

Dr. Andrea L'Afflitto

Contact Information

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Work Experience Assistant Professor.

Department of Aerospace and Mechanical Engineering, The University of Oklahoma, Norman, OK. August, 2015 – Present

Research in robust output-feedback control, optimal control, and differential games theory for aerospace engineering applications. *Application:* design of autopilots for UAS.

Teaching portfolio:

- Flight Controls (G/U)
- Nonlinear Dynamical Systems and Control (G/U)
- Advanced Dynamics & Control of Mechanical Systems (G/U)
- Optimization & Optimal Control (G/U)

Service:

- Graduate studies committee member (2017 – Present).

Summer Faculty Fellow.

Army Research Lab, Aberdeen, MD. Summer 2017, 2018

Collaboration on the design, implementation, and testing of nonlinear robust controls for quadrotor aircraft.

International Space Station – Systems and Operations Engineer.

German Aerospace Agency (DLR), Cologne, Germany. January, 2007 – May, 2008

Payload and operations coordinator of EXPOSE-E: a payload installed outside the European module Columbus for the International Space Station.

Education

Ph.D. in Aerospace Engineering.

Georgia Institute of Technology, Atlanta, GA, USA. August 2011 – April 2015

Research in *optimal control, finite-time state-feedback optimal control, partial-state state-feedback optimal control, and semistabilization of nonlinear dynamical systems.*

Master of Science in Mathematics.

Virginia Polytechnic Institute and State University, Blacksburg, VA, USA. August 2009 – May 2010.

Research in calculus of variations and optimal control theory with applications to spacecraft and aircraft fuel-optimal path planning.

Master of Science in Aerospace Engineering and Astronautics.

Federico II University, Naples, Italy. September 2004 – September 2006.

Research in space systems design in conjunction with an internship at the Italian Space Agency (ASI). *Summa cum laude.*

Bachelor of Science in Aerospace Engineering.

Federico II University, Naples, Italy. September 2001 – September 2004.

Research in space systems design in conjunction with an internship at Co.Ri.S.T.A. (Alenia Spazio Group). *Summa cum laude.*

Publications

Books:

- B1. A. L’Afflitto. *A Mathematical Perspective on Flight Dynamics and Control*, Springer, London, UK – ISBN 978-3-319-47466-3.

Book Chapters:

- BC1. K. Mohammadi and A. L’Afflitto. *Robust Adaptive Output Tracking for Quadrotor Helicopters*, in “Adaptive Robust Control and its Applications” , Dr. Le Anh Tuan ed., InTech, pp. 77-100, ISBN: 978-953-51-5729-8.
- BC2. A. L’Afflitto, W. M. Haddad. *A Variational Approach to the Fuel Optimal Control Problem for UAV Formations*, in “Recent Advances in Aircraft Technology” , Dr. Ramesh Agarwal ed., InTech, pp. 221-248, ISBN: 979-953-307-635-4.

Journal Papers:

