Colonel Kirk W. Johnson

Commandant, Detachment 3, Space Delta 13
Senior Lecturer, School of Advanced International Studies
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Biographical Information

Education

PhD, Aerospace Engineering, 2016, Texas A&M University, College Station, TX
Dissertation: *Approaches for Modeling Satellite Relative Motion*
MS, Astronautical Engineering, 2010, Air Force Institute of Technology, WPAFB, OH
Thesis: *Relative Orbit Elements for Satellites in Elliptical Orbits*
BS, Mechanical Engineering (with Aerospace Concentration), 2000, Worcester Polytechnic Institute, Worcester, MA

Military Education

Air War College (distance learning) - 2019
Intermediate Developmental Education (in-residence equivalency) - 2011
Air Command and Staff College (by correspondence) - 2011
Squadron Officer School (in residence) - 2006

Professional History

June 2023 - Present	*Commandant* Detachment 3, Space Delta 13 *Senior Lecturer* School of Advanced International Studies (SAIS), Johns Hopkins University
July 2021 - Present	*Adjunct Assistant Professor of Aerospace Engineering* Air Force Institute of Technology, WPAFB, OH
July 2021 - May 2023	*Director, West Space Seminar* *Assistant Professor of Space Strategic Studies* Air War College, Maxwell AFB, AL
August 2016 - July 2021	*Assistant Professor of Aerospace Engineering*
May 2019 - July 2021	*Deputy Head, Department of Aeronautics and Astronautics*
August 2017 - May 2019	*Deputy Director, Center for Space Research and Assurance* Air Force Institute of Technology, WPAFB, OH

October 2019 - June 2020	*Chief Engineer, Afghan Personnel and Pay System* Combined Security Transition Command - Afghanistan (CSTC-A), Kabul, Afghanistan
August 2013 - August 2016	*PhD Student / AFIT Liaison Officer* Texas A&M University, College Station, TX
September 2011 - August 2013	*Chief and Deputy Chief, Engineering Division* Directed Energy Program Office, Kirtland AFB, NM
June 2012 - December 2012	*Foreign Military Sales Case Officer* Office of Security and Cooperation - Iraq (OSC-I), Baghdad, Iraq
June 2010 - September 2011	*Chief, Performance Analysis and Software Branch* Directed Energy Program Office, Kirtland AFB, NM
March 2010 - June 2010	*Chief, Airborne Laser Testbed Development Branch* Airborne Laser Testbed Program Office, Kirtland AFB, NM
August 2008 - March 2010	*Masters Student* Air Force Institute of Technology, WPAFB, OH
April 2008 - August 2008	*Operations Officer, Aircraft Analysis Squadron* National Air and Space Intelligence Center, WPAFB, OH
May 2007 - April 2008	*Chief, Air Weapons Dynamics Branch* National Air and Space Intelligence Center, WPAFB, OH
September 2005 - May 2007	*Combat Identification Program Manager* National Air and Space Intelligence Center, WPAFB, OH
December 2003 - August 2005	*Instructor* 341st Operations Support Squadron, Malmstrom AFB, MT
June 2001 - November 2003	*ICBM Combat Crew Commander and Deputy Commander* 564th Missile Squadron, Malmstrom AFB, MT
July 2000 - May 2001	*Student* Operational Space Prerequisite Training and ICBM IQT 392nd Training Squadron, Vandenberg AFB, CA

Certifications and Memberships

USAF Space Professional, Level 2
DoD Acquisition Professional:
- Program Management, Level 2
- Systems Engineering, Level 2
- Test and Evaluation Engineering, Level 1

Sigma Gamma Tau
Tau Beta Pi

Major Honors, Awards, and Decorations

2021 Meritorious Service Medal
2020 Defense Meritorious Service Medal (for contributions to CSTC-A)

2013 Defense Meritorious Service Medal (for contributions to the Missile Defense Agency)
2012 Defense Meritorious Service Medal (for contributions to OSC-I)
2010 Air Force Modeling & Simulation Cross-functional Team Award
2010 AFA Theodore von Karman Award
2006 Top Third Graduate, Outstanding Contributor, Squadron Officer School
2004 341st Space Wing Guardian Challenge Instructor
2001 Distinguished Graduate, ICBM Initial Qualification Training
2000 Top Graduate, Officer Space Prerequisite Training

