

Raghvendra V. Cowlagi – Curriculum Vitae

BACKGROUND

1. Education

| | | |
|--------------------------------|--|------|
| Ph.D., Aerospace Engineering | Georgia Institute of Technology, Atlanta, GA | 2011 |
| M.Tech., Aerospace Engineering | Indian Institute of Technology Bombay, Mumbai, India | 2005 |
| B.E., Electronics Engineering | University of Mumbai, India | 2003 |

2. Work Experience

| | | |
|---|--|-----------|
| Associate Professor | Aerospace Engineering Department, WPI | 2019 – |
| Assistant Professor | Aerospace Engineering Program, WPI | 2013 – 19 |
| Guidance, Navigation, and Controls Engineer | Aurora Flight Sciences Corp., Cambridge, MA | 2012 – 13 |
| Postdoctoral Fellow | Massachusetts Institute of Technology, Cambridge, MA | 2011 – 12 |
| Research Assistant | Georgia Institute of Technology, Atlanta, GA | 2006 – 11 |
| Project Engineer | Indian Institute of Technology Bombay, Mumbai, India | 2005 – 06 |
| Teaching Assistant | Indian Institute of Technology Bombay, Mumbai, India | 2003 – 05 |

3. Professional Memberships and Offices

- Senior Member, Institute of Electrical and Electronics Engineers (IEEE)
- Senior Member, American Institute of Aeronautics and Astronautics (AIAA)
- Member, AIAA Guidance, Navigation, and Controls Technical Committee
- Member, American Society of Mechanical Engineers (ASME)

SCHOLARSHIP

4. Honors and Awards Related to Scholarship

4a. National and International Recognition

- 2016 Air Force Office of Scientific Research *Young Investigator Research Program (YIP)* award
- *Student Best Paper* award, 2009 American Control Conference, St. Louis, MO, USA
- 2005 *Aeronautical Society of India award* for Outstanding Performance in the M.Tech. degree program

4b. Within WPI

- 2017 Sigma Xi *Outstanding Junior Faculty* award
- *James Nichols Heald Research Fund*, September 2016 and September 2018
- 2016 Department of Mechanical Engineering *Excellence in Research* award

4c. Other

- Journal of Guidance, Control, and Dynamics *Excellent Reviewer* recognition, December 2016.
- *Best Presentation* awards: 2009 & 2010 American Control Conferences.
- American Automatic Control Council *Travel award* for the 2009 American Control Conference, St. Louis, MO, USA.
- IEEE-ICRA *Travel award* for the International Conference on Robotics & Automation 2012, St. Paul, MN, USA.

4d. As Advisor or Nominator

- 2019 WPI Sigma Xi Outstanding Doctoral Dissertation Award to Dr. Benjamin Cooper (former Ph.D. student)
- First place in 2017 WPI Graduate Research Innovation Exchange (GRIE) graduate category to Dr. Benjamin Cooper (former Ph.D. student)
- 2017 AIAA GNC *Undergraduate Conference Experience travel award* to Mr. Keith P. Rockwood (AE B.S. student, class of 2017).

5. Publications

Notes:

- Names of student co-authors are underlined.
- In the controls research community, it is standard practice at all leading conferences to demand full manuscripts at the time of initial submission (instead of an extended abstract, as are widely accepted in other communities). These drafts are then subjected to peer review similar to a journal article, but no rebuttal or revisions are allowed. Due to this peer review process, papers in leading conferences in the control engineering community are considered significant contributions to the technical literature. Such papers are indicated below under the heading "*Peer-Reviewed Conference Papers.*"

5a. Peer-Reviewed Journal Articles

14. J. Fang, Z. Zhang, and R. V. Cowlagi, "Decentralized route-planning for multi-vehicle teams to satisfy a subclass of linear temporal logic specifications," *Automatica*, in review.
13. Z. Zhang, R. Du, and R. V. Cowlagi, "Randomized sampling-based trajectory optimization for uavs to satisfy linear temporal logic specifications," *Aerospace Science and Technology*, vol. 96, p. 105591, January 2020.
12. R. Du and R. V. Cowlagi, "Interactive sensing and planning for a quadrotor vehicle in partially known environments," *Journal of Guidance, Control, and Dynamics*, vol. 42, no. 7, pp. 1601–1611, July 2019.

11. B. S. Cooper and R. V. Cowlagi, "Interactive planning and sensing in unknown static environments with task-driven sensor placement," *Automatica*, vol. 105, no. 7, pp. 391–398, July 2019.
10. B. S. Cooper and R. V. Cowlagi, "Path-planning with waiting in spatiotemporally-varying threat fields," *PLoS ONE*, vol. 13, no. 8, p. e0202145, August 2018.
9. R. V. Cowlagi, J. P. Sperry, and J. C. Griffin, "Unmanned aerial vehicle trajectory optimization for executing intelligent tasks," *Journal of Guidance, Control, and Dynamics*, vol. 41, no. 6, pp. 1389–1396, June 2018.
8. R. V. Cowlagi, "Hierarchical trajectory optimization in hybrid dynamical systems," *Automatica*, vol. 77, no. 3, pp. 112–119, 2017.
7. R. V. Cowlagi and Z. Zhang, "Route guidance for satisfying temporal logic specifications on aircraft motion," *Journal of Guidance, Control, and Dynamics*, vol. 40, no. 2, pp. 390–401, 2017.
6. R. V. Cowlagi and J. H. Saleh, "Coordinability and consistency: Application of systems theory in accident prevention and system safety," *Journal of Loss Prevention in the Process Industries*, vol. 33, pp. 200–212, January 2015.
5. R. V. Cowlagi and P. Tsiotras, "Curvature-bounded traversability analysis for motion planning of mobile robots," *IEEE Transactions on Robotics*, vol. 30, no. 4, pp. 1011–1019, 2014.
4. R. V. Cowlagi and J. H. Saleh, "Coordinability and consistency in accident causation and prevention: Formal system-theoretic concepts for safety in multilevel systems," *Risk Analysis*, vol. 33, no. 3, pp. 420–433, 2013.
3. R. V. Cowlagi and P. Tsiotras, "Hierarchical motion planning with dynamical feasibility guarantees for mobile robotic vehicles," *IEEE Transactions on Robotics*, vol. 28, no. 2, pp. 379 – 395, 2012.
2. R. V. Cowlagi and P. Tsiotras, "Multi-resolution motion planning for autonomous agents via wavelet-based cell decompositions," *IEEE Transactions on Systems, Man and Cybernetics: Part B - Cybernetics*, vol. 42, no. 5, pp. 1455–1469, 2012.
1. J. H. Saleh, K. Marais, E. Bakolas, and R. V. Cowlagi, "Highlights from the literature on accident causation and system safety: Review of major ideas, recent contributions, and challenges," *Reliability Engineering and System Safety*, vol. 95, no. 11, pp. 1105–1116, 2011.