- J1. A. L’Afflitto and T. A. Blackford. *Constrained Dynamical Systems, Robust Model Reference Adaptive Control, and Unreliable Reference Signals*. International Journal of Control – In Press.
- J2. A. L’Afflitto. *Barrier Lyapunov Functions and Constrained Model Reference Adaptive Control*. IEEE Control Systems Letters – Vol. 2, 3, May 2018, pp. 441-446.
- J3. A. L’Afflitto, R. B. Anderson, and K. Mohammadi, *An Introduction to Nonlinear Robust Control for Unmanned Quadrotor Aircraft*. IEEE Control Systems Magazine – Vol. 38, 3, May 2018, pp. 102-121.
- J4. A. L’Afflitto and K. Mohammadi, *Equations of Motion of Rotary-Wing UAS with Time-Varying Inertial Properties*. AIAA Journal of Guidance, Control, and Dynamics – Vol. 41, 2, Feb. 2018, pp. 559-564.
- J5. A. L’Afflitto and W. M. Haddad, *Abnormal Optimal Trajectory Planning of Multi-Body Systems in the Presence of Holonomic and Nonholonomic Constraints*. Journal of Intelligent & Robotic Systems, Vol. 89, 1, Jan. 2018, pp. 51-67.
- J6. A. L’Afflitto and K. Mohammadi, *Robust Observer-Based Control of Nonlinear Dynamical Systems with State Constraints*. Journal of the Franklin Institute, Vol. 354, 16, Nov. 2017, pp. 7385-7409.
- J7. A. L’Afflitto, *Continuous Lyapunov Functions, Differential Games, and Stabilization of Nonlinear Systems*. IET Control Theory and Applications, Vol. 11, 15, Oct. 2017, pp. 2486-2496.
- J8. A. L’Afflitto, *Differential Games, Finite-Time Partial-State Stabilization of Nonlinear Dynamical Systems, and Optimal Robust Control*. International Journal of Control, Vol. 90, 9, June 2017, pp. 1861-1878.
- J9. A. L’Afflitto, *Differential Games, Partial-State Stabilization, and Model Reference Adaptive Control*. Journal of the Franklin Institute, Vol. 354, 1, Jan. 2017, pp. 456-478.
- J10. W. M. Haddad and A. L’Afflitto, *Finite-Time Stabilization and Optimal Feedback Control*. IEEE Transactions on Automatic Control, Vol. 61, 4, April 2016, pp. 1069-1074.
- J11. A. L’Afflitto, W. M. Haddad, and E. Bakolas, *Partial-State Stabilization and Optimal Control*. International Journal of Robust and Nonlinear Control, Vol. 26, 5, Mar. 2016, pp. 1026-1050.
- J12. A. L’Afflitto and W. M. Haddad, *Optimal Singular Control for Nonlinear Semistabilization*. International Journal of Control, Vol. 89, 6, Jan. 2016, pp. 1222-1239.
- J13. W. M. Haddad and A. L’Afflitto, *Finite-Time Partial Stability, Stabilization, and Optimal Feedback Control*. Journal of the Franklin Institute, Vol. 352, 6, Mar. 2015, pp. 2329-2357.
- J14. A. L’Afflitto, W. M. Haddad, and Q. Hui, *Optimal Control for Linear and Nonlinear Semistabilization*. Journal of the Franklin Institute, Vol. 352, 3, Mar. 2015, pp. 851-881.
- J15. E. Rabbow, G. Horneck, P. Rettberg, J. U. Schott, C. Panitz, A. L’Afflitto, et. al. *EXPOSE, an Astrobiological Exposure Facility on the International Space Station – from Proposal to Flight*. Origin of Life and Evolution of Biosphere, Vol. 39, 6, Dec. 2009, pp. 581-598.

Workshops:

- W1. A. L’Afflitto, R. B. Anderson, and J. A. Marshall. *Robust adaptive control of multi-rotor UAVs*, American Control Conference, July 2019.

Conference Papers:

- C1. A. L’Afflitto. *Barrier Lyapunov Functions and Constrained Model Reference Adaptive Control*, in proc. IEEE Conference on Decision and Control, December 2018.
- C2. A. L’Afflitto, *Robust Adaptive Control for Constrained Dynamical Systems Following Unreliable Reference Signals*, in proc. American Control Conference, July 2018.
- C3. K. Mohammadi and A. L’Afflitto, *A Continuous First-Order Sliding Mode Control Law, Dynamic Systems and Control Conference*, in proc. Dynamic Systems and Control Conference, October 2017.
- C4. A. L’Afflitto, *Differential Games, Asymptotic Stabilization, and Robust Optimal Control of Nonlinear Systems*, in proc. Conference on Decision and Control, December 2016.
- C5. A. L’Afflitto and W. M. Haddad, *Optimal Singular Control for Nonlinear Semistabilization*, in proc. American Control Conference, Chicago, IL, July 2015.
- C6. W. M. Haddad and A. L’Afflitto, *Finite-Time Partial Stability Theory and Fractional Lyapunov Differential Inequalities*, in proc. American Control Conference, Chicago, IL, July 2015.
- C7. A. L’Afflitto and W. M. Haddad, *Necessary Conditions for Control Effort Minimization of Euler-Lagrange Systems*. AIAA Guidance, Navigation, and Control Conference, AIAA Science and Technology Forum, Kissimmee, FL, January 2015.
- C8. A. L’Afflitto, W. M. Haddad, and E. Bakolas, *Partial-State Stabilization and Optimal Feedback Control*. Conference on Decision and Control, Los Angeles, CA, December 2014.
- C9. A. L’Afflitto, W. M. Haddad, and Q. Hui *Optimal Control for Linear and Nonlinear Semistabilization*. American Control Conference, Portland, OR, June 2014.
- C10. A. L’Afflitto and W. M. Haddad, *Singular Linear-Quadratic Control for Semistabilization*. Conference on Decision and Control, Florence, Italy, December 2013.
- C11. W. M. Haddad, Q. Hui, and A. L’Afflitto, *Semistabilization, Feedback Dissipativity, System Thermodynamics, and Limits of Performance*. American Control Conference, Washington, DC, June 2013.
- C12. A. L’Afflitto and C. Sultan, *On The Optimal Fuel and Energy Consumption for Spacecraft Path Planning in Low Earth Orbit*. IFAC Conference 2011, Milan, Italy, August 2010.
- C13. A. L’Afflitto and C. Sultan, *On the Fuel and Energy Consumption Optimization Problem in Aircraft Path Planning*. IEEE Conference on Decision and Control, Atlanta, GA, December 2010.
- C14. A. L’Afflitto and C. Sultan, *On Calculus of Variations in Aircraft and Spacecraft Formation Flying Path Planning*. AIAA Guidance, Navigation and Control Conference, Toronto, Canada, August 2010.
- C15. A. L’Afflitto and C. Sultan, *Calculus of Variations for Guaranteed Optimal Path Planning of Aircraft Formations*. IEEE International Conference on Robotics and Automation, Anchorage, AK, May 2010.
- C16. A. L’Afflitto and C. Sultan, *Applications of Calculus of Variations to Aircraft and Spacecraft Path Planning*. AIAA Guidance, Navigation and Control Conference, Chicago, IL, August 2009.
- C17. J. Zyiwicki, A. L’Afflitto, E. Rabbow, R. Willnecker, and J. Shieman, *EXPOSE-E: Application of a decentralized payload operations concept for European Payloads on the ISS*. 59th International Astronautical Congress (IAC), 2008.