Teaching

Courses Taught

ASYS 530: Introduction to Space Programs and Operations (3 credits)	Fall 2016 (5 students) Fall 2017 (7 students)
ASYS 632: Satellite Design & Test (4 credits)	Summer 2019 (10 students)
ASYS 699: Problems in Satellite Formation Flying (2 credits)	Fall 2020 (1 student)
LD 6200: Strategic Leadership (3 credits)	Fall 2021 (15 students) Fall 2022 (15 students)
MECH 532: Introductory Space Flight Dynamics (4 credits) –both In Residence and Distance Learning sections	Winter 2017 (30 students)
MECH 632: Intermediate Space Flight Dynamics (4 credits)	Spring 2017 (24 students) Spring 2018 (15 students)
MECH 633A: Spacecraft Maneuver and Rendezvous (4 credits)	Summer 2021 (14 students)
MECH 699: Orbits in Cislunar Space (4 credits)	Spring 2021 (1 student)
MECH 720: Analytical Mechanics (4 credits)	Winter 2019 (2 students) Winter 2021 (7 students)
MECH 899: Special Topics in Optimal Control (2 credits)	Spring 2019 (1 student)
WF 6502: Global Campaigning (4 credits)	Spring 2022 (15 students) Spring 2023 (15 students)

Course and Curriculum Development

I developed new pedagogical methods for all the ASYS and MECH courses listed above. In addition, I adapted MECH 632 to use a new text (*Fundamentals of Spacecraft Attitude Determination and Control* by Markley and Crassidis); I developed a special topics course (MECH 899) as a new course using a new textbook (*Optimal Control*, by 3rd ed., by Lews, Vrabie, and Syrmos); and I developed two other special studies (ASYS 699 and MECH 699) as new courses. For the West Space Scholars program at SAIS, I developed the Strategic Leadership course and served as Course Director for Fall 2023; and I led the overall program design, including courses in International Security and the Space Domain, Comparative Grand Strategy, History and Theory of Military Strategy, Spacepower Development, and Joint Global Campaigning.

Master's Theses Advised

3. Townley, Talon A., "Limited-Duty-Cycle Satellite Formation Control via Differential Drag," March 2019

2. Mercier, Mark R., "Optimal Inspection of a Satellite with Dynamic Zone Constraints," March 2019

1. LaRue, Robert B., "Algorithms for Small Satellite Formation Flying," March 2018

Master's Thesis Committee Memberships

Committee chairs are indicated in parentheses.

23. Lopez, Luella N.-W. (Zagaris), "Developing a Relative Navigation Technique for 6U CubeSats Performing Formation Flying Missions," 2022

22. Urban, Alexander C. (Cox), "Development of Minimum ΔV Trajectories to Service GEO Assets from Cislunar Space," 2022

21. Kurtz, Mark (Keys), "A Simulation Framework for Hardware-in-the-Loop Testing of the Grissom-P CubeSat," 2022

20. Grossi, Paul A. (Zagaris), "Safe Spacecraft Rendezvous and Proximity Operations via Reachability Analysis," 2021

19. Cavitt, Ranell (Cobb), "Perturbation Effects on Delta V Requirements for Formation Flying CubeSats in Low Earth Orbit," 2021

18. Scala, Daniel S. (Cobb), "Developing Mission Assurance for a Dual Payload, Two Satellite CubeSat Mission," 2021

17. Knister, Simon R. (Little), "Evaluation Framework for Cislunar Space Domain Awareness (SDA) Systems," 2020

16. Collins, Alexander R. (Hess), "Development of Cislunar Space Logistics Networks for Satellite Constellation Support Using Event-Driven Generalized Commodity Network Flows," 2019

15. Ostman, Josh (Hess), "Cislunar Trajectory Generation with Sun-Exclusion Zone Constraints Using a Genetic Algorithm and Direct Method Hybridization," 2019

14. Runco, John J. (Bettinger), "Computational Aerothermodynamic Analysis of Satellite Trans-Atmospheric Skip Entry Survivability," 2019

13. Chavez, Christian M. (Hess), "Optimal Motion Camouflage Concepts Applied to Satellite Proximity Operations," 2019

12. Webb, Jeremiah M. (Bettinger), "Comprehensive Study of Optimal Synergetic Skip Entries with Dynamic Thrust Vectoring Control," 2019

11. Hudson, Keith A. (Lingenfelter), "Application of Automated Balancing Methods for an Attitude Control Test Platform with Non-orthogonal Masses," 2018

10. Spendel, David F. (Hess), "Parameter Study of an Orbital Debris Defender Using Two Team, Three Player Differential Game Theory," 2018

9. Dahlke, Jacob A. (Hess), "Optimal Trajectory Generation in a Dynamic Multi-body Environment Using a Pseudospectral Method," 2018

8. Katzovitz, Justin D. (Hess), "Space-based Maneuver Detection and Characterization Using Multiple Model Adaptive Estimation," 2018

7. Hoffman, Jeremiah R. (Palazotto), "Passive Load Testing for Evaluation of Electromechanical Actuators," 2018

6. VanZandt, Perry K. (Cobb), "Geosynchronous Belt Proximity Operations Mission Planner," 2018

5. Lowery, Jason P. (Cobb), "Measuring Light Curve Uncertainty for Surrogate Geostationary Satellite Models," 2017

4. Rich, Adam T. (Wiesel), "Investigating Analytical and Numerical Methods to Predict Satellite Orbits Using Two-Line Element Sets," 2017