5b. Peer-Reviewed Conference Papers

38. C. L. St. Laurent and R. V. Cowlagi, "Depth-first coupled sensor configuration and path-planning in unknown static environments," in *Proceedings of the 2021 European Control Conference, 2021*, in review.
37. R. V. Cowlagi, R. C. Debski, and A. M. Wyglinski, "Risk quantification for automated driving using information from v2v basic safety messages," in *2021 IEEE 93rd Vehicular Technology Conference (VTC2021-Spring)*, Helsinki, Finland, 25–28 April 2021, in review.
36. C. L. St. Laurent and R. V. Cowlagi, "Coupled sensor configuration and path-planning in unknown static environments," in *Proceedings of the 2021 American Control Conference, 2021*, in review.
35. J. Fang, H. Zhang, and R. V. Cowlagi, "Interactive route-planning and mobile sensing with a team of robotic vehicles in an unknown environment," in *Proceedings of the AIAA Guidance, Navigation, and Control Conference, 2021 AIAA SciTech Forum & Exposition, 2021*.
34. N. Kanthasamy, A. M. Wyglinski, and R. V. Cowlagi, "Effects of interference on beamforming-enabled vehicular networks in multipath propagation environments," in *2020 IEEE 91st Vehicular Technology Conference (VTC2020-Spring)*, Antwerp, Belgium, 25–28 May 2020.
33. B. S. Cooper and R. V. Cowlagi, "Decentralized interactive planning and sensing in an unknown spatiotemporal threat field," in *2019 Sixth Indian Control Conference (ICC)*, Hyderabad, India, 18–20 December 2019, pp. 110–115.
32. B. S. Cooper and R. V. Cowlagi, "Interactive planning and sensing in spatiotemporally varying uncertain environments," in *2019 18th European Control Conference (ECC)*, Naples, Italy, 25–28 June 2019, pp. 2058–2064.
31. Z. Zhang and R. V. Cowlagi, "A fast sampling-based optimal route-planning algorithm to satisfy linear temporal logic specifications," in *Proceedings of the Guidance, Navigation, and Control Conference, 2018 AIAA SciTech Forum & Exposition*, no. AIAA 2018-1590, Kissimmee, FL, USA, January 8–12 2018.

30. J. Fang, Z. Zhang, and R. V. Cowlagi, "Decentralized route-planning to satisfy global linear temporal logic specifications on multiple aircraft," in *Proceedings of the Guidance, Navigation, and Control Conference, 2018 AIAA SciTech Forum & Exposition*, no. AIAA 2018-1862, Kissimmee, FL, USA, January 8–12 2018.
29. B. S. Cooper and R. V. Cowlagi, "Interactive planning and sensing in uncertain environments with task-driven sensor placement," in *Proceedings of the 2018 American Control Conference*, Milwaukee, WI, USA, 27–29 June 2018, pp. 1003–1008.
28. N. Kanthasamy, R. Du, K. S. Gill, A. M. Wyglinski, and R. V. Cowlagi, "Assessment of positioning errors on v2v networks employing dual beamforming," in *Proceedings of the 2018 IEEE 88th Vehicular Technology Conference: VTC2018-Fall*, Chicago, IL, USA, 27–30 August 2018.
27. N. Kanthasamy, R. V. Cowlagi, and A. M. Wyglinski, "State estimation for mitigating positioning errors in v2v networks employing dual beamforming," in *Proceedings of the IEEE Connected and Autonomous Vehicles Symposium 2018*, Chicago, IL, USA, 27–30 August 2018.
26. R. Du and R. V. Cowlagi, "Interactive sensing and path-planning with incremental 3d path repair for a quadrotor uav in cluttered and partially known environments," in *Proceedings of the 56th IEEE Conference on Decision & Control*, Melbourne, VIC, Australia, 12–15 December 2017, pp. 933–938.
25. R. V. Cowlagi, J. T. Chambers, and N. Baltadjiev, "Route-planning for real-time safety-assured autonomous aircraft," in *Proceedings of AIAA Aviation Forum & Exposition 2016, Multidisciplinary Design Optimization*, Washington, DC, USA, June 2016.
24. J. Chambers, N. Baltadjiev, and R. V. Cowlagi, "Real-time safety-assured autonomous aircraft," in *Proceedings of AIAA Aviation Forum & Exposition 2016, Multidisciplinary Design Optimization*, Washington, DC, USA, 2016 2016.
23. R. V. Cowlagi and Z. Zhang, "Motion-planning with temporal logic specifications for a nonholonomic vehicle kinematic model," in *Proceedings of the 2016 American Control Conference*, Boston, MA, USA, 6–8 July 2016, pp. 6411 – 6416.
22. Z. Zhang and R. V. Cowlagi, "Motion-planning with global temporal logic specifications for multiple nonholonomic robotic vehicles," in *Proceedings of the 2016 American Control Conference*, Boston, MA, USA, 6–8 July 2016, pp. 7098 – 7103.
21. R. V. Cowlagi and J. P. Sperry, "Unifying artificial intelligence and trajectory optimization for UAV guidance," in *Proceedings of the Guidance, Navigation, and Control Conference, 2016 AIAA SciTech Forum & Exposition*, no. AIAA-2016-0381, San Diego, CA, USA, 4 – 8 January 2016.
20. D. Cyr, P. Guarino, J. I. Hitchen, R. Morar, J. P. Sperry, R. V. Cowlagi, D. Olinger, and D. J. Nyren, "Stabilization of helicopter sling loads with passive and active control surfaces," in *Proceedings of the 54th AIAA Aerospace Sciences Meeting, 2016 AIAA SciTech Forum & Exposition*, no. AIAA-2016-2031, San Diego, CA, USA, 2016.
19. R. V. Cowlagi, "Hierarchical hybrid control with classical planning and trajectory optimization," in *Proceedings of the 5th IFAC Conference on Analysis and Design of Hybrid Systems*, Atlanta, GA, October 14 – 16 2015, pp. 175–180.
18. Z. Zhang and R. V. Cowlagi, "Incremental path repair in hierarchical motion-planning with dynamic feasibility guarantees for mobile robotic vehicles," in *European Control Conference ECC'15*, Linz, Austria, 15–17 July 2015.
17. R. V. Cowlagi, "Multiresolution aircraft guidance in a spatiotemporally-varying threat field," in *Proceedings of the Guidance, Navigation, and Control Conference, 2015 AIAA SciTech Forum & Exposition*, no. AIAA 2015-1078, Kissimmee, FL, USA, 5–9 January 2015.
16. R. V. Cowlagi, "Multiresolution path-planning with traversal costs based on time-varying spatial fields," in *Proceedings of the 53rd IEEE Conference on Decision & Control*, Los Angeles, CA, USA, December 15–17 2014, pp. 3745–3750.
15. R. V. Cowlagi and D. N. Kordonowy, "Geometric abstractions of vehicle dynamical models for intelligent autonomous motion," in *Proceedings of the 2014 American Control Conference*, Portland, OR., June 4 – 6 2014, pp. 4840–4845.
14. D. Allaire, J. Chambers, R. V. Cowlagi, D. Kordonowy, M. Lecerf, L. Mainini, F. Ulker, and K. Willcox, *An Offline/Online {DDAS} Capability for Self-Aware Aerospace Vehicles*. Elsevier, 2013, vol. 18, no. 0, pp. 1959 – 1968, 2013 International Conference on Computational Science. [Online]. Available: <http://www.sciencedirect.com/science/article/pii/S1877050913005085>