- C18. E. Rabbow, A. L’Afflitto, C. Paniz, and G. Reitz, *EXPOSE-E – The Astrobiological Exposure Facility on ISS – from proposal to flight*. 59th International Astronautical Congress (IAC), 2008.

Invited Talks:

- I1. Model reference adaptive control and UAS autopilot design. University of Napoli, Italy, “Federico II”, May 21-22, 2018.
- I2. From theory to practice: A nonlinear robust control to assist quadrotor pilots in adverse conditions. Naval Future Force Science and Technology Expo, July 20, 2017.
- I3. Robust Control, Optimal Control, and Differential Games. University of New Mexico, October 28, 2016.
- I4. Optimal Control and Differential Games: From Spacecraft Attitude Control to Formation Flying. Kirtland Air Force Base, August 11, 2016.
- I5. Robust Control, Optimal Control, and Differential Games. Wright-Patterson Air Force Base, July 22, 2016.
- I6. Optimal Control and Differential Games: From Spacecraft Attitude Control to Formation Flying. Italian Center for Aerospace Research (CIRA) – May 19, 2016.
- I7. Research Challenges in Control Theory for Aerospace Applications. Italian Center for Aerospace Research (CIRA) – May 16, 2016.
- I8. Feedback Optimal Control, Robust Control, and Differential Games: Theory, Numerical Solutions, and Applications. Oak Ridge National Laboratory (ORNL) – April 28, 2016.

Awards

Funding:

- **A. L’Afflitto** and D. K. Walters. *Robust Adaptive Controls for Shipboard Landing of Multi-Rotor Unmanned Aerial Vehicles*, Office of Naval Research, May 2019 – April 2020. Cumulative: **\$401,484**; Personal share: **\$221,016**.
- **A. L’Afflitto**. *Exceptional Achievement in Research Award*, The University of Oklahoma, July 2018. Cumulative: **\$2,500**.
- **A. L’Afflitto**. **Young Faculty Award**, *DARPA-RA-17-01-YFA-FP-090, TA24 – A bio-inspired approach to fly undetected in cluttered environments*, DARPA, July 2018 – June 2021. Cumulative: **\$498,513**.
- **A. L’Afflitto**. *T3C1S4C – UAS Control System – Robotics CTA 2017-18 Biennial Program Plan*, Army Research Lab through Robotics Collaborative Technology Alliance, January 2018 – December 2020. Cumulative: **\$185,343**.
- **A. L’Afflitto** and Z. Siddique. *Collaborative Research: Unmanned Aerial Systems and Specialized Workforce Development to Support Oklahoman Agriculture and Industry*, NSF ATE Program, July 2017 – July 2020. Cumulative: **\$408,804**; Personal share: **\$224,842**.
- **A. L’Afflitto**. *Summer Research Experience: Programming UAS for Improved Weather Forecasts*, NSF Oklahoma EPSCoR REU, May – August 2017. Cumulative: **\$5,000**.
- S. Koch, P. Chilson, E. Rasmussen, R. Huck, **A. L’Afflitto**, and J. Salazar-Cerreno. *Three-Dimensional Profiling of the Severe-Weather Environment*, NOAA, April 2016 – August 2018. Cumulative: **\$240,200**; Personal share: **\$41,797 + fringe**.

Editorial Activities:

- IET Control Theory and Applications – Top 5% most outstanding reviewer out of over 1000.

Scholarships and Fellowships:

- AIAA Guidance Navigation and Control Graduate Student Award, 2015
Waived for having gained Ph.D. degree in 2015.
- Domenica Rea D’Onofrio Scholarship, Fall 2011 – Spring 2015.
- Wolfe Fellowship, Summer 2012.

- Pratt Fellowship, Spring 2009.

**Editorial
Activities**

Journals:

- IEEE – Transactions on Aerospace and Electronic Systems, Associate editor, 2019 – Present.
- Elsevier – Control Engineering Practice, Associate editor, 2015 – Present.
- Springer – Journal of Intelligent & Robotic Systems, Guest editor, 2017.

Conferences:

- AIAA SciTech 2020, Intelligent and Autonomous Aerial Systems, Technical Area Co-Chair.
- AIAA SciTech 2019, Associate editor.
- Networked and Autonomous Air and Space Systems Conference 2018, Editorial board member.
- American Control Conference 2017, Associate editor.

Reviewer

Books:

- Springer.

Journals:

- *AIAA Journal of Guidance, Control, and Dynamics.*
- *Elsevier Automatica.*
- *Elsevier Systems & Control Letters.*
- *Elsevier Journal of the Franklin Institute.*
- *Elsevier Nonlinear Dynamics.*
- *Elsevier European Journal of Control.*
- *Elsevier Acta Astronautica.*
- *IEEE Control Systems Letters.*
- *IEEE Transactions on Control Systems Technology.*
- *IEEE Transactions on Automatic Control.*
- *IEEE Transactions on Mechatronics.*
- *IEEE Transactions on Aerospace and Electronic Systems.*
- *IEEE Control Systems Magazine.*
- *IET Control Theory and Applications.*
- *Taylor & Francis International Journal of Control.*
- *Taylor & Francis International Journal of Systems Science.*
- *Wiley International Journal of Robust and Nonlinear Control.*
- *Wiley Optimal Control, Applications and Methods.*
- *Wiley Asian Journal of Control.*

Conferences:

- *IEEE American Control Conference, 2010, 2011, 2013, 2016, 2018, 2019.*
- *IEEE Conference on Decision and Control, 2012–2015, 2018.*
- *IEEE International Conference on Robotics and Automation, 2019.*
- *IEEE Multi-conference on Systems and Control, 2010–2012, 2016.*
- *IEEE International Conference on Control, Decision, and Information Technologies, 2018.*
- *IFAC International Conference on Automatic Control, 2011, 2014.*
- *AIAA Conference on Aviation Technology, Integration, and Operations (ATIO), 2011–2012.*
- *AIAA Space Logistics Best Paper Award, 2011.*

Internships

Mathematical Modeling.

Advanced Superconducting Test Accelerator (ASTA), Fermilab, Batavia, IL. July – August, 2013

Analyzed electron beam instabilities and designed optimal state-feedback control laws for minimizing beam emittance and convergence of the beams to an assigned manifold.

System Engineer.

Italian Space Agency (ASI), Rome, Italy. January – June, 2006

Created database structures to support a facility currently in use at the Italian Space Agency aimed at in-house feasibility studies using a *concurrent design methodology* and ECSS standards. Furthermore, contributed to the design in phase 0 of a satellite for Earth observation.

System Engineer.

Consortium of Research of Advanced Remote Sensing Systems (Alenia Spazio Group), Naples, Italy. January – July 2004

Pre-feasibility study and development of the remote sensing system for a satellite of the Italian Space Agency (ASI) aimed at autonomous robotic on orbit servicing.

Professional Associations

- *IEEE* Technical Committee on Aerospace Control – Member
- *AIAA* Technical Committee on Guidance Navigation, and Control – Member
- *AIAA* Young Professionals Committee – Former Region 1 Deputy Director
- *AIAA* Space Logistics Technical Committee – Former Member
- *AIAA* – Senior Member
- *IEEE* – Member

Community Service

- *AIAA* Oklahoma Section, Region IV – Treasurer, 2015 – Present.
- *AIAA* Scholarship and Student Award – Judge, 2010 – 2015.
- *AIAA* Region 1 Rocket Competition – Chair Organizing Committee, 2011 – 2012.
- *AIAA* Zarem Award – Judge, 2010.