3. Reabe, Marissa C. (Wiesel), "Formation Flight of Earth Satellites on KAM Torus Using Classical Orbital Elements," 2017

2. Oliver, Rachel (Cobb), "Model Fidelity Analysis for the Production of Accurate Theoretical Light Curves," 2017

1. Childress, Jonathan (Swenson), "Control Allocation Methods for Constrained and Over Actuated Satellite Attitude Control Systems," 2017

PhD Dissertation Committee Memberships

Committee chairs are indicated in parentheses. Committees on which I served as Dean's representative are indicated by an asterix.

5. Palmer, Everett B. (Wiesel), "Stochastic Satellite Air Drag with the Ballistic Coefficient as a Random Variable," 2021.

4. Harris, Wyatt J., (Cobb), "Visual Navigation and Control for Spacecraft Proximity Operations with Unknown Targets," 2021.

3. Hall, Zachary J., (Singla, Penn State University), "Probabilistic Methods for Maneuvering Satellite Tracking," 2021.

2. Scarcella, Peter, (Spencer, Penn State University), "Simultaneous Pose and Mapping of a Non-Cooperative Maneuvering Target Using an Octree-Based Approach," 2021.

1. *Bowers, James C. (Fiorino), "Techniques, Analysis, Calibration, and Standards for High Energy Laser Sensors in Support of High Energy Laser Field Test Minimum Collection Requirements," 2018

Professional Studies Papers and Strategic Studies Papers Advised

3. Willis, Shawn M., (Col, USSF), "The Role of Cislunar Orbits in Strategic Competition and Warfare with China," 2023.

2. Cassidy, Michael R., (LtCol, USMC), "Space Electronic Warfare: Role of the United States Space Force in Integrated Deterrence," 2022.

1. Smith, Kenneth J., (Lt Col, USSF), "The Advantages and Challenges of International Collaboration in Space," 2022

Research

Funded Research Projects

- "Algorithms for Small-Satellite Formation Flying," 2017-2018, AFRL/RV, $10.75k, PI.
- "The Future of Proximity Operations in Space–Technical Analysis," 2018, AU, $5k, PI.
- "Grissom 6U CubeSat Bus with Beacon," 2018, undisclosed, $50k, Co-PI (Fuller).
- "Propellantless Satellite Formation Control for LCE (Laser Crosslink Experiment)," 2018-2019, SPAWAR Systems Center Pacific, $24k, PI.
- "Grissom 6U CubeSat Bus," 2018-2019, AFRL/RV, $60k, PI.

- "AFIT Support for the Orbital Engagement Maneuver (OEM) Integrated Validation Team (IVT)," 2018-2019, AFSPC, $100k, Co-PI (Cobb).
- "Aerospace Control, Estimation, and Stochastics I Short Course," 2018, NASIC, $20k, Co-PI (Bettinger).
- "Rapid CubeSat Design, Fabrication, and Test," 2019, undisclosed, $90k, PI.
- "Satellite Attitude Control Testbed Upgrades," 2019, undisclosed, $38k, Co-PI (Cobb).
- "CubeSat-Optimized Software-Defined Flight Radio," 2019-2020, undisclosed, $150k, Co-PI (Albrecht).
- "Developing Artificial Intelligence Opponents for Contested Space Simulations," 2019-2020, AFRL/RV, $100k, Co-PI (Cobb).
- "Localization of Terrestrial and Space-Based Radio Frequency Transmitters," 2019-2020, AFRL/RV, $16k, PI.
- "Image Processing and Orbit Determination for Angles-Only Space-Based SSA," 2019-2020, AFRL/RV, $16k, PI.
- "Orbit-Dynamics Based Visual Servoing for Space Vehicles," 2019-2020, AFRL/RV, $16k, PI.
- "Rapid CubeSat Build and Test," 2019-2020, AFRL/RV, $50k, PI.
- "Integration of NPS's Terahertz Imaging Camera for On-Orbit Demonstration," 2019-2021, undisclosed, $90k, Co-PI (Albrecht).
- "AFIT Support for Operations in Contested Space," 2019-2022, Space Security and Defense Program, $420k, Co-PI (Cobb).
- "Cislunar Logistics Network Optimization," 2021-2022, AFRL/RV, $16k, PI.
- "Proximity Detection Mission," 2019-2023, undisclosed, $2,325k, PI.

Journal Articles

3. Hall, Z., Singla, P., and Johnson, K., "Reachability-Based Search for Tracking of Noncooperative Maneuvering Satellites in Data Sparse Environment," *Journal of the Astronautical Sciences*, Vol. 70, No. 9, March 2023.
2. Spendel, D., Hess, J., Johnson, K., and Cobb, R., "Developing and Analyzing Strategies Using Pursuer-Evader-Defender Differential Game Theory for Orbital Engagements," *Journal of DoD Research and Engineering*, Vol. 3, No. 2, July 2020.
1. Spendel, D., Hess, J., Johnson, K., and Cobb, R., "Evaluating Orbital Defender Performance Trades Using Differential Game Theory," *Journal of DoD Research and Engineering*, Vol. 3, No. 1, March 2020.

Conference Publications (accepted on the basis of a peer reviewed abstract)

12. Williams, B., Johnson, K., Knister, S., Hayhurst, D., and Little, B., "Cislunar Space Domain Awareness Architecture Evaluation," American Astronautical Society Paper 21-520, August 2021.

11. Hall, Z., Johnson, K., and Singla, P., "A Particle Filtering Approach to Space-Based Maneuvering Satellite Location and Estimation," American Astronautical Society Paper 20-569, August 2020.

10. Collins, A. R., and Johnson, K. W., "Development of Cislunar Space Logistics Networks for Satellite Constellation Support," AIAA Paper 2020-2135, January 2020.

9. Scarcella, P. C., Johnson, K. W., and Hess, J. A., "Consider Filtering Applied to Maneuver Detection for Relative Orbit Determination," American Astronautical Society Paper 19-872, August 2019.

8. Mercier, M. R., and Johnson, K. W., "Optimal Inspection Trajectories with Enforcement of Chief and Inspector-Centered Dynamic Zone Constraints," American Astronautical Society Paper 19-895, August 2019.

7. Spendel, D., Hess, J., Cobb, R., and Johnson, K., Undisclosed title, American Astronautical Society Guidance, Navigation, and Control Conference, Colorado Springs, CO, January 2019.

6. Mercier, M. R., and Johnson, K. W., "Optimal Inspection of a Nadir-Pointing Satellite with Dynamic Angle Constraints," American Astronautical Society Paper 19-407, January 2019.

5. LaRue, R. B., and Johnson, K. W., "Algorithms for Small Satellite Formation Initialization," American Astronautical Society Paper 18-231, August 2018.

4. LaRue, R. B., and Johnson, K. W., "Reconfiguration of Small-Satellite General Circular Orbit Formations," AIAA Paper 2018-2219, January 2018.

3. K. W. Johnson, S. R. Vadali, and K. T. Alfriend, "Comparison of Orbit Element Sets for Modeling Perturbed Satellite Relative Motion," American Astronautical Society Paper 16-357, February 2016 (published in *Advances in the Astronautical Sciences*, Vol. 158, Univelt, pp. 3349-3362).

2. K. W. Johnson, S. R. Vadali, and K. T. Alfriend, "Simulating Satellite Relative Motion with a Second-order Hoots Theory," 52nd Annual Technical Meeting of the Society of Engineering Science, October 2015.

1. R. E. Sherrill, A. J. Sinclair, T. A. Lovell, K. W. Johnson, and D. D. Decker, "The Virtual-Chief Method for Modeling Relative Motion of Noncircular Satellites," American Astronautical Society Paper 11-208, February 2011 (published in *Advances in the Astronautical Sciences*, Vol. 140, Univelt, pp. 1515-1524).

Other Conferences

4. Mercier, M. R., and Johnson, K. W., "6-DOF Constrained Optimal Satellite Inspection Trajectories," Dayton-Cincinnati Aerospace Sciences Symposium, March 2019.

3. Mercier, M. R., and Johnson, K. W., "Optimal Inspection of a Nadir-Pointing Satellite with Dynamic Angle Constraints," Dayton Engineering Sciences Symposium, October 2018.

2. Townley, T. A., and Johnson, K. W., "Limited Duty Cycle Satellite Formation Control via Differential Drag and Lift," Dayton Engineering Sciences Symposium, October 2018.

1. LaRue, R. B., and Johnson, K. W., "Algorithms for Small Satellite Formation Flying," Dayton-Cincinnati Aerospace Sciences Symposium, February 2018.

Service

AFIT Graduate School of Engineering and Management

2016-2018	Member, Faculty Council Awards Committee

AFIT Department of Aeronautics and Astronautics

2017-2018	Member, Civilian Faculty Search Committee
2017	Member, Best Thesis Committee

Professional Organizations

August 2020	Session Chair (Rendezvous, Relative Motion, Proximity Missions, and Formation Flying - I) AAS/AIAA Astrodynamics Specialist Conference
March 2019	Session Chair (Space II) Dayton-Cincinnati Aerospace Sciences Symposium
October 2018	Session Chair (Design & Optimization I) Dayton Engineering Sciences Symposium
February 2018	Session Chair (Space I and Space IV) Dayton-Cincinnati Aerospace Sciences Symposium