13. J. H. Jeon, R. V. Cowlagi, S. C. Peters, S. Karaman, E. Frazzoli, P. Tsiotras, and K. Iagnemma, "Optimal motion planning with the half-car dynamical model for autonomous high-speed driving," in *Proceedings of the 2013 American Control Conference*, Washington, DC, USA, 17 – 19 Jun 2013.
12. D. N. Kordonowy, J. T. Chambers, and R. V. Cowlagi, "Contingency management for condition-aware unmanned aerial vehicles," in *Proceedings of the AIAA Infotech@Aerospace 2013 Conference*, Boston, MA, USA, 19 – 22 Aug 2013.
11. R. V. Cowlagi and P. Tsiotras, "Hierarchical motion planning with kinodynamic feasibility guarantees: Local trajectory planning via model predictive control," in *Proceedings of the 2012 IEEE International Conference on Robotics and Automation*, St. Paul, MN, USA, May 14–18 2012, pp. 4003–4008.
10. F. Alibay, V. Desaraju, R. V. Cowlagi, J. E. Duda, A. W. Johnson, and J. A. Hoffman, "Multi-vehicle lunar operations simulation using SEXTANT," in *Proceedings of the AIAA Space 2012 Conference & Exposition*, Pasadena, CA, USA, Sep 2012.
9. R. V. Cowlagi and P. Tsiotras, "Multi-resolution h-cost motion planning: A new framework for hierarchical motion planning for autonomous mobile vehicles," in *Proceedings of the IEEE/RSJ International Conference on Intelligent Robots & Systems IROS 2011*, San Francisco, CA, USA, 25–30 Sep 2011, pp. 3501–3506.
8. R. V. Cowlagi and P. Tsiotras, "On the existence and synthesis of curvature-bounded paths inside nonuniform rectangular channels," in *Proceedings of the 2010 American Control Conference*, Baltimore, MD, USA, 30 Jun – 2 Jul 2010, pp. 5382 – 5387.
7. R. V. Cowlagi and P. Tsiotras, "Kinematic feasibility guarantees in geometric path planning using history-based transition costs over cell decompositions," in *Proceedings of the 2010 American Control Conference*, Baltimore, MD, USA, 30 Jun – 2 Jul 2010, pp. 5388 – 5393.
6. R. V. Cowlagi and P. Tsiotras, "Multi-resolution path planning: Theoretical analysis, efficient implementation, and extensions for dynamic environments," in *Proceedings of the 49th IEEE Conference on Decision and Control*, Atlanta, GA, 15 – 17 Dec 2010.
5. R. V. Cowlagi and J. H. Saleh, *Coordinability and Consistency in Accident Causation and System Safety: Towards a Formal Foundation of Safety in Sociotechnical and Multilevel Systems*. London, United Kingdom: Taylor & Francis, 2010, pp. 1836–1844.
4. R. V. Cowlagi and P. Tsiotras, "Shortest distance problems in graphs using history-dependent transition costs with application to kinodynamic path planning," in *Proceedings of the 2009 American Control Conference*, St. Louis, MO, USA, 9 – 12 Jun 2009, pp. 414 – 419.
3. R. V. Cowlagi and P. Tsiotras, "Multiresolution path planning with wavelets: A local replanning approach," in *Proceedings of the 2008 American Control Conference*, Seattle, WA, USA, 11–13 Jun 2008, pp. 1220–1225.
2. R. V. Cowlagi and P. Tsiotras, "Beyond quadrees: Cell decompositions for path planning using the wavelet transform," in *Proceedings of the 46th IEEE Conference on Decision and Control*, New Orleans, LA, 12–14 Dec 2007, pp. 1392–1397.
1. S. P. Bhat and R. V. Cowlagi, "Semi-global practical stability of periodic time-varying systems via averaging: A Lyapunov approach," in *Proceedings of the 45th IEEE Conference on Decision and Control*, San Diego, CA, USA, 13 – 15 Dec 2006, pp. 361–365.

5c. Book Chapters

1. B. S. Cooper and R. V. Cowlagi, "Dynamic Sensor-Actor Interactions for Path-Planning in a Threat Field." In: Blasch E., Ravela S., Aved A. (eds) *Handbook of Dynamic Data Driven Applications Systems*, 2018. Springer, Cham. https://doi.org/10.1007/978-3-319-95504-9_19

5d. Publications at Non-Peer-Reviewed Venues

2. B. S. Cooper and R. V. Cowlagi, "Dynamic sensor-actor interactions for path-planning in a threat field," in *Proceedings of the 1st International Conference on InfoSymbiotics / DDDAS*, Hartford, CT, Aug 2016.
1. P. Tsiotras and R. V. Cowlagi, "Achieving increased mobility and autonomy for ground vehicles over rough terrain," in *Proceedings of the 26th Army Science Conference*, Orlando, FL, USA, 6–8 Dec 2008.

6. Grants Awarded

| Project Title | Agency | Amount Awarded | | Duration | Collaborators | | Role and Portion at WPI | Students Supported |
|---|---------|----------------|--------|-------------------|------------------------|--------------------------------------|-------------------------|---|
| | | To WPI | Total | | WPI | Non-WPI | | |
| CPS: Breakthrough: Selective Listening - Control for Connected Autonomous Vehicles in Data-Rich Environments | NSF-CPS | \$425K | \$425K | Apr. '17–Mar. '21 | A. Wyglinski (ECE) | – | PI, 67% | R. Du N. Kanthasamy |
| MRI: Development of an Autonomous, Connected and Data-Driven Vehicle for Multi-Disciplinary Research and Project-Based Learning | NSF-CNS | \$300K | \$300K | Oct. '16–Sep. '19 | X. Huang (ECE, PI) | – | Co-PI | Y. Xiao |
| NSF Student Travel Grant for IEEE VTS Connected & Autonomous Vehicles Summer School at WPI | NSF-CNS | \$5K | \$5K | Jul. '16–Jun. '17 | A. Wyglinski (ECE, PI) | – | Co-PI | – |
| ↻ Multiscale Dynamic Data-Driven Guidance and Control for Autonomous Vehicle Networks | AFOSR | \$360K | \$360K | Jan. '17–Dec. '20 | – | – | PI, 100% | B. S. Cooper J. Fang C. L. St.Laurent |
| Real-time Safety-Assured Autonomous Aircraft SBIR Phase II - Option | USAF | \$83.5K | \$250K | Feb. '17–Aug. '17 | – | Aurora Flight Sciences Corp. (Prime) | PI, 100% | Z. Zhang |
| Real-time Safety-Assured Autonomous Aircraft SBIR Phase II - Base | USAF | \$185K | \$500K | Aug. '15–Feb. '17 | – | Aurora Flight Sciences Corp. (Prime) | PI, 100% | Z. Zhang R. Du B. S. Cooper |
| Real-time Safety-Assured Autonomous Aircraft SBIR Phase I | USAF | \$37.4K | \$150K | Jul. '14–Mar. '15 | – | Aurora Flight Sciences Corp. (Prime) | PI, 100% | Z. Zhang |

7. Graduate Research Advised at WPI

7a. Ph.D. Dissertations

| Student | Milestones | | | | Dissertation Title | Products (Note 1) | Funding | Current Status |
|---|------------|------------|---------------------------------|-----------------|--|----------------------|------------------|-----------------|
| | Start | Qual. Exam | Proposal | Defence | | | | |
| Chase St. Laurent (ME) | Aug. '17 | Jan. '19 | Oct. '20 | Dec. '21 (exp.) | Multimodal Task-Driven Planning and Sensing for an Agent in Uncertain Environments | 2CR | AFOSR | Student |
| Nivetha Kanthasamy (ECE) | Aug. '17 | Aug. '18 | TBD | TBD | TBD | 3C | NSF | Student |
| Ruixiang Du (ME) | Sep. '15 | Apr. '16 | Discontinued due to visa denial | | – | 2J, 2C | NSF | Student |
| ∇ Jie Fang (ME) | Aug. '15 | Apr. '16 | Sep. '17 | Jun. '20 | Interactive Route-Planning And Mobile Sensing With A Team Of Multiple Robotic Vehicles To Satisfy Linear Temporal Logic Specifications | 2C, 1JR | AFOSR | Mathworks, Inc. |
| Benjamin Cooper ^(Notes 2,3) (AE) | Jan. '15 | Apr. '15 | Jan. '17 | Nov. '18 | Interactive Planning and Sensing for Aircraft in Uncertain Environments with Spatiotemporally Evolving Threats | 2J, 3C | AFOSR, USAF SBIR | BAE Systems |
| Zetian Zhang (AE) | Aug. '13 | Apr. '14 | Apr. '16 | Nov. '18 | Motion-Planning and Control of Autonomous Vehicles to Satisfy Linear Temporal Logic Specifications | 3J, 5C | USAF SBIR | Amazon, Inc. |

Note 1: Product mnemonic: J = peer-reviewed journal article, C = peer-reviewed conference paper, R = article/paper currently in review

Note 2: 2019 WPI Sigma Xi Outstanding Doctoral Dissertation Award

Note 3: First place in 2017 WPI Graduate Research Innovation Exchange (GRIE) graduate category

7b. M.S. Directed Research

WPI-AE does not support M.S. theses. Instead, M.S. and dual-degree B.S./M.S. students participate in research via *directed research*, which is a fixed-duration (e.g., one or more semesters) activity for credit.

| Semester | Students | Research Topics | Funding |
|--------------------|---------------------------------------|--|---------|
| Fall '20 | Aleye Okhipo | Precision aerial delivery with thrusted parafoils | – |
| | Yin Xiao | Trajectory planning for connected autonomous vehicles | NSF |
| Sum. '20 | Yin Xiao | Trajectory planning for connected autonomous vehicles | NSF |
| | Rebecca C. Debski ^(Note 2) | Risk quantification for connected autonomous vehicles | NSF |
| Spr. '20 | Zachary J. Zolotarevsky | Precision aerial delivery guidance for parafoils | – |
| | Aleye Okhipo | Precision aerial delivery with thrusted parafoils | – |
| | Yin Xiao | Trajectory planning for connected autonomous vehicles | – |
| | Conor Blomquist | Small UAV experimental work | – |
| | Brian M. Ferraroti | Small UAV experimental work | – |
| Fall '19 | Zachary J. Zolotarevsky | Precision aerial delivery guidance for parafoils | – |
| | Rebecca C. Debski | Precision aerial delivery guidance for parafoils | – |
| | Evan R. Kelly | Trajectory planning for connected autonomous vehicles | – |
| | John R. O'Neill | Trajectory planning for connected autonomous vehicles | – |
| | Hao Wang | Trajectory planning for connected autonomous vehicles | – |
| | Hanqing Zhang | Sensor placement and planning to satisfy LTL specifications | – |
| | Yin Xiao | Intent estimation for connected autonomous vehicles | – |
| Brian M. Ferraroti | Small UAV experimental work | – | |
| Sum. '19 | Zachary J. Zolotarevsky | Precision aerial delivery guidance for parafoils | AFOSR |
| | Evan R. Kelly | Trajectory planning for connected autonomous vehicles | NSF |
| | John R. O'Neill | Trajectory planning for connected autonomous vehicles | NSF |
| | Alan S. Olejnik | DoD applications of coupled sensor placement and planning | – |
| Spr. '19 | Nabeel J. Tokatli | Data-driven wind modeling for precision aerial delivery | – |
| | Troy P. Bergeron | Precision aerial delivery guidance for parafoils | – |
| | Heather L. Cummings | Optimal trajectory generation for differential flat systems | – |
| | John R. O'Neill | Trajectory planning for connected autonomous vehicles | NSF |
| | Zeel Shah | Sensor placement and planning in spatiotempral threat fields | – |
| | Bailey M. Waterman | Coordinated UAV navigation | – |
| | Yin Xiao | Experimental work | – |
| Fall '18 | Nabeel J. Tokatli | Data-driven wind modeling for precision aerial delivery | – |
| | Troy P. Bergeron | Precision aerial delivery guidance for parafoils | – |
| | Matias F. Campos | Kalman filter with delayed measurements | – |
| | Bailey M. Waterman | Coordinated UAV navigation | – |
| Spr. '18 | Matias F. Campos | Kalman filter with delayed measurements | – |

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| | Tyler M. Weiss | Parafoil modeling and simulation | – |
| | Kevin J. Martin | Parafoil modeling literature review | – |
| | Aaron M. Vien | Small UAV experimental work | – |
| Fall '17 | Spiridon Kasapis | Experimental work | – |
| | Shreyash Shantha Kumar | Traffic simulation literature review | – |
| | Aaron M. Vien | Small UAV experimental work | – |
| Sum. '17 | Shreyash Shantha Kumar | Traffic simulation literature review | NSF |
| Spr. '16 | James I. Hitchen | Sling load stabilization experiments | – |
| | Joseph P. Sperry ^(Note 1) | UAV trajectory planning | – |
| | Thanacha Choopojcharoen | Trajectory planning for LTL specifications | – |
| | Shanmuga P. Harikumar | Trajectory planning for a robotic arm | – |
| Fall '15 | James I. Hitchen | Sling load stabilization experiments | – |
| | Joseph P. Sperry | UAV trajectory planning | – |
| Spr. '14 | Payam Razavi | Trajectory planning for LTL specifications | – |
| | Zhaolong Liu | Trajectory optimization for the half-car dynamical model | – |
| | Jighjigh Tersoo-Ivase | Helicopter sling load stabilization | – |
| Fall '13 | Payam Razavi | Trajectory planning for LTL specifications | – |
| | Jighjigh Tersoo-Ivase | Experimental work | – |

Note 1: Resultant publications: journal article [9], conference paper [21] in §5

Note 2: Resultant publication: conference paper [37] in §5

8. Professional Presentations

- *U.S. Army Small Unmanned Aircraft Systems Technology Innovation Event*, U.S. Army Combat Capabilities Development Center-Soldier Center (CCDC); Virtual Conference; October 2020; host Mr. S. Nelson.
- *Department of Mechanical Engineering, Michigan State University*, East Lansing, MI, USA; October 2019; host Prof. S. Bopardikar.
- *Department of Mechanical Engineering, WPI*, host Prof. Y. Zheng.
- *Imperial College London, Department of Aeronautics*, South Kensington, London, UK; June 2018; host Prof. A. Paranjape.
- *Syracuse Research Corporation*, Syracuse, NY, USA; March 2018; host Dr. R. DelZoppo.
- *United Technologies Research Center*, East Hartford, CT, USA; February 2017; host Dr. S. Bopardikar.
- *Department of Mechanical and Aerospace Engineering, University at Buffalo: The State University of New York*, October 2016; host Prof. P. Singla.
- *Robotics division at Laboratoire d'analyse et d'architecture des systèmes (LAAS-CNRS)*, Toulouse, France; July 2015, host Prof. T. Simeon.
- *IEEE VTS Connected and Autonomous Vehicles Summer School @ WPI*, July 2016; host Prof. A. M. Wyglinski.
- *SIAM Conference on Control and its Applications (CT15)*, Paris, France; July 2015.
- *AFOSR Annual Young Investigators Research Program Meeting*, Washington, DC, USA; June 2015.

- *Robotics Engineering Colloquium, WPI; October 2014, host Prof. S. Chernova.*
- *Department of Mechanical Engineering, Tufts University, Medford, MA, USA; March 2014, host Prof. Jason Rife.*
- *2nd NSF Workshop on Formal Composition of Motion Primitives, Philadelphia, PA, USA; April 2013.*
- *United Technologies Research Center, East Hartford, CT, USA; April 2012, host Dr. S. Kannan.*
- *Department of Mechanical Engineering and Materials Sciences, Duke University, Durham, NC, USA; March 2012, host Prof. Devendra P. Garg.*
- *Halliburton Research and Development Center, Dallas, TX, USA; February 2012, host Dr. J. Dykstra.*
- *Aurora Flight Sciences Corp., Research & Development Center, Cambridge, MA, USA; February 2012, host Dr. J. Paduano.*
- *Department of Mechanical Engineering, WPI, Worcester, MA, USA; February 2012.*
- *Robotics Section, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA; February 2012, host Dr. R. Volpe.*
- *Center for Systems and Control Engineering, Indian Institute of Technology Bombay, Mumbai, India; January 2011, host Prof. R. Banavar.*
- Presentations at many of the conference venues listed under the previous subsections titled "*Publications in Peer-Reviewed Conference Proceedings*" and "*Publications at Non-Peer-Reviewed Venues.*" Since 2016, my students have presented at conferences whenever possible.

TEACHING EXPERIENCE

9. Honors and Awards Related to Teaching

- 2019 Romeo L. Moruzzi Young Faculty Award for Innovation in Undergraduate Education.
- 2019 Morgan-Worcester Award for Distinguished Instructorship.
- 2016 AIAA Region 1 Student Conference, 2nd Prize in Team Category (as advisor): For the MQP titled "*Autonomous Quadrotor Navigation and Guidance.*"
- 2014-15 Provost MQP Award in Aerospace Engineering (as co-advisor): For the project titled "*Active Control for Helicopter Sling Load Stabilization,*" co-advised with Prof. David J. Olinger (AE).
- 2014-15 Aerospace Engineering MQP Award (as advisor): For the project titled "*Autonomy Package for Unmanned Aerial Vehicles.*"

10. Teaching Innovations at WPI

- New graduate courses:
 - *AE 5222 Optimal Control of Dynamical Systems* – Offered every alternate year since C-2015. When this course was introduced, it was the only course in WPI on the topic of optimal control.
 - *AE 5224 Air Vehicle Dynamics and Control* – Offered every alternate year since C-2016.
- New undergraduate course:
 - *AE 3713 Introduction to Aerospace Control Systems* – Offered every year since D-2020.
- Take-home experiments:
 - Introduced and implemented the idea of providing students with kits with Arduino-based electronics to perform experiments in a flexible and personalized manner.
 - Implemented in *AE 4733* since A-2015.
 - Implemented in *AE/ME 3703* in D-2019.
- Developed textbook-style lecture notes spanning three courses: *AE 3713*, *AE 4733*, and *AE 4723*.

11. Courses Taught at WPI

- AE/ME 3703: Introduction to Control of Dynamical Systems
- AE 3713: Introduction to Aerospace Control Systems
- AE 4733: Guidance, Navigation, and Communications
- AE 4723: Aircraft Dynamics and Control
- AE 5222: Optimal Control of Dynamical Systems
- AE 5224: Air Vehicle Dynamics and Control

Data for the following questions on the WPI student course evaluation form are provided below:

- **Q1.** Overall rating of the quality of the course (scale of 1 – 5).
- **Q2.** Overall rating of the instructor's teaching (scale of 1 – 5).
- **Q7 (previously Q9).** Amount learned from the course (scale of 1 – 5).
- **Q19 (previously Q26B).** Total hours/week spent on coursework *outside* of scheduled lecture hours. Data provided in the tables below indicates the number of responses that indicated more than 10hrs per week.

AE 4733: Guidance, Navigation, and Communications

| Term offered | #Enrolled | Mean Q1 | Mean Q2 | Mean Q7 | Q19 | #Responses |
|---------------------------------|-----------|---------|---------|---------|-----|------------|
| A-term 2013 ^(Note 1) | 40 | 3.74 | 3.86 | 3.59 | 19 | 32 |
| A-term 2014 | 48 | 4.30 | 4.53 | 4.40 | 26 | 43 |
| A-term 2015 | 45 | 4.18 | 4.26 | 4.15 | 29 | 38 |
| A-term 2016 | 55 | 4.67 | 4.78 | 4.59 | 38 | 54 |
| A-term 2017 | 50 | 4.73 | 4.82 | 4.82 | 30 | 45 |
| A-term 2018 | 54 | 4.73 | 4.80 | 4.48 | 17 | 30 |
| A-term 2019 | 63 | 4.51 | 4.71 | 4.26 | 31 | 41 |
| A-term 2020 ^(Note 2) | 64 | 4.24 | 4.28 | 4.43 | 15 | 21 |

Note 1: Cross-listed as AE/ME 4733; data shown here are for both sections combined.

Note 2: Remote course delivery due to COVID-19-related campus restrictions.

AE 4723: Aircraft Dynamics and Control

| Term offered | # Enrolled | Mean Q1 | Mean Q2 | Mean Q7 | Q19 | #Responses |
|--------------|------------|---------|---------|---------|-----|------------|
| B-term 2015 | 31 | 4.38 | 4.58 | 4.42 | 12 | 26 |
| B-term 2016 | 38 | 4.83 | 4.92 | 4.80 | 20 | 36 |
| B-term 2017 | 49 | 4.68 | 4.78 | 4.68 | 23 | 37 |
| B-term 2018 | 52 | 4.72 | 4.86 | 4.64 | 18 | 36 |
| C-term 2020 | 77 | 4.92 | 4.88 | 4.68 | 12 | 25 |

AE 5222: Optimal Control of Dynamical Systems

| Term offered | # Enrolled | Mean Q1 | Mean Q2 | Mean Q7 | Q19 | #Responses |
|---------------------------------|------------|---------|---------|---------|-----|------------|
| C-term 2015 ^(Note 1) | 17 | 4.69 | 5.00 | 4.69 | 7 | 13 |
| D-term 2017 ^(Note 2) | 48 | 4.88 | 4.84 | 4.66 | 26 | 32 |
| D-term 2019 | 33 | 4.87 | 4.93 | 4.80 | 13 | 15 |

Note 1: Cross-listed as AE/ME 5222; data are for both sections combined.

Note 2: Online and in-class sections; data are for both sections combined.

AE 5224: Air Vehicle Dynamics and Control

| Term offered | # Enrolled | Mean Q1 | Mean Q2 | Mean Q7 | Q19 | #Responses |
|---------------------------------|------------|---------|---------|---------|-----|------------|
| C-term 2016 ^(Note 1) | 23 | 4.29 | 4.57 | 4.25 | 7 | 14 |
| C-term 2018 ^(Note 2) | 20 | 4.40 | 4.47 | 4.27 | 10 | 15 |
| C-term 2018 ^(Note 2) | 24 | 4.50 | 4.50 | 4.87 | 5 | 8 |

Note 1: Cross-listed as AE/ME 5224, with online and in-class sections for each; data are for all four sections combined.

Note 2: Online and in-class sections; data are for both sections combined.

AE/ME 3703: Introduction to Control of Dynamical Systems

| Term offered | # Enrolled | Mean Q1 | Mean Q2 | Mean Q7 | Q19 | #Responses |
|-------------------------------|------------|---------|---------|---------|-----|------------|
| B-term 2013 ^(Note) | 43 | 3.38 | 3.88 | 3.57 | 14 | 35 |
| D-term 2019 ^(Note) | 57 | 4.69 | 4.84 | 4.56 | 20 | 32 |

Note: Cross-listed as AE/ME 3703; data are for both sections combined.

AE 3713: Introduction to Aerospace Control Systems

| Term offered | # Enrolled | Mean Q1 | Mean Q2 | Mean Q7 | Q19 | #Responses |
|-------------------------------|------------|---------|---------|---------|-----|------------|
| D-term 2020 ^(Note) | 68 | 4.16 | 4.40 | 4.24 | 12 | 25 |

Note: Remote course delivery due to COVID-19-related campus restrictions.

12. Undergraduate Projects Advised at WPI

12a. Interactive Qualifying Projects

The Interactive Qualifying Project (IQP) is a 1-unit (6-credit) mandatory component of the WPI undergraduate curriculum. An IQP addresses a sociotechnical topic not necessarily related to the students' major degree. Students typically complete the IQP in their junior year.

| Project Title | Students and co-advisors (italicized) | Year |
|---|---|---------|
| On the Societal Impact of Self-Driving Trucks | Eliot Fine (ECE), Justin Harris (ME), Dylan Murray (BUS) <i>Prof. Alexander Wyglinski (ECE)</i> | 2017-18 |

12b. Major Qualifying Projects

The Major Qualifying Project (MQP) is a 1-unit (6-credit) mandatory component of the WPI undergraduate curriculum. An MQP addresses an engineering topic within the students' major degree. Students typically complete the MQP in their senior year. All MQPs are advised by faculty affiliated with the students' major degree program.

| Project Title | Students and co-advisors (italicized) | Year |
|---|--|---------|
| Long-Range Precision Aerial Delivery System | Terrance Cooper, Thierry de Crespigny, Scott D'Attilio, Rebecca Debski, Christopher Ferrari, Kiernan Joyce, William Schwend, Mackenzie Warren <i>Sponsored by CCDC Soldier Center, Natick, MA</i> | 2020-21 |
| Quad-plane Design for Autonomous Cargo Delivery | Duncan H. Driscoll, Brian M. Ferrarotti, Jason I. Karlin, Rushab D. Patil | 2019-20 |
| 3D Swarm Construction | Cameron A. Collins, Josue Contreras Albuja, Neel Dhanaraj, Hannan Liang, Trevor A. Lizzo, Caleb T. Wagner, <i>Profs. Carlo Pinciroli* (RBE), Xinming Huang (ECE), and Gregory Lewin (RBE)</i> | 2019-20 |

| | | |
|---|--|---------|
| Vertical Take-off and Landing Autonomous Aircraft Design | Quintin Barker, Troy P. Bergeron, Jacob A. Goldsberry, Romelle Jack, Benjamin H. Pasculano, Bailey M. Waterman, Tyler M. Weiss, Zachary J. Zolotarevsky <i>Prof. David J. Olinger</i> | 2018-19 |
| Design of an MAV for the 2019 SAE Aero Design Competition | Diana D. Celaj, Heather L. Cummings, Nicholas J. Cunha, Adam J. Frewin, Zachary C. Hearl, Nicholas J. Manos, Michael A. Oswald, Amelia B. Wilson <i>Prof. David J. Olinger*</i> | 2018-19 |
| Remote Control Aircraft for SAE Aero Design West Competition | Ryan Capozzi, Emily Chretien, Shintaro Clanton, Elio Daci, Timothy Jones, Andrew Libby, Stephen Peccerillo, Blake Rice, John Russell, Kamyar Sajjadi, Clifford Smith, Nabeel Tokatli <i>Prof. David J. Olinger*</i> | 2017-18 |
| Interactive Sensing and Planning (Note 1) | Roger Aiuidi, Augustine Kelty, Maria Sierra Rossi, Mary Vierling, Rose Whittle, Thomas Stilwell | 2017-18 |
| Plume Analysis and Detection | Eric D Fast, Stephen M Harnais, Ryan M Wiesenberg <i>Profs. Michael Demetriou* and Nikolaos Gatsonis</i> | 2016-17 |
| Coordinated Quadrotor Unmanned Aerial Vehicles | Nicholas Green, Jonathan Griffin, Christopher Mastrangelo, Keith Rockwood, Aaron Vien | 2016-17 |
| Classroom Experiment in Longitudinal Stability and Control | Zachary Edelman, Victor Levorse, Brendan Sullivan, Zachary Wingerter <i>Prof. David J. Olinger</i> | 2016-17 |
| Autonomous Quadrotor Navigation and Guidance (Note 2) | Jonathan Blythe, Krzysztof Borowicz, Alyssa Hollander | 2015-16 |
| Heterogeneous Network of Autonomous Vehicles | Binxin Liu, David Moore, Dylan Shields, <i>Prof. Michael A. Demetriou</i> | 2015-16 |
| Active Control for Helicopter Sling Load Stabilization (Note 3) | Joseph Sperry, Dusty Cyr, Radu Morar, <i>Prof. David J. Olinger</i> <i>Sponsored by CCDC Soldier Center, Natick, MA</i> | 2014-15 |
| Passive Control for Helicopter Sling Load Stabilization | James Hitchen, Peter Guarino, Wesley Morawiec, <i>Prof. David J. Olinger*</i> <i>Sponsored by CCDC Soldier Center, Natick, MA</i> | 2014-15 |

| | | |
|---|--|---------|
| Vision-based Obstacle Avoidance for Small UAVs (Note 4) | Sam Friedman, Cy Ketchum, Kevin Hancock | 2014-15 |
| Landing Platform Deck | Travis Austin, Gabriel Diaz, Zhaolong Li <i>Prof. Michael A. Demetriou*</i> | 2013-14 |

* Main advisor for the project.

Note 1: Honorable mention for Aerospace Engineering MQP award, 2017-18.

Note 2: Winner of 2nd prize, Team Category, 2016 AIAA Region 1 Student Conference, April 22-23, Worcester, MA.

Note 3: Winner of the Provost MQP Award in Aerospace Engineering, 2014-15. This MQP resulted in a conference paper published and presented at the AIAA SciTech 2016 conference, San Diego, CA.

Note 4: Winner of the Aerospace Engineering MQP award, 2014-15.

12c. Summer Undergraduate Research Fellowship

WPI offers a stipend to selected undergraduate students to conduct research during the summer under the Early Research Experience in E-Term (EREE) program, formerly known as the Summer Undergraduate Research Fellowship (SURF) program.

| Student | Year | Research Topic |
|---|------|--|
| Jonathan C. Griffin ^(Note 1) | 2016 | UAV route guidance |
| Joseph P. Sperry | 2014 | Trajectory tracking for an autonomous aircraft in an urban environment using sonar sensors |

Note 1: Resultant publication: journal article [9] in §5

13. Independent Studies Conducted at WPI

| Term | Number of students | Equivalent course |
|--------|--------------------|---|
| D-2020 | 4 | <i>AE 4733 Guidance, Navigation, and Communications</i> |
| B-2019 | 1 | <i>AE 4733 Guidance, Navigation, and Communications</i> |
| D-2019 | 1 | <i>AE 3703 Introduction to Control of Dynamical Systems</i> |
| B-2016 | 1 | <i>RBE 3000-level capstone experience</i> |
| D-2016 | 1 | <i>ME 5000 Applied Analytical Methods in Engineering</i> |

SERVICE

14. Editorial and Referee Activities

- **Associate Editor**, IEEE Control Systems Society Conference Editorial Board, 2015 – present
- **Associate Editor**, *Aerospace Science and Technology* by Elsevier, 2014 – 17; 2019 –
- **Associate Editor**, *ASME Journal of Autonomous Vehicles and Systems*, 2019 –
- **Associate Editor**, AIAA Guidance, Navigation, and Control Conference, 2015–
- **Track Co-Chair**, Uncertainty Quantification track, 2021 AIAA Guidance, Navigation, and Control Conference (virtual conference)
- **Track Co-Chair**, Distributed and Cooperative Systems track, 2019 AIAA Guidance, Navigation, and Control Conference, San Diego, CA, USA
- **Technical Program Committee Member**, 2018 IEEE Connected and Autonomous Vehicles Symposium, Chicago, IL, USA
- **Technical Program Committee Member**, 2016 American Control Conference, Boston, MA, USA
- **Reviewer for multiple journals including:**
IEEE Trans. Robotics; IEEE Trans. Automatic Control; Robotics & Automation Letters; IEEE Trans. Industrial Electronics; J. Guidance, Control, and Dynamics; Aerospace Science and Technology; European J. Control; Automatica; IEEE Trans. Automation Science & Engineering; Robotics and Autonomous Systems; The Aeronautical Journal; ASME J. Dynamic Systems, Measurement, and Control; Nuclear Engineering & Technology; Risk Analysis
- **Reviewer for multiple conferences including** (all annual):
American Control Conference; IEEE Conference on Decision and Control; IEEE International Conference on Robotics and Automation; IEEE/RSJ International Conference on Intelligent Robots and Systems; European Control Conference

15. Department and University

- WPI Board of Trustees Information Technology Task Force (2020 – 21)
- WPI Committee on Academic Operations (2019 – 22)
- WPI Committee on Information Technology Policy (2019 – 22)
- Undergraduate Committee, Aerospace Engineering Program (2016 – 20).
- Graduate Committee, Aerospace Engineering Program (2014 – 16).
- Graduate Committee, Department of Mechanical Engineering (2013 – 17).
- Organizer of ME Graduate Seminar (2013 – 15).
- Organizer of AE Graduate Seminar (2015 – 16).
- Aerospace Engineering Program Committee (2013 – 14).
- WPI Graduate Research Innovation Exchange (GRIE) competition: lead judge 2017 (Robotics & Cyberphysical Systems category); judge 2014 – 2016.
- Thesis or Dissertation Committee Member:
 11. Qiqiang Hou, ECE Ph.D. student; advisor Prof. A. Clark.
 10. Calder Phillips-Grafflin, RBE Ph.D. student; advisor Prof. D. Berenson.
 9. Dmitry Sinyukov, RBE Ph.D. student; advisor Prof. T. Padir.
 8. Tatiana Egorova, AE Ph.D. student; advisor Prof. N. A. Gatsonis.
 7. Mahdi Heydari, ME Ph.D. student; advisor Prof. M. A. Demetriou.
 6. Fahad Khan, ME Ph.D. student; advisor Prof. B. Sivilonis.
 5. Ryan Fredette, AE M.S. student; advisor Prof. D. J. Olinger.
 4. Xiaoran Chen, ME M.S. student; advisor Prof. C. Furlong-Vazquez.

3. Garth Blocher, ME M.S. student; advisor Prof. C. Furlong-Vazquez.
2. Yang Song, ME M.S. student; advisor Prof. J. Sullivan.
1. Min Ying, ME M.S. student; advisor Prof. S. Nestinger.

16. Community

- DiscoverSTEM career fair at Acton-Boxborough High School, Acton, MA; November 2017
- STEM showcase at Kennedy Elementary School, Cambridge, MA; March 2017 and May 2018
- Occasional volunteer service at the *India Society of Worcester*, Shrewsbury, MA.