

Dr. Andrea L'Afflitto

Contact Information

865 Asp Ave.
Aerospace and Mechanical Engineering
The University of Oklahoma
Norman, OK 73019 USA
WWW: <http://laffitto.com>

Voice: (405) 325-7885
Fax: (405) 325-1088
E-mail: a.laffitto@ou.edu

Last updated: October, 2018

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.

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 Dissipation, 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:

11. Model reference adaptive control and UAS autopilot design. University of Napoli, Italy, “Federico II”, May 21-22, 2018.
12. 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.
13. Robust Control, Optimal Control, and Differential Games. University of New Mexico, October 28, 2016.
14. Optimal Control and Differential Games: From Spacecraft Attitude Control to Formation Flying. Kirtland Air Force Base, August 11, 2016.
15. Robust Control, Optimal Control, and Differential Games. Wright-Patterson Air Force Base, July 22, 2016.
16. Optimal Control and Differential Games: From Spacecraft Attitude Control to Formation Flying. Italian Center for Aerospace Research (CIRA) – May 19, 2016.
17. Research Challenges in Control Theory for Aerospace Applications. Italian Center for Aerospace Research (CIRA) – May 16, 2016.
18. 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’Affitto.** *Exceptional Achievement in Research Award*, The University of Oklahoma, July 2018. Cumulative: **\$2,500**.
- **A. L’Affitto.** **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’Affitto.** *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’Affitto** 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’Affitto.** *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’Affitto**, 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:

- Elsevier – Control Engineering Practice, Associate editor, 2015 – Present.
- Springer – Journal of Intelligent & Robotic Systems, Guest editor, 2017.

Conferences:

- 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:

- *Elsevier Automatica*.
- *Elsevier Systems & Control Letters*.
- *Elsevier Journal of the Franklin Institute*.
- *Elsevier Nonlinear Dynamics*.
- *Elsevier European Journal of Control*.
- *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*.
- *Taylor & Francis International Journal of Control*.
- *Taylor & Francis International Journal of Systems Science*.
- *IET Control Theory and Applications*.
- *Wiley International Journal of Robust and Nonlinear Control*.
- *Wiley Optimal Control, Applications and Methods*.
- *Wiley Asian Journal of Control*.
- *AIAA Journal of Guidance, Control, and Dynamics*.
- *Elsevier Acta Astronautica*.

Conferences:

- *IEEE American Control Conference*, 2010, 2011, 2013, 2016, 2018, 2019.
- *IEEE Conference on Decision and Control*, 2012–2015, 2018.
- *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.