

IOWA STATE UNIVERSITY
Department of Aerospace Engineering

FULL NAME: Simone Servadio **TITLE:** Assistant Professor

EDUCATION

Politecnico di Milano, Italy	Aerospace Engineering	B.S.	2015	GPA 101/110
Politecnico di Milano, Italy	Space Engineering	M.S.	2017	GPA 110/110
The University of Texas at Austin, USA	Aerospace Engineering	Ph.D.	2021	GPA 4.0

CURRENT AND PREVIOUS ACADEMIC POSITIONS:

Iowa State University, USA	Assistant Professor	August 2023 to present.
University of Colorado at Boulder, USA	Visiting Professor	June 2022 to July 2022
Massachusetts Institute of Technology, USA	Postdoctoral Associate	May 2021 to August 2023
The University of Texas at Austin, USA	Graduate Research Assistant	June 2018 to May 2021
The University of Texas at Austin, USA	Teaching Assistant	June 2018 to May 2021

CONSULTING:

- Launcher Space, Los Angeles, CA: selection of target derelict for ADR missions. Jan 2022 to Oct 2022
- Kall Morris Inc. (KMI), Marquette, MI: mission planning and optimization. Jun 2022 to Jan 2023
- Vast Space, Long Beach, CA: orbital debris inspection concept study Nov 2023 to Feb 2024

HONORS AND AWARDS:

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- Best Paper Second Runner-up - 23rd International Conference of Information Fusion. General category.
- Breakwell Student Paper Award for the paper titled: "Estimation of the conditional state and covariance with Taylor polynomials" at the 31st AAS/AIAA Space-Flight Mechanics Meeting.
- Certificate of Appreciation. 2022 Space Weather Summer School hosted at the University of Colorado Boulder, organized by The University of Michigan and the Massachusetts Institute of Technology.
- 2020 Professional Development Award. The University of Texas at Austin.
- 2020 Teaching Assistant Certification, The University of Texas at Austin
- 2019 Warren A. and Alice L. Meyer Endowed Scholarship in Engineering.
- 2019 Professional Development Award. The University of Texas at Austin.
- 2018 Professional Development Award. The University of Texas at Austin.
- Supervisor of Jonak Bhagawati and Sushant Chiramana and coauthor of "Development of a Temporal Space Debris Population Calculator" awarded best research video in 2024 National Conference on Undergraduate Research, April 8-10, Long Beach, CA.

MEMBERSHIP IN PROFESSIONAL AND HONORARY SOCIETIES:

- Institute of Electrical and Electronics Engineers (IEEE) Member (2019)
- American Institute of Aeronautics and Astronautics (AIAA) Member (2019)
- American Astronautical Society (AAS) Member (2018)

UNIVERSITY COMMITTEES AND ADMINISTRATIVE ASSIGNMENTS:**Committees:**

- Member, Curriculum Committee, Aerospace Engineering, Iowa State University: 2024, 2023.
- Founder, GNC Committee, Aerospace Engineering, Iowa State University: 2024, 2023.
- MOU Iowa State University and Universita' degli Studi di Perugia. 2027-2024.

Conference Activities:

- Technical Chair, ISU 18th Symposium on Undergraduate Research, Student Innovation Center, Ames, IA, 16 April 2024. Session: Mechanical Engineering I.
- AIAA Technical Chair, AAS/AIAA 2023 SciTech Forum, Jan 23-27, 2023, National Harbor, MD. Session: Guidance Navigation and Control I.
- AIAA Technical Chair, AAS/AIAA 2023 SciTech Forum, Jan 23-27, 2023, National Harbor, MD. Session: Guidance Navigation and Control II.
- AIAA Technical Chair, AAS/AIAA 2023 SciTech Forum, Jan 23-27, 2023, National Harbor, MD. Session: Spacecraft Structures I.

Current Review Activities:

Excellent Reviewer for the *Journal of Guidance, Control, and Dynamics* 2022, 2021.

- Journal Of Guidance, Control, and Dynamics
- Journal of the Astronautical Sciences
- Journal of Spacecraft and Rockets
- