

[J-36] L. Kantha, D. Lawrence, H. Luce, H. Hashiguchi, T. Tsuda, R. Wilson, T. Mixa and M. Yabuki, "Shigaraki UAV-Radar Experiment (ShUREX): Overview of the campaign with some preliminary results", *Prog. Earth Planet. Sci.*, 4:19, 2017, DOI 10.1186/s40645-017-0133-x.

[J-35] H. Luce, L. Kantha, H. Hashiguchi, D. Lawrence, M. Yabuki2, T. Tsuda, T. Mixa, "Comparisons between high-resolution profiles of squared refractive index gradient M2 measured by the Middle and Upper Atmosphere Radar and unmanned aerial vehicles (UAVs) during the Shigaraki UAV-Radar Experiment 2015 campaign", *Ann. Geophys.*, 35, 423–441, 2017, [www.ann-geophys.net/35/423/2017/](http://www.ann-geophys.net/35/423/2017/), doi:10.5194/angeo-35-423-2017.

[J-34] J. Heiligers, **D. Guerrant.**, and D. Lawrence, "Exploring the Heliogyro's Superior Orbital Control Capabilities for Solar Sail Halo Orbits", *AIAA J. Guidance, Control, and Dynamics*, Vol 10, pp. 2569-2586, 2017. DOI 10.2514/1.G002184.

[J-33] E. W. Frew and D. A. Lawrence, "Tracking Dynamic Star Curves using Guidance Vector Fields", *AIAA J. Guidance, Control and Dynamics*, Vol. 40, No. 6, pp. 1488-1498, 2017, DOI 10.2514/1.G002134.

- [J-32] **D. Weibel**, D. Lawrence, and S. Palo, "Optical Beacon Sensor for Small Unmanned Aerial System State Estimation", *Journal of Field Robotics*, Vol. 34, No. 3, 2017, DOI 10.1002/rob.21648.
- [J-31] D. E. Scipi3n, D. A. Lawrence, M. A. Milla, R. F. Woodman, D. A. Lume, and B. B. Balsley, "Simultaneous observations of structure function parameter of refractive index using a high-resolution radar and the DataHawk small airborne measurement system", *Ann. Geophys.*, Vol. 34, pp. 767-780, 2016, doi:10.5194/angeo-34-767-2016.
- [J-30] D. Fritts, L. Wang, M. Geller, D. Lawrence, J. Werne, and B. Balsley, "Numerical Modeling of Multi-Scale Dynamics at a High Reynolds Number: Instabilities, Turbulence, and an Assessment of Ozmidov and Thorpe Scales", *J. Atmospheric Sciences*, Vol. 73, No. 2, 2016, pp. 555-578. DOI: 10.1175/JAS-D-14-0343.1.
- [J-29] H. Fernando, E. Pardyjak, S. Sabitino, F. Chow, S. De Wekker, S. Hoch, J. Hacker, J. Pace, T. Pratt, Z. Pu, W. Steenburgh, C. Whiteman, Y. Wang, D. Zajic, B. Balsley, R. Dimitrova, G. Emmitt, C. Higgins, J. Hunt, J. Knievel, D. Lawrence, Y. Liu, D. Nadeau, E. Kit, B. Blomquist, P. Conry, R. Coppersmith, E. Creegan, M. Felton, A. Grachev, N. Gunawardena, C. Hang, C. Hocut, B. Huynh, M. Jeglum, D. Jensen, V. Kulandaivelu, M. Lehner, L. Leo, D. Liberzon, J. Massey, K. McEnerney, S. Pal, T. Price, M Sghiatti, Z. Silver, M. Thompson, H. Zhuang, and T. Zsedrovits, "The MATERHORN: Unraveling the Intricacies of Mountain Weather", *Bulletin of the American Meteorological Society*, Nov., 2015, pp. 1945-1967.
- [J-28] **D. Guerrant** and D. Lawrence, "Tactics for Heliogyro Solar Sail Attitude Control via Blade Pitching", *AIAA J. Guidance, Control, and Dynamics*, Vol. 38, Special Issue in Honor of Richard Battin, Vol. 38, no. 9, pp. 1785-1799, 2015, doi: 10.2514/1.G000861.
- [J-27] A. Bradley, S. Palo, G. LoDolce, **D. Weibel**, and D. Lawrence, "Air Deployed Micro Buoy measurement of temperatures in the marginal ice zone upper ocean during the MIZOPEX campaign", *J. Atmospheric And Oceanic Technology*, Vol. 32, May, 2015, pp. 1058-1070. DOI: 10.1175/JTECH-D-14-00209.1
- [J-26] **D. Weibel**, D. Lawrence and S. Palo, "Small Unmanned Aerial System Attitude Estimation for Flight in Wind", *AIAA J. Guidance, Control, and Dynamics*, Vol. 38, No. 7, 2015, pp. 1300-1305.
- [J-25] J. Elston, B. Argrow, M. Stachura, **D. Weibel**, D. Lawrence, and **D. Pope**, "Overview of Small Fixed-Wing Aircraft for Meteorological Sampling", *J. Atmospheric And Oceanic Technology*, Vol. 32, Jan., 2015, pp. 97-115. DOI: 10.1175/JTECH-D-13-00236.1
- [J-24] **N. Bernstein**, D. Lawrence, and L. Pao, "Dynamics Modeling for Parallel Haptic Interfaces with Force Sensing and Control", *IEEE Trans. On Haptics*, Vol. 6, No. 4, pp. 429-439, 2013. DOI [10.1109/TOH.2013.3](https://doi.org/10.1109/TOH.2013.3).
- [J-23] D. A. Lawrence and B. B. Balsley, "High-Resolution Atmospheric Sensing of Multiple Atmospheric Variables using the DataHawk Small Airborne Measurement System", *J. Atmospheric And Oceanic Technology*, Vol. 30, 2352-2366, Oct, 2013, doi: <http://dx.doi.org/10.1175/JTECH-D-12-00089.1>
- [J-22] B. B. Balsley, D. A. Lawrence, "Fine-Scale Characteristics of Temperature, Wind, and Turbulence in the Lower Atmosphere (0-1,300 m) Over the South Peruvian Coast", *Boundary-Layer Meteorology*, Vol. 147, No. 1, pp. 165-178, April, 2013, DOI: 10.1007/s10546-012-9774-x.
- [J-21] **B. P. Rigney**, L. Y. Pao, and D. A. Lawrence, "Nonminimum Phase Adaptive Inverse Control for Settle Performance Applications", *Mechatronics*, Vol. 20, No. 1, pp. 35-44, 2010.
- [J-20] D. A. Lawrence and M. S. Whorton, "Coning Control of Solar Sails Using Magnetic Momentum Error Reduction", *AIAA J. Spacecraft and Rockets*, Vol. 46, No. 6, Nov.-Dec., pp. 1298-1308, 2009.

[J-19] J. Elston, E. W. Frew, D. Lawrence, **P. Gray**, and B. Argrow, "Net-Centric Communication and Control for a Heterogeneous Unmanned Aircraft System", *J. Intelligent and Robotic Systems*, Vol. 56, pp. 199-232, 2009.

[J-18] D. A. Lawrence and M. S. Whorton, "Solar Sail Dynamics and Coning Control in Circular Orbits", *AIAA J. Guidance, Control, and Dynamics*, Vol. 32, No. 3, pp. 974--985, 2009.

[J-17] **B. Rigney**, L. Y. Pao, and D. A. Lawrence, "Nonminimum Phase Dynamic Inversion for Settle Time Applications", *IEEE Trans. Control System Technology*, Vol. 17, No. 5, pp. 989--1005, 2009.

[J-16] D. A. Lawrence, E. W. Frew, and **W. J. Pisano**, "Lyapunov Vector Fields for Autonomous UAV Flight Control", *AIAA J. Guidance, Control, and Dynamics*, Vol. 31, No. 5, pp. 1220--1229, 2008.

[J-15] E. W. Frew, D. A. Lawrence, and S. Morris, "Coordinated Standoff Tracking of Moving Targets using Lyapunov Guidance Vector Fields", *AIAA J. Guidance, Control, and Dynamics*, Vol. 31, No. 4, pp. 84--107, 2008.

[J-14] D. A. Lawrence and **T. E. Holden**, "Essentially Globally Asymptotically Stable Nutation Control Using a Single Reaction Wheel", *AIAA J. Guidance, Control, and Dynamics*, Vol. 30, No. 6, Nov.-Dec., 2007, pp. 1783--1793.

[J-13] D. A. Lawrence, L. Y. Pao, **C. D. Lee**, and **R. Y. Novoselov**, "Synergistic Visual/Haptic Rendering Modes for Scientific Visualization", *IEEE Computer Graphics and Applications*, Vol. 24, No. 6, pp. 22--30, 2004.

[J-12] **C. D. Lee**, D. A. Lawrence, and L. Y. Pao, "Isotropic Force Control For Haptic Interfaces", *Control Engineering Practice*, Vol. 12/11, pp. 1423--1436, 2004.

[J-11] D. A. Lawrence, L. Y. Pao, A. M. Dougherty, **M. A. Salada**, and **Y. Pavlou**, "Rate-Hardness: A New Performance Metric for Haptic Interfaces", *IEEE Transactions on Robotics and Automation*, Vol. 16, no. 4, Aug., 2000, pp. 357--371.

[J-10] M. Radenkovic and D. A. Lawrence, "Using Burst Recovery Concepts to Obtain Global Stability and Performance of Discrete-Time Adaptive Controllers for Time Varying Systems", *IEEE Transactions on Automatic Control*, Vol. 39, No. 11, Nov., 1994, pp. 2357--2362.

[J-9] D. A. Lawrence, "Adaptive System Stability Robustness via Burst Recovery", *Automatica*, Vol. 31, No. 4, 1994, pp. 571--580.

[J-8] D. A. Lawrence and J. D. Chapel, "Compliance Control Safety: An Architecture-Independent Analysis", *Journal of Robotic Systems*, Vol. 11, No. 8, 1994, pp. 725--742.

[J-7] D. A. Lawrence and J. D. Chapel, "Quantitative Control of Manipulator/Task Interaction", *IEEE Control Systems Magazine*, Vol. 14, No. 2, 1994, pp. 14--25.

[J-6] D. A. Lawrence, "Stability and Transparency in Bilateral Teleoperation", *IEEE Transactions on Robotics and Automation*, Vol. 9, No. 5, Oct, 1993, pp. 624--637.

[J-5] D. A. Lawrence, W. A. Sethares, and W. Ren, "Parameter Drift Instability in Disturbance-Free Adaptive Systems", *IEEE Transactions on Automatic Control*, Vol. 38, No. 4, April, 1993, pp. 584--587.

[J-4] D. A. Lawrence, "Adaptive Algorithm Structure: Impacts on Stability and Performance", *IEEE Transactions on Automatic Control*, Vol. 35, No. 12, Dec., 1990, pp. 1355--1359.

[J-3] D. A. Lawrence and C. R. Johnson, Jr., "Recursive Parameter Identification Algorithm Stability Analysis via Pi-Sharing", *IEEE Transactions on Automatic Control*, Vol. AC--31, No. 1, January, 1986, pp. 16-24.

[J-2] W. A. Sethares, D. A. Lawrence, C. R. Johnson, Jr., and R. R. Bitmead, "Parameter Drift in LMS Adaptive Filters", *IEEE Transactions on Acoustics, Speech, and Signal Processing*, Vol. ASSP--34, No. 4, August, 1986, pp. 868--879.

[J-1] C. R. Johnson, Jr., D. A. Lawrence, and J. P. Lyons, Jr., "A Flaw in the Reduced-Order Behavior of a Direct Adaptive Pole Placer", *IEEE Transactions on Automatic Control*, Vol. AC--28, No. 9, September, 1983, pp. 922--924.

### Refereed Conference Proceedings (My students indicated by bold font)

[C-118] **N. Kenny** and D. Lawrence, "Electric Lift Augmentation of Scientific Balloons Using Gossamer Blades", proc. *Academic High Altitude Conference*, Ames, IA, **March, 2023** <https://doi.org/10.31274/ahac.15626>.

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[C-109] **S. Cook**, D. Lawrence and W. Wilki, "Proximal Blade Twist Feedback Control for a Heliogyro," *Fourth International Symposium on Solar Sailing*, Kyoto, Japan, 17-20 January 2017.

[C-108] **S. Cook**, D. Lawrence, and W. Wilkie, "Structural Dynamics and Control Implications for Modal Damping of a Simplified Two-Blade Heliogyro Model", *Proc.67th International Astronautical Congress*, 27-30 Sept. 2016, Toulouse, France IAC-16,C4,8,11,x33711.

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[C-13] D. A. Lawrence, "Optimizing Dynamic Transparency in Teleoperator Architectures", *Proc. 15th AAS Guidance and Control Conference*, Keystone, CO, Feb., 1992, pp. 353--365.

[C-12] **H. M. Hmam** and D. A. Lawrence, "Biped Control via Nonlinear Dynamics", *Proc. 29th Allerton Conference on Communication, Control, and Computing*, Monticello, IL, Oct., 1991, pp. 1117--1126.

[C-11] D. A. Lawrence, W. A. Sethares, and W. Ren, "Drift Instability in Adaptive Systems", *Proc. IEEE Conference on Decision and Control*, Honolulu, Dec., 1990, pp. 3230--3235.

[C-10] D. A. Lawrence and **T. J. Wardlow**, "Approximate Circle Control Design for Lightly Damped Plants", *Proc. 1990 American Control Conference*, San Diego, CA, May, 1990.

[C-9] D. A. Lawrence, "Actuator Limitations on Achievable Manipulator Impedance", *Proc. IEEE International Conference on Robotics and Automation*, Scottsdale, AZ, May, 1989, pp. 560--565.

[C-8] W. A. Sethares and D. A. Lawrence, "Output Error Identification is not Globally Stable in the Non-Ideal Case", *IEEE Conference on Decision and Control*, Austin, TX, December, 1988, pp. 1528--1529.

[C-7] D. A. Lawrence, "Impedance Control Stability Properties in Common Implementations", *Proc. IEEE International Conference on Robotics and Automation*, Philadelphia, PA, April, 1988, pp. 1185--1191. **This paper was given the Distinguished Publication Award by Martin Marietta Astronautics.**

[C-6] R. M. Stoughton and D. A. Lawrence, "Impedance Control---Achieving Stability in Practice", *Proc. AIAA Conference on Guidance, Navigation, and Control*, Monterey, CA, August, 1987, pp. 221--226.

[C-5] W. A. Sethares, D. A. Lawrence, and C. R. Johnson, Jr., "Parameter Drift in Equation Error Identification", *Proc. 24th IEEE Conference on Decision and Control*, Ft. Lauderdale, FL, December, 1985 (7 pages).

[C-4] W. A. Sethares, D. A. Lawrence, C. R. Johnson, Jr., and R. R. Bitmead, "On the Existence of Unbounded Parameters in Adaptive Filtering", *Proc. 19th Conference on Information Sciences and Systems*, Baltimore, MD, March, 1985 (6 pages).

[C-3] D. A. Lawrence and C. R. Johnson, Jr., "Output Error Identification Without SPR Assumptions", *Proc. 23rd IEEE Conference on Decision and Control*, Las Vegas, NV, December, 1984, pp. 977-982.

[C-2] D. A. Lawrence and C. R. Johnson, Jr., "Recursive Parameter Identification Stability Analysis via Pi-Sharing", *Proc. 18th Conference on Information Sciences and Systems*, Princeton, NJ, March, 1984, pp. 507--511.

[C-1] D. A. Lawrence, C. R. Johnson, Jr., and B. D. O. Anderson, "Exponential Convergence and Robustness of Persistently Excited Recursive-Least-Squares-With-Forgetting Output Error Identification", *Proc. 17th Conference on Information Sciences and Systems*, Baltimore, MD, March, 1983, pp. 293--298.

### **Invited/Non-Refereed Conference Publications or Presentations**

[I-16] Söder, Jens, Lawrence, Dale A., Gerding, Michael, and Lübken, F.-J., "In-situ sensing of atmospheric turbulence", *European Geophysical Union*, April 10, 2019, Vienna Austria, EGU2019-13071.

[I-15] Luce, H., L. Kantha, H. Hashiguchi, D. Lawrence, M. Yabuki and T. Tsuda, 2017. Comparisons between TKE dissipation rates estimated from MU radar and UAV-borne Pitot data during ShUREX 2016 campaign. Keynote Talk presented at MST15/EISCAT18 Meeting, NIPR, Tokyo, Japan. May 29-30, 2017.

[I-14] Luce, H., L. Kantha, H. Hashiguchi, N. Nishi, D. Lawrence, M. Yabuki and T. Tsuda, 2017b. A detailed analysis of steep humidity gradients above a turbulent cloud top using MU radar, UAV and balloon measurements. Poster presented at MST15/EISCAT18 Meeting, NIPR, Tokyo, Japan. May 29-30, 2017.

[I-13] Luce, H., L. Kantha, H. Hashiguchi, M. Yabuki, T. Tsuda, D. Lawrence and T. Mixa, 2017c. Comparisons between high-resolution profiles of squared refractive index gradient M2 estimated from MU radar and UAV data collected during the ShUREX 2015 campaign. Poster presented at MST15/EISCAT18 Meeting, NIPR, Tokyo, Japan. May 29-30, 2017.

[I-12] Luce, H., L. Kantha, H. Hashiguchi, M. Yabuki, T. Tsuda, D. Lawrence and T. Mixa, 2017d. Concurrent MU radar, UAV and balloon observations of temperature and moisture fine-scale structure during the ShUREX 2015 campaign. Poster presented at MST15/EISCAT18 Meeting, NIPR, Tokyo, Japan. May 29-30, 2017.

[I-11] Luce, H., H. Hashiguchi, L. Kantha, D. Lawrence, T. Mixa, T. Tsuda and M. Yabuki, 2017e. Evaluation of the performance of the radar imaging technique using small UAVs as hard targets during ShUREX campaigns (2015-2016). Poster presented at MST15/EISCAT18 Meeting, NIPR, Tokyo, Japan. May 29-30, 2017.

[I-10] Wilson, R., H. Hashiguchi, L. Kantha, D. Lawrence, T. Mixa, M. Yabuki, H. Luce and T. Tsuda, 2017f. Turbulence measurements from UAV and meteorological balloons: a comparison. Poster presented at MST15/EISCAT18 Meeting, NIPR, Tokyo, Japan. May 29-30, 2017.

[I-11] M. Aitken, N. Ahmed, D. Lawrence, B. Argrow, and E. Frew, "Assurances and machine self-confidence for enhanced trust in autonomous systems", RSS 2016 Workshop on Social Trust in Autonomous Systems.

[I-10] H. Hashiguchi, T. Mori, L. Kantha, D. Lawrence, H. Luce, T. Mixa, R. Wilson, T. Tsuda, M. Yabuki, "Shigaraki UAV radar Experiment: Application of UAAV technology to measurement of turbulent mixing in the atmosphere", *Japan Geoscience Union (JpGU)/AGU Meeting*, May 24, 2016, Chiba City, Japan, 2016.

[I-9] L. Lillard, E. Frew, B. Argrow, and D. Lawrence, "Assurances for Enhancing Trust in Autonomous Systems", *Proc. 2015 AAAI Fall Symposium*, Nov., 2015.

[I-8] De Wekker, S.F.J., J. Knierel, Y. Liu, G.D. Emmitt, S. Pal, B. Balsley, D. Lawrence, S. Hoch, Y. Wang, C. Hocut, and H.J. Fernando, "Multi-scale flows and boundary layer structure during the MATERHORN field study: Observations and simulations during the morning transition period", Presentation at the Davos Atmosphere and Cryosphere Assembly (DAVOS-13), Davos, Switzerland, July, 2013.

[I-7] **W. Pisano** and D. Lawrence, "Control Limitations of Small Unmanned Aerial Vehicles in Turbulent Environments", *Proc. AIAA Guidance, Navigation and Control Conference*, Chicago, IL, Aug., 2009, AIAA-2009-5909 (11 pages).

[I-6] **W. J. Pisano** and D. A. Lawrence, "Autonomous Gust Insensitive Aircraft", *Proc. AIAA Guidance, Navigation and Control Conference and Exhibit*, Honolulu, Hawaii, Aug. 18-21, 2008, AIAA 2008-6510 (17 pages).

[I-5] **G. Gruener** and D. A. Lawrence, "Haptic Communication for Remote Ultrasound Diagnosis", *Medicine Meets Virtual Reality 6, Technology: Tooling Up for the Future of Health Care*, San Diego, CA, Jan, 1998. (Talk only: no published proceedings).

[I-4] D. A. Lawrence, N. Kermiche, and R. Su, "Identification of Underwater Mines via Surface Acoustic Signature", *Proc. 2nd Symposium on Technology and the Mine Problem*, Naval Postgraduate School, Monterey, CA, Nov. 18-21, 1996. **This paper won the Charles Rowzee Award, Honorable Mention of Best Overall Technical Paper**

[I-3] D. A. Lawrence, J. D. Chapel, and T. M. Depkovich, "Issues, Concerns, and Initial Implementation Results for Space-Based Telerobotic Control", *Proc. 1987 Goddard Conference on Space Applications of AI and Robotics*, Greenbelt, MD, May, 1987.

[I-2] J. D. Chapel and D. A. Lawrence, "Alternative Force Control Strategies for Remote Space Teleoperation", *Proc. 10th AAS Guidance and Control Conference*, Keystone, CO, February, 1987.

[I-1] D. A. Lawrence and C. R. Johnson, Jr., "On Adaptive Regulation of Flexible Spacecraft", *Proc. 3rd VPI&SU Symposium on Dynamics and Control of Flexible Spacecraft*, Blacksburg, VA, June, 1981, pp. 237--254.

## Patents

D. A. Lawrence and S. Aphanuphong, "Endoscope Apparatus, Actuators, and Methods Therefor", US Patent 8,123,678, issued Feb., 28, 2012. Continuation with additional claims allowed on 8/15/2014.

## External Research Funding Awarded

Role	Project Title	Source	Collaborators	My Portion	Period
PI	Unmanned Aerial System Payload Autonomous Alignment Capture System, Docking System	Air Force Phase I STTR	TB2 Aerospace	\$25,000	2003
Co-PI	RAPID: In-situ Observations to Characterize Multi-Scale Turbulent Atmospheric Processes Impacting Climate at Southern High Latitudes	NSF/OPP	A. Doddi	\$110,000	2023-2024
PI	Collaborative Research: New	NSF	GATS, Inc.	\$460,730	2021-2024



	Pathways to Enhanced Turbulence and Mixing via Kelvin-Helmholtz Instability Tube and Knot Dynamics				
Co-PI	Collaborative Proposal: High-Altitude Turbulence and Particulate Measurements near the BOLT II Flight Trajectory	AFOSR	B. Argrow	\$120,000	2021-2022
Co-PI	Analysis to evaluate and improve model performance in the Central Arctic: Unique perspectives from autonomous platforms during MOSAiC	NSF	G. deBoer	\$270,000	2018-2022
PI	Instabilities, Dynamics, and Energetics accompanying Atmospheric Layering (IDEAL)	NSF	GATS, Inc.	\$553,712	2016-2020
Co-PI	Stratospheric Turbulence Resolution and Aero-Optical Transmission for Hypersonics	AFOSR/MURI	U. Minn., Embry-Riddle, GATS, Inc.	\$1,080,000	2017-2022
PI	Eight Externally-sponsored Senior Design Projects:	JPL, NASA, AFRL, CETI, Raytheon, Sierra Nevada, UCAR, Lockheed Martin		\$180,000	2017
Co-PI	Atmospheric Profiles, Clouds, and the Evolution of Sea Ice Cover in the Beaufort Sea	ONR	J. Maslanik	\$315,000	2016-2019
Co-PI	UAV-Deployed Microbuoys for Arctic Sensing	DARPA	S. Palo	\$190,000	2014-2015
PI	Externally-sponsored Senior Design Projects: STATIS, RACER, SPECTRE, ETHOS, ASTERIA, BLISS	Ball, JPL, NASA, Northrup-Grumman, SWRI, Surrey Satellite Ssystems,		\$120,000	2014-2015
Co-PI	Assured Autonomy	NSF Center for Unmanned Aerial Systems	Brian Argrow, Eric Frew	\$13,000	2012-2015
Co-PI	Evaluation of Routine Atmospheric Scientific Measurements using Unmanned Systems	DOE/ARM	Gijs de Boer, Scott Palo, Brian Argrow	\$36,000	2014-2015
Co-PI	DataHawk Parts, ground station parts and labor for ARM personnel training	DOE/ARM	Gijs de Boer	\$31,000	2014-2015
Co-I	Observations of Wind Turbine Wakes Using Unmanned Aircraft Systems	CIRES/IRP	John Cassano, Julie Lundquist, Brian Argrow, Eric Frew, Katja	\$2,000	2014

			Friedrich		
PI	Formation-Flying for Atmospheric Studies Using Small, Autonomous Aircraft	CIRES/IRP	Ben Balsley (former PI)	\$27,000	2014
PI	NBL Campaign: Continued In-Situ Measurements and DNS	GATS, Inc.	Ben Balsley (former PI)	\$22,000	2012-2014
Co-I	Advanced Technologies for Coordinated In Situ Atmospheric Sensing	NASA/SBIR	Jack Elston, Brian Argrow	\$3,000	2014
PI	Collaborative Research: Quantifying KHI, Turbulence Processes and Radar Biases Using Radar Observations and In Situ Measurements at JRO and Very-High-Resolution DNS	NSF/ATM	Ben Balsley (former PI), David Fritts, Ron Woodman	\$80,000	2011-2015
PI	Externally-sponsored Senior Design Projects: TIRESIAS, SAVI, DARE, GHOST, PIRANHA	Ball, JPL, NASA, Lockheed Martin		\$100,000	2013-2014
PI	DataHawk Flocks: Self-Contained sUAS Modules for High-Resolution Atmospheric Measurements	ARO/DURIP		\$158,000	2013-2014
PI	Emerging sUAS In-Situ Sensing Technology	NSF Center for Unmanned Aerial Systems	Brian Argrow	\$75,000	2012-2015
PI	High-Resolution Atmospheric Studies During the Matterhorn Campaigns: DataHawk Observations and Analyses	ARO	Ben Balsley (former PI)	\$150,000	2012-2015
PI	Atmospheric Profiles, Clouds and the Evolution of Sea Ice Cover in the Beaufort and Chukchi Seas	ONR	Axel Schweiger, University of Washington	\$226,700	2012-2015
PI	Fused VCM Vemf and Servo Demodulation Measurements for In-Drive Spiral Write	Western Digital Corp.		\$80,000	2012-2013
PI	MicroFlex Technology for Early Detection of Lung Cancer	NIH/Phase II STTR	Quest Product Development Corp.	\$576,000	2012-2015
Co-PI	Investigations of Spatial and Temporal Variability of Ocean and Ice Conditions In and Near the Marginal Ice Zone	NASA	James Maslanik, et al	\$86,100	2011-2013
Co-PI	Cooperative Planning Grant: I/UCRC for Unmanned Systems	NSF/IUCRC	Timothy McLain, et al	Travel only	2011
Co-PI	Support to the Wildland-Urban Interface Communities Research Program	NIST	Excet, Inc.	\$20,000	2011-2012
PI*	Force Feedback Control of a Shape Memory Alloy Active Catheter for Minimally Invasive Micro-Surgery	NSF Phase IB STTR	Quest Product Development Corp.	\$26,000	2008-2009
PI	MicroFlex Tools to Improve Sinus	NIH Phase II STTR	Quest Product	\$512,000	2008-

	Diagnostics and Surgery		Development Corp.		2011
PI*	Force Feedback Control of a Shape Memory Alloy Active Catheter for Minimally Invasive Micro-Surgery	NSF Phase I STTR	Quest Product Development Corp.	\$76,000	2008-2009
PI	CubeSail Preliminary Design	NASA/Marshall	George Born	\$25,000	2007-2008
Co-PI	Remote Management of a Cooperative Heterogeneous UAS Team	Raytheon Corp.	Eric Frew Brian Argrow	\$35,000	2006-2007
PI	Solar Sail Trajectory Control	NASA/Marshall		\$50,000	2005-2006
PI	MicroFlex Technology for Early Diagnosis of Lung Cancer	NIH Phase I STTR	Rose Biomedical Development Corp.	\$80,000	2005-2007
PI	MicroFlex Tools to Improve Sinus Diagnostics and Surgery	NIH Phase I STTR	Rose Biomedical Development Corp.	\$81,000	2005-2007
Co-PI	Loosely Cooperating Micro Air Vehicle Networks for Toxic Plume Characterization	NSF ITR	Kamran Mohseni Richard Han	\$420,000	2004-2009
Co-PI	Time-Optimal Repetitive Control Algorithms	Maxtor Corp.	Lucy Pao	\$37,500	2004-2007
PI	Solar Sail Integrated Simulation Tool	NASA/JPL		\$98,000	2003-2005
Co-PI	Visual/Haptic Interfaces for Spatial Learning	NSF	Lucy Pao	\$223,000	2001-2004
PI	Fast Adaptive Disturbance Rejection for Disk Drives	Quantum Corp.		\$50,000	2000-2001
PI	Adaptive Equalization for Disk Drives	Colorado Center for Information Storage		\$75,000	1999--2001
PI*	Miniaturized Electro-Magnetic Vibration Isolation System	DOD Phase II SBIR	Left Hand Design Corp.	\$99,000	2001-2003
PI*	High-Accuracy 200mm Siderostat	NASA Phase II SBIR	Left Hand Design Corp.	\$75,000	2001-2002
PI*	Long Stroke, Nanometer Accuracy Cryogenic Actuator with Zero Hold Power	NASA phase I STTR	Left Hand Design Corp.	\$19,000	2000-2001
PI	Synergistic Visual/Haptic Computer Interfaces	NSF	Lucy Pao	\$219,000	1997-2001
Co-PI	Instrumentation for Research on the Synergism between Haptic and Visual Communication in Human-Computer Interfaces	ONR/DURIP	Lucy Pao	\$67,500	1997-1998
PI*	Lightweight Low Power Thermally Stable Large Field of Regard High Accuracy Gimbal	NASA Phase I SBIR	Left Hand Design Corp.	\$30,000	1998-1999
PI*	Combined Fast-Steering and Alignment Mirror for Space-Based Interferometry	NASA Phase II SBIR	Left Hand Design Corp.	\$75,000	1997-1998
Co-PI	Visual/Haptic Synergy in Human-	NSF (through the	Lucy Pao	\$28,000	1997-

	Computer Interfaces	CU Optoelectronics Computing Systems Center)			1998
Co-PI	Haptic Communication in Human- Computer Interfaces	NSF (through the CU Optoelectronic Computing Systems Center)	Lucy Pao	\$20,000	1996- 1997
Co-PI	Computer Environment for Design Collaboration, Integration, and Capture	NASA/Langley	Renjeng Su	\$52,000	1996- 1997
PI	Modular Isolation Microgravity Experiment (MIME)	NASA/HQ, In-STEP		\$109,700	1994- 1995
PI	Small Satellite Control	NASA (through the CU Center for Space Construction)		\$39,000	1993- 1996
PI	Orbital Positioning and Joining of Large Vehicles and Structures	NASA (through the CU Center for Space Construction),		\$88,200	1992- 1995
PI	Nonlinear Boundary Layer Control for Multivariable Limit Protection	General Electric Aircraft Engines		\$56,000	1991- 1992
Co-PI	Migration of Complex Engine Models into Silicon: A Feasibility Study	General Electric Aircraft Engines	Ranga Vemuri	\$41,000	1989- 1990
Total				\$8,551,000	

PI\* indicates PI on the CU portion of the consortium SBIR/STTR award when I was not the overall grant PI

### Internal Funding Awarded---University of Colorado

Role	Project Title	Source	Collaborators	My Portion	Period
Co-PI	Projects Based Learning Equipment Support	CU Engineering Excellence Fund	Trudy Schwartz, Scott Palo, Matt Rhode	\$18,000	2012- 2013
PI	HoverBird UAV	CU Technology Transfer Proof of Concept Grant		\$10,000	2006- 2007
Co-PI	Development of Hardware Control Experiments	Engineering Excellence Fund	Todd Murphey Lucy Pao Dave Meyer John Hauser	\$15,000	2005
Co-PI	Haptic Interface for Remote Ultrasound Diagnosis	CU School of Medicine/College of	John Lewin	\$20,000	1996

		Engineering, Biomedical Engineering Start Up Fund			
Co-PI	Multimedia to Bring the ITL Building to Life	CU Changing the Learning Paradigm Through Technology Fund	Lawrence Carlson Dolores Etter	\$20,000	1996
Co-PI	Engineering Enrichment for APMA 2360	CU ITL Curriculum Development	James Meiss David Clough	\$7,500	1996
PI	Aerospace Guidance and Control Laboratory Extension	CU Undergraduate Excellence Fund		\$9,000	1996
PI	Control System Demonstrator/Sensor Design and Characterization	Integrated Teaching Laboratory Curriculum Development Fund		\$11,500	1994
PI	Aerospace Control Laboratory Upgrade	Undergraduate Excellence Fund		\$10,000	1993
PI	Hands On Control System Demonstrator	Integrated Teaching Laboratory Curriculum Development Fund		\$14,000	1993
PI	Accelerometer Construction and Characterization	Integrated Teaching Laboratory Curriculum Development Fund		\$6,000	1993
Total				\$141,000	

### Internal Funding Awarded---University of Cincinnati

Role	Project Title	Source	Collaborators	My Portion	Period
PI	Robot Control for Locomotion and Manipulation	University Research Council		\$6,000	1990
PI	Real-Time Impedance Control for Robotic Manipulators	UC Computer Center		\$5,000	1989
PI	Manipulator Impedance Control	Herman Schneider Laboratory		\$6,000	1988
PI	Multiple Criteria Adaptive Control	University Research Council		\$5,700	1988
Total				\$22,700	

### Graduate Courses Taught

Course	Title	Devel.	Where	When	Cr.	En.	Taught With	FCQ Ave Course Instr.
ASEN 5024 (changed to 6024 in S12)	Nonlinear Systems	Maj.Rev.  CAETE BBA	CU	S 99	3	11		3.3/4 3.8/4
				S 01	3	10		2.4/4 2.6/4
				S 07	3	15		3.2/6 3.5/6
				S 10	3	22		4.6/6 5.1/6
				S 12	3	14		4.6/6 4.9/6
				S 19	3	18		3.8/6 3.7/6
				F21	3	18		New Regime

ASEN 5519	System Identification for Control	New	CU	F 96 F 99 S 08 S17 S23	3 3 3 3 3	5 9 10 8 8		3.6/4 3.8/4 3.5/4 3.9/4 4.5/6 4.9/6 5.6/6 5.7/6 New Regime
ASEN 5114	Automatic Control Systems	New, Labs Min. Rev.	CU	F 00 F02 F 03 F 04 F 10 F11 F14 F18 S22	3 3 3 3 3 3 3 3 3	10 27 18 19 15 20 15 30 21		4.0/4 4.0/4 3.3/4 3.5/4 3.5/4 3.7/4 3.5/4 3.7/4 5.6/6 5.4/6 5.4/6 5.4/6 4.8/6 4.8/6 4.5/6 4.7/6 New Regime
ASEN 5014	Linear Control Design	Min. Rev.  CAETE CAETE CAETE CAETE BBA Remote In-person	CU	F 98 F 03 F 04 F 05 F06 F 07 F 08 F 09 F 12 F19 F20 F22	3 3 3 3 3 3 3 3 3 3 3 3	17 24 9 23 33 15 21 31 10 27 63 39		3.2/4 3.6/4 3.2/4 3.6/4 3.1/4 3.4/4 FNR 4.8/6 5.1/6 5.1/6 5.1/6 4.5/6 4.7/6 4.8/6 4.8/6 5.2/6 5.6/6 4.5/6 4.8/6 New Regime New Regime
ASEN 6519	Graduate Projects		CU	F 09 S 10	3 3	10 12	Eric Frew Eric Frew	5.8/6 5.0/6 4.7/6 4.0/6
ASEN 6519	Integrated Spacecraft Design	New Maj. Rev.	CU	S 95 S 96	3 3	5 8	Steve Jolly Renjeng Su	FNR 4.0/4 3.0/4
ECE 615	Automatic Control Laboratory	New	UC	W 90 W 91	4 4	34 17		2.6* 2.5* FNR
ECE 614	Digital Control	Maj. Rev.	UC	F 90	3	30		2.1* 1.9*
ECE 745	Linear Systems	New	UC	W 89 F 90	3 3	18 16		1.4* 1.9* 1.4*
ECE 746	Adaptive Control	New	UC	S 89	3	10		FNR
ECE 855	Nonlinear Systems	New	UC	S 90	3	15		2.0* 1.4*
ECE 971	Current Topics	New	UC	S 91	3	11	Art Helmicki	FNR

Key: New = new course developed  
Maj. Rev. = major course revision (e.g. mostly new topics/materials)  
Min. Rev. = minor course revision (e.g. some new topics/materials, new book)  
Demos = Added hardware/computational/simulation demonstrations in lecture  
Labs = Added hardware/computational/simulation laboratory experiments  
CAETE = lectures recorded for distance learning as well as on-campus students  
FNR = forms not returned, or course not evaluated  
NYA = net yet available  
New Regime = new style of FCQ: no aggregate instructor and course ratings  
Not Collected = FCQs not collected for the University (COVID-19)  
\*UC course evaluations are rated from 1 (excellent) to 5 (poor)

## Undergraduate Courses Taught

Course	Title	Devel.	Where	When	Cr.	En.	Taught With	FCQ Ave Course Instr.
ASEN 2004	Aerospace Vehicle Design and Performance	Min. Rev.	CU	S10 S11	4 4	81 86	Ryan Starkey Mark Krebs	4.8/6 4.4/6 4.9/6 4.9/6
ASEN 3200	Spacecraft Orbit Mechanics and Attitude Dynamics and Control	New, Labs Min. Rev.  Min. Rev.	CU	S 99 S 00 S 01 S 06 S 08 S14	4 4 4 4 4 4	51 66 70 74 60 87	George Born George Born George Born George Born Steve Nerem Dan Sheeres	2.7/4 3.1/4 2.6/4 2.4/4 2.4/4 2.4/4 2.6/4 2.3/4 4.7/6 5.1/6 4.0/6 3.7/6
ASEN 3128	Aircraft Dynamics	Min. Rev.  Remote	CU	S17 S18 S19 F 19 S20	4 4 4 4 4	137 143 198 100 63	Nisar Ahmed Nisar Ahmed Nisar Ahmed Nisar Ahmed John Ma	3.3/6 2.8/6 3.7/6 2.8/6 3.4/6 2.8/6 4.4/6 3.8/6 Not collected
ASEN 4114	Automatic Control Systems	New, Labs  Min. Rev.	CU	F 00 F 02 F 03 F 04 F 10 F11 F14	3 3 3 3 3 3 3	10 27 18 19 10 8 15		4.0/4 4.0/4 3.3/4 3.5/4 3.5/4 3.7/4 3.5/4 3.7/4 5.6/6 5.4/6 5.4/6 5.4/6 4.8/6 4.8/6
ASEN 4018	Senior Projects 1 (Course Coordinator)	All New Lect	CU	F13 F14 F18	4 4 4	82 88 130		4.3/6 3.9/6 5.0/6 4.3/6 4.4/6 3.2/6
ASEN 4018	Senior Projects 1 (Projects Advisory Board Faculty)	Maj. Rev.	CU	F 02 F 03 F 05 F 06 F11 F12 F22	5 5 5 5 4 4 4	12 10 18 20 16 16 34	Other Projects Advisory Board Faculty	FNR 2.7/4 2.2/4 FNR 5.3/6 5.2/6 5.5/6 5.9/6 5.3/6 5.4/6 New Regime
ASEN 4028	Senior Projects 2 (Course Coordinator)		CU	S14 S15 S18	4 4 4	82 88 130		4.3/6 3.5/6 5.0/6 4.1/6 4.4/6 3.8/6
ASEN 4028	Senior Projects 2 (Projects Advisory Board Faculty)	Maj. Rev.	CU	S 03 S 04 S 06 S 07 S12 S23	5 5 5 5 4 4	12 10 18 16 16 35	Other Projects Advisory Board Faculty	FNR 3.0/4 3.0/4 3.3/4 2.7/4 5.0/6 4.3/6 5.5/6 5.9/6 New Regime
ASEN 3300	Aerospace Electronics	Min. Rev.	CU	S 03 S 04 S 05	4 4 4	54 74 79	Penina Axelrad Alex Hoehn	3.1/4 2.5/4 2.6/4 2.5/4 2.4/4 2.5/4
ASEN 3014	Systems Analysis I	Demos Min. Rev.	CU	F 93 F 95	3 3	59 36		2.4/4 2.4/4 2.4/4 2.4/4
ASEN 3024	Systems Analysis II	Demos Demos	CU	F 94 S 95 S 96 S 97	3 3 3 3	22 20 31 39		2.9/4 3.1/4 3.2/4 3.8/4 3.2/4 3.3/4 2.4/4 2.6/4

				S 98	3	53		2.6/4 3.0/4
ASEN 4018	Senior Design Laboratory I (Control Systems Focus)	New	CU	F 91	3	12		2.9/4 2.6/4
		Maj. Rev.		F 92	3	16		3.5/4 3.6/4
				F 93	3	17		2.9/4 2.7/4
				F 94	3	8		3.7/4 3.7/4
				F 95	3	13		3.1/4 3.4/4
				F 96	3	8		FNR
		Maj. Rev.		F 97	3	13		3.8/4 3.8/4
ASEN 4028	Senior Design Laboratory II (Control Systems Focus)	New	CU	S 92	3	9		2.7/4 2.7/4
				S 93	3	16		2.8.4 2.6/4
				S 94	3	17		2.7/4 3.0/4
				S 95	3	5		FNR
				S 96	3	14		3.5/4 3.7/4
				S 97	3	7		3.4/4 3.3/4
		S 98		3	13	FNR		
ECE 490	Introduction to Control	Min. Rev.	UC	W 91	4	32		2.5* 2.3*
ECE 615	Automatic Control Laboratory	New	UC	W 90	4	37		2.6* 2.5*
				W 91	4	17		FNR

Key: New = new course developed  
Maj. Rev. = major course revision (e.g. mostly new topics/materials)  
Min. Rev. = minor course revision (e.g. some new topics/materials, new book)  
Demos. = Added hardware/computational/simulation demonstrations in lecture  
Labs. = Added hardware/computational/simulation laboratory experiments  
FNR = forms not returned, or course not evaluated  
\*UC course evaluations are rated from 1 (excellent) to 5 (poor)

### Students Supervised as Primary Advisor

Name	Degree	Date	Univ./Dept	Joint Supervision With	Title
Kenneth W. A. Marcelle	Ph.D.	6/92	UC/ECE		Frequency Domain Performance Analysis of Adaptive Systems
Hatem M. Hmam	Ph.D.	12/92	UC/ECE		Biped Control via Nonlinear Dynamics
Philip G. Good	Ph.D.	5/93	CU/ASEN		Local Interaction Control for Space Construction
Gabriel Gruener	Ph.D.	6/98	CU/MCEN	(Lawrence Carlson)	Telementoring Using Haptic Communication
Timothy Holden	Ph.D.	5/99	CU/ASEN		Active Nutation Damping of Asymmetric Spinning Spacecraft: A Lyapunov Design Approach
Jay A. St. Pierre	Ph.D.	5/02	CU/ASEN		Six Degree-of-Freedom Lorentz Force Actuators for Vibration Isolation and Line of Sight Stabilization
Christopher D. Lee	Ph.D.	8/02	CU/ECEN	Lucy Pao	Modeling and Control of a 5 DOF Haptic Interface Using Matrix Fraction Representation of Paired Hand/Mechanism Impedances



Joseph M. Fulton	Ph.D.	8/06	CU/ ASEN	Scott Palo	LQG/LTR Optimal Attitude Control of Small Flexible Spacecraft Using Free-Free Boundary Conditions
Nicholas Bernstein	Ph.D.	5/07	CU/ ASEN	Lucy Pao	Force Sensor Modeling and Friction Compensation for Haptic Interfaces
Brian P. Rigney	Ph.D.	12/08	CU/ ECEN	Lucy Pao	Adaptive Settle-Optimal Control of Servomechanisms
William J. Pisano	Ph.D.	5/09	CU/ ASEN		The Development of an Autonomous Gust Insensitive Unmanned Aerial Vehicle
Sutha Aphanuphong	Ph.D.	5/14	CU/ ASEN		Dynamics, Control, and Fabrication of a Micro SMA Endoscope
Doug Weibel	Ph.D.	5/15	CU/ASEN	Scott Palo	Improving the accuracy of in-situ lower ABL wind measurements using sUAS
Daniel Guerrant	Ph.D.	5/15	CU/ASEN		Structural, Attitude, and Trajectory Control of Heliogyro Solar Sails
Abhiram Doddi	Ph.D.	8/21	CU/ASEN		Turbulence Measurement and Modeling
Sarah Cook	Ph.D.	12/22	CU/ASEN		Control of Friction and Damping in Heliogyro Solar Sails
Christopher Roseman	Ph.D.	5/22	CU/ASEN	Brian Argrow	Modeling of Heat Transfer for Fine Wire Anemometry at High Altitudes
Nicholas Kenny	Ph.D.	12/23	CU/ASEN		Gossamer Propellers for Scientific Ballooning
Total Ph.D.	17				
Timothy J. Wardlow	M.S.	12/89	UC/ ECE		Identification of Lightly Damped Systems
Paul F. Redder	M.S.	8/91	UC/ ECE		Stability Analysis of Parallel Block Form Adaptive Systems
Neal Clements	M.S.	5/92	UC/ ECE		The Circle Approximation Constraint in Compensator Design
Joseph R. Broda	M.S.	5/92	UC/ ECE		Adaptive Parameter Estimation Technique to Track Plant Variations for a Jet Engine
Thomas A. Martin	M.S.	5/92	UC/ ECE		Simplified Model of and Aircraft Engine Oil System
Christoph Degand	M.S.	8/94	U. Stuttgart		Learning and Adaptive Attitude Control Systems for Small Satellites
Timothy Linn	M.S.	8/94	CU/ ASEN		Integrated Teaching Lab Control Demonstrator
Tom McFeeters	M.S.	5/95	CU/ ASEN		Non-thesis
Mark Salada	M.S.	5/96	CU/ ASEN		Non-thesis
Michael Moreau	M.S.	5/97	CU/ ASEN		Non-thesis
Ioannis Pavlou	M.S.	5/98	CU/ ASEN		Non-thesis
Willard Simmons	M.S.	8/99	CU/ ASEN		Non-thesis
Unkyong Hand	M.S.	12/00	CU/ ECEN		A New Adaptive Algorithm for Disturbance Cancellation in Disk Drives
Gregory Mungas	M.S.		CU/ ASEN		Non-thesis
James Mascarelli	M.S.		CU/		Non-thesis

			ASEN		
Xiao-Hui Zhang	M.S.	5/00	CU/ ECEN	Renjeng Su	Non-thesis
Nicholas Bernstein	M.S.	5/01	CU/ ASEN	Lucy Pao	Non-thesis
Jennifer Kellogg	M.S.	5/01	CU/ ASEN		Non-thesis
Douglas Bryant	M.S.	5/02	CU/ ASEN		Non-thesis
Roman V. Novoselov	M.S.	5/02	CU/ ECEN	Lucy Pao	Haptic Rendering of Data on Irregular and Unstructured Grids
Brian W. Foy	M.S.	5/05	CU/ MCEN	(Derek Reamon)	Hover Controls for a Unique Small-Scale Thrust Reversing UAV
Jeffrey Fehring	M.S.	5/03	CU/ ASEN		Non-thesis
Alex Arustamayan	M.S.	8/03	CU/ ASEN		Non-thesis
Wiebin Xu	M.S.	5/04	CU/ ECEN	Lucy Pao	Non-thesis
Scott Piggott	M.S.	5/05	CU/ ASEN		Solar Sail Trajectory Design and Control in Unrestricted Frames
Sutha Aphanuphong	M.S.	8/08	CU/ ASEN		Embedded Heaters and Sensors for Micro SMA Actuators
Samuel Califf	M.S.	8/08	CU/ ASEN		Pitch Dynamics of a Unique Vertical Takeoff and Landing Unmanned Aerial Vehicle
Farheen Rizvi	B.S./M.S.	12/10	CU/ ASEN		Attitude Dynamics and Coning Control for Solar Sails
Scott Mishra	M.S.	5/13	CU/ASEN		Non-thesis
Huy Le	M.S.	12/13	CU/ASEN		Non-thesis
David Poorman	M.S.	5/14	CU/ASEN		State Estimator Evaluation for SUAS in Wind
David Pope	M.S.	8/15	CU/ASEN	Brian Argrow	Non-thesis
Tyler King	M.S.	5/15	CU/ASEN		Non-thesis
Sarah Smith	M.S.	5/15	CU/ASEN		Heliogyro Blade Actuation and Control in the Presence of Friction
Nathan Curry	M.S.	5/16	CU/ASEN		Non-thesis
Phillip d'Amore	M.S.	5/17	CU/ASEN		Optical Guidance for Precision UAV Landing
Bryce Hill	M. S.	5/18	CU/ASEN		Non-thesis
Jonathan Hamilton	M.S.	5/20	CU/ASEN		Non-thesis
Shrivatsan Charri	M.S.	5/21	CU/ASEN		Non-thesis
Total MS	39				
Andrew White	B.S. Hon. Thesis	5/04	CU/ ECEN	Lucy Pao	Next Generation Haptic Interface Stepper Motor PWM Driver Design
Total BS	1				

Key: Joint supervision in parentheses: advisor of record only

### Student Thesis Committee Membership

Name	Degree	Date	Committee Chair	Univ./Dept.
Robert Sasse	Ph.D.	Exp 5/25	Brian Argrow	CU/ASEN
Samantha Sheppard	Ph.D.	Exp 5/24	John Farnsworth	CU/ASEN
Aleix Garulo	M.S.	2020	John Farnsworth	CU/ASEN
Emily Ranquist	Ph.D.	2021	Brian Argrow	CU/ASEN
Damon Van Burren	Ph.D.	2020	Penina Axelrad	CU/ASEN
Tyler Mixa	Ph.D.	2018	Lakshmi Kantha	CU/ASEN
H. J. Jayakrishnan	M.S.	2018	Scott Palo	CU/ASEN
Tevis Nichols	Ph.D.	2017	Brian Argrow	CU/ASEN
Khashayar Parsay	Ph.D.	2016	HansPeter Schaub	CU/ASEN
Michael Frazer	Ph.D.	2015	Mahmood Hussein	CU/ASEN
Anthony Carfang	Ph.D.	2015	Eric Frew	CU/ASEN
Tevis Nichols	Ph.D.	2016	Brian Argrow	CU/ASEN
Holly Borowski	Ph.D.	2016	Eric Frew	CU/ASEN
Fiona Dunne	Ph.D.	2014	Lucy Pao	CU/ECEN
Mike Krieg	Ph.D.	2012	Kamran Mohseni	CU/ASEN
Jason Durrie	Ph.D.	2016	Eric Frew	CU/ASEN
Hua Zhong	Ph.D.	2015	Lucy Pao	CU/ECEN
Maceij Statura	Ph.D.	2012	Eric Frew	CU/ASEN
Erik Hogan	Ph.D.	2010	HansPeter Schaub	CU/ASEN
Jack Elston	Ph.D.	2010	Eric Frew	CU/ASEN
Jeffrey Butterworth	Ph.D.	2011	Lucy Pao	CU/ECEN
Mari Shirazi	Ph.D.	2009	Regan Zane	CU/ECEN
Cory Dixon	Ph.D.	2009	Eric Frew	CU/ASEN
Brady Young	M.S.	2008	Scott Palo	CU/ASEN
Jason DeSalvo	Ph.D.	2008	David Meyer	CU/ECEN
Eric Baird	Ph.D.	2007	Kamran Mohseni	CU/ASEN
Vahid Yousefzadeh	Ph.D.	2007	Robert Erickson	CU/ECEN
Jeremiah Hall	M.S.	2007	Kamran Mohseni	CU/ASEN
Alex Matras	Ph.D.	2006	Mark Balas	CU/ASEN
Eric Mehiel	Ph.D.	2004	Mark Balas	CU/ASEN
Kathryn Johnson	Ph.D.	2004	Lucy Pao	CU/ECEN
Chanat La-orpacharapan	Ph.D.	2004	Lucy Pao	CU/ECEN
William Hindman	Ph.D.	2003	Charbel Farhat	CU/ASEN
Alan Wright	Ph.D.	2003	Mark Balas	CU/ASEN
Craig Cutforth	Ph.D.	2002	Lucy Pao	CU/ECEN
Premal Madhani	Ph.D.	2002	Penina Axelrad	CU/ASEN
Karl Stol	Ph.D.	2001	Mark Balas	CU/ASEN
Osama Al-Naseem	Ph.D.	2001	Robert Erickson	CU/ECEN
Robert Fuentes	Ph.D.	2001	Mark Balas	CU/ASEN
Xiao Zhang	Ph.D.	2001	Renjeng Su	CU/ECEN
Hilton Chan	B.S.	1999	John Hall	CU/Physics
Steven Kranock	Ph.D.	1999	Lee Peterson	CU/ASEN
Jacob Freeman	M.S.	1998	Mark Balas	CU/ASEN
Kevin Gifford	Ph.D.	1997	George Morgenthaler	CU/ASEN
Kendall Nii	Ph.D.	1997	Renjeng Su	CU/ECEN
Lisa Ward	Ph.D.	1996	Penina Axelrad	CU/ASEN
Donald Waters	Ph.D.	1996	Mark Balas	CU/ASEN
Bruce Chesley	Ph.D.	1996	Penina Axelrad	CU/ASEN
Lawrence Robertson	Ph.D.	1996	Mark Balas	CU/ASEN

Ashok Srivastava	Ph.D.	1996	Renjeng Su	CU/ECEN
David Smart	Ph.D.	1995	Lee Peterson	CU/ASEN
Yung Jae Lee	Ph.D.	1996	Mark Balas	CU/ASEN
Janet Stuart	Ph.D.	1996	Mark Balas	CU/ASEN
James Mohl	Ph.D.	1995	Mark Balas	CU/ASEN
Christopher Steffen	Ph.D.	1994	Renjeng Su	CU/ECEN
Gabriel Gruener	M.S.	1994	Lawrence Carlson	CU/MCEN
Y.-H. Chang	Ph.D.	1994	Mark Balas	CU/ASEN
Huaider Pai	Ph.D.	1994	Renjeng Su	CU/ECEN
Hai Ho	Ph.D.	1994	Miloje Radenkovic	CU/ECEN
Roger Toennis	M.S.	1993	Renjeng Su	CU/ECEN
Anita Carpenter	M.S.	1993	Mark Balas	CU/ASEN
Mostefa Mesbah	Ph.D.	1993	Mark Balas	CU/ASEN
Jim Chapel	Ph.D.	1992	Renjeng Su	CU/ECEN
Abbas Fardoun	Ph.D.	1992	Ewald Fuchs	CU/ECSN
Milos Doroslovacki	Ph.D.	1992	Hong Fan	UC/ECE
Ali Gooyabadi	Ph.D.	1991	Mark Balas	CU/ASEN
James Cook	M.S.	1992	Lawrence Carlson	CU/MCEN
Ahcene Menikh	Ph.D.	1992	Min Yen Wu	CU/ECEN
K. X. Miao	Ph.D.	1991	Hong Fan	UC/ECEN
Sherlyn Kelly-Thompson	M.S.	1991	Patrick Garrett	UC/ECEN
Sayed Jaweed	M.S.	1991	Bruce Walker	
Nicholas Rethman	M.S.	1990	Philip Wilsey	UC/ECEN
Srichander Ramaswamy	Ph.D.	1990	Bruce Walker	UC/AEEM
Xiaoming Hu	M.S.	1989	Hong Fan	UC/ECEN
Ram Vemuri	M.S.	1989	Hong Fan	UC/ECEN
D. R. Church	M.S.	1989	Patrick Garrett	UC/ECEN
Total Ph.D.	57			
Total MS	14			
Total BS	1			

### Undergraduate Research Projects Supervised

Name	Date	Type	Topic
Tervor Barth	S/F 2018	NSF IUCRC	Rugged air data sensing for small UAVs
Austin Lillard	S 2014	CIRES IRP	Coordinated Control of Multiple UAVs for Atmospheric Sensing
Matthew Osborne Yoshijuki Hasegawa David Goluskin	F 2005 S 2006	NSF REU (with K. Mohseni)	MAV aerodynamic design and modeling
Spencer Riggs Joshua Fromm	F 2006	UROP (with K. Mohseni)	MAV prototype construction and testing
Andrew White	S 2004	NSF REU (with Lucy Pao)	Next generation haptic interface stepper motor PWM driver design
Pepe Larios	F 1995	UROP	Haptic Interface Electronics Development
Shane Brown	S 1994	UROP	Teleoperator mechanical design
Fadi Dawood	F 1994	UROP	Actuator finite element modeling

	Sum 1994	NASA grant	
Richard Jaramillo	F 1994 Sum 1994	UROP NASA grant	Vibration isolation mechanical design
Trung Ha	F 1994 Sum 1994	UROP NASA grant	Space shuttle vibration data characterization
Jason Wynn	F 1994 Sum 1994	UROP NASA grant	Vibration isolation simulation
Shin Urashima	S 1993	UROP	Teleoperation actuator control

### Independent Study Projects Supervised

Name	Date	Credits	Topic
Jonathon Stark	Sum 2011	3	Rocket lab telemetry system
Marek Sotola	F 2010	3	CUPIC/NetUAS interface
Jonathon Stark	Sum 2010	3	Remote controlled kites
Eric Payton	Sum 2010	3	Autonomous launch UAV
Eric Payton	S 2010	3	Atmospheric Profiling UAV
Jason Durrie	S 2009	3	Folding Wing MAV deployment
Apratim Shaw	F 2008	3	MAV flight control
Ryan Olds	F 2007	3	High altitude balloon dynamics modeling
Ryan Olds	S 2008	3	High altitude balloon precision pointing control
Zachary Hazen	S 2006	3	Small UAV propulsion model validation
John Lewis	F 2005	3	Micro servo prototype for UAVs
Ryan Donahue	S 2004	3	Cooperative control for micro UAVs
Behrang Annabi	S 2003	3	Micro UAV inertial measurement unit
Alex Arustamayan	S 2003	3	GPS navigation for UAVs
Jason DeSalvo	F 2003	3	Hysteresis modeling for a shape memory actuator
Richard Roosen	F 2003	3	Attitude determination using a micro IMU for UAVs
Welton Hong	F 1996-	3	RoboCar design competition
Eric Rice	S 1997	3	
Nils Hoivik		3	
Jill Kamienski		3	
Michele Stein		3	
Michael Figaro		3	
John Gifford		3	
Stefan Allen		3	
Brian Rigney		3	
Jacob Freeman	F 1997	3	Haptic interface power amplifier
Richard Wise	S 1997	3	Spacecraft precision pointing
Chris Wells	S 1997	3	Jet belt feasibility study
Ioannis Pavlou	S 1996	3	Haptic interface control
Mark Salada	F 1996	3	Virtual surfaces in haptic interfaces

Mike Urano	F 1995	3	Active camera stabilization
Darrin Jeffers	S 1995	3	Shape memory actuator modeling
David Shafter	F 1994	3	Microactuator feasibility study
Tom McFeeters	Sum 1994	1	Force sensor sensitivity study
Michael Huber	S 1993	3	Control for building earthquake protection
Steven Kohls	S 1991	3	Ultrasonic tracking for a mobile robot
Victor Hunt	S 1990	3	Jet engine control
Total	30		

### Miscellaneous Teaching Activity

Faculty advisor for the Center for Space Construction Orbital Reflector Construction Tiger Team (Fall, '92), consisting of 2 hour weekly classes over one semester where design of a space-deployable antenna was carried out.

Designed and directed construction of two pilot ITL modules: "Hands-On Control System Demonstrator", and "Accelerometer Design and Characterization". The control system demonstrator, in particular, has been used extensively as a class demonstration (ASEN 3014, Fall), and as a demonstration for ITL fundraising and planning (Engineering Development Council Review, Oct, 1993, Back to Campus Day for Colorado Legislators, Nov, 1993 and ITL External Review Workshop, Jan 1994).

Developed and presented guest lectures on "Dynamic Systems and Control", as well as a hands-on laboratory module for open-ended exploration of basic principles on a ITL pilot module "Quarter Car Suspension System" for GEEN 1400 Freshman Design Laboratory (Fall 1994).

Presented a dynamics and control session for the High School Honors Institute (summer 1994) utilizing the "Hands-On Control System Demonstrator" developed for the ITLL. A similar presentation was prepared for a visit by Prairie High School.

Developed an ITL module for engineering enrichment of the sophomore differential equations course (APMA 2360). Module consisted of a small wind tunnel where students conducted hands-on experiments on aircraft stability and its relation to mathematical models in the phase plane. This module was used by approximately 300 students in the Fall semester (1995). This module was the basis for a succession of "wind chambers" that were used for many years in the Sophomore Aerospace Vehicles course (ASEN 2004).

Supervised (along with Larry Carlson (MCEN)) development efforts in multimedia and information infrastructure facilities for the ITLL, as part of a grant from the Changing the Learning Paradigm through Technology President's Initiative Fund (1993, 1994).

Revised an ASEN 4018/4028 section to enable a large, interdisciplinary senior project with students from several engineering departments to participate in an international autonomous robot competition (AUVSI RoboCar) in two successive years (1996,1997).

Member of Curriculum and Teaching Committee focusing on redesign of Junior and Senior year curricula. Led efforts in Senior Design Laboratory revision and Systems and Control course revision, leading to 5 new proposed undergraduate courses that were instituted as part of the Curriculum 2000 revision (ASEN 4018/4028, ASEN 3200, ASEN 3300, ASEN 3128).

Led department assessment retreat and subsequent development of an assessment system, including an outcome-based grading method, software tools to implement the method, and training for faculty and TAs. The system was implemented as part of a successful ABET accreditation review (1999).

Provided two guest lectures on disk drive control for ECEN 5008 (Spring 2000, coordinated by Renjeng Su).

Developed spacecraft dynamics and control laboratory modules and associated real time control software and experiment procedures for ASEN 4114/5114 (2002). These modules were upgraded and replicated with Engineering Excellence funds in 2006.

Presented guest lectures on electromechanical power systems for Senior Design students (2007,2008,2009).

Developed a Summer Aerobotics Challenge (with Kamran Mohseni and Richard Han) for high school students, conducted during weekly lectures and laboratory sessions over one month (summer 2006), culminating in flight testing of student software and hardware designs for precision air dropping of chalk capsules (“fire retardant”) from small unmanned aerial vehicles.

Developed and delivered a traveling 90 minute lecture and hands-on demonstration on the use of Laplace transforms to understand dynamical systems, using a single link robot and an oscilloscope, for calculus 3 students at Peak to Peak Charter School in Lafayette, CO (Fall, 2008).

## Department Service

Activity	Role	Period	Location
RECUV Center Leadership	Center Director	2020 -	CU/ASEN
Focus Area Lead	Autonomous Systems	2019--2020	CU/ASEN
Post Tenure Review – Brian Argrow	Chair	2022	CU/ASEN
PUEC – James Nabity	Member	2019	CU/ASEN
Professor Emeritus – Lakshmi Kantha	Chair	2022	CU/ASEN
PUEC – John Farnsworth	Member	2018	CU/ASEN
Faculty Search Committee	Chair -- Design Instructor	2017	CU/ASEN
PUEC --- Eric Frew Promotion	Member	2017	CU/ASEN
Mentoring Committee for Melvin Rafi	Member	2022-	CU/ASEN
Mentoring Committee for Zachary Sunberg	Member	2020-	CU/ASEN
Mentoring Committee for Natasha Bosanac	Member	2018-	CU/ASEN
Mentoring Committee for Nisar Ahmed	Member	2014-2022	CU/ASEN
AES Rooftop Facilities Committee	Member	2020-	CU/ASEN
Elect/Comp. Curr. Rev. Committee	Member --- Electronics	2013	CU/ASEN
Aerospace Ventures Committee	Member	2014-2015	CU/ASEN
Faculty Search Committee	Member – Small Satellites	2014-2015	CU/ASEN

Faculty Search Committee	Member - Bioastronautics	2012	CU/ASEN
Faculty Search Committee	Chair –Control Systems	2012-2013	CU/ASEN
Faculty Evaluation Committee	Member	2013	CU/ASEN
Faculty Evaluation Committee	Member	2012, 2013, 2019	CU/ASEN
Faculty Evaluation Committee	Chair	2011	CU/ASEN
PUEC – Jay McMahon P&T	Member	2020	CU/ASEN
PUEC --- Ryan Starkey P&T	Member	2014	CU/ASEN
PUEC --- Kurt Maute Promotion	Member	2011-2012	CU/ASEN
Curriculum and Teaching Committee	Member	2010-2018	CU/ASEN
PUEC Committee—Mahmoud Hussein reappointment	Chair	2010	CU/ASEN
Mentoring Committee for Eric Frew	Member	2006 - 2010	CU/ASEN
Mentoring Committee for Kamran Mohseni	Member	2004-2007	CU/ASEN
Junior Faculty Hiring Committee	Chair	2005-2006	CU/ASEN
Faculty Hiring Committee	Member	2003-2006	CU/ASEN
Curriculum and Teaching Committee	Chair	2005-2006	CU/ASEN
Curriculum and Teaching Committee	Member	2004-	CU/ASEN
Curriculum and Teaching Committee	Chair, Assessment Subcommittee	1999-2005 2016-2017	CU/ASEN
AAHE Summer Academy	ASEN team leader	1998	CU/ASEN
Graduate Committee	Member	1997-1998 2005-2006 2017--	CU/ASEN
Graduate Committee	Chair, Subcommittee for Vehicle Systems focus area	2006-2007	CU/ASEN
Ph.D. Qualifying Exam Committee	Member	1994, 1998, 2001, 2003-	CU/ASEN
Executive Committee	Member	1997-1999 2018--	CU/ASEN
Aeronautics Strategy Committee	Member	1999-2000	CU/ASEN
Ad Hoc Space Needs Committee	Member	1997-1998	CU/ASEN
Instrument Shop Committee	Member	1999-2004	CU/ASEN
Facilities Committee	Member	1991-1995	CU/ASEN
Ad Hoc Faculty Retreat Planning Committee	Member	1993	CU/ASEN
IEEE Student Branch	Faculty Advisor	1989-1991	UC/ECE
Faculty Search Committee	Member	1988-1990	UC/ECE
Graduate Program Committee	Member	1988-1991	UC/ECE
Ph.D. Qualifying Exam Committee	Member	1988-1991	UC/ECE
Mission/Vision Committee	Member	1989-1990	UC/ECE



### College Service

Activity	Role	Period
First Level Review Committee	Member, vice-chair	2020-2022
College Assessment Committee	Member, ASEN Representative	2007-2008
Research and Engineering Center for Unmanned Vehicles	Founding Member Center Director	2004 2019 --
Colorado Center for Information Storage	Founding Member	2001
Colorado Center for Information Storage Executive Committee	Member	2001-2007
Undergraduate Academic Affairs Committee	Member	1995-1998
ITL Control Focus Committee	Chair, organized faculty toward development of control systems modules and facilities in the ITLL	1994-1998
High School Honors Institute	Outreach: tours, demos	1994
Lecture at Peak-to-Peak High School	Outreach: "Laplace Transforms in Engineering" for a calculus 3 class	2008
Summer Aerobotics Challenge	Outreach: created a 4-week classroom design challenge and flight competition for high school students (with Kamran Mohseni and Richard Han)	2006

### Professional Service

Organization	Role/Activity	Period
International Society for Atmospheric Research using Remotely piloted Aircraft (ISARRA)	Member, Conference Planning Committee	2018
AIAA National Technical Committee for Guidance Navigation and Control	Member at large, Subcommittee member for best student paper at the GNC conference---selected winner from 9 finalists based on paper and presentations at the conference, Subcommittee member for graduate student award--selected winner from 11 finalists based on resume, Chair of the best paper selection committee for the GNC conference---handled 74 papers in 4 rounds of peer ratings.	2006-2010 2007  2008  2009
Brigham Young University	Ext. Referee for Faculty P&T	2011
IEEE, AIAA, ASME	Ad hoc reviewer for journals and conferences, averaging about 10 manuscripts/year	1988 -
IEEE Conference on Decision and Control	Associate editor, arranged 2-3 reviews each for 15 papers	1994
American Control Conference	Associate editor, arranged 2 reviews each for 18	1995

	papers	
National Science Foundation	Panel member, proposal review	2002, 2008
IEEE International Conference on Robotics and Automation	Local arrangements committee member	1990
IEEE	Member, executive committee for local section	1989--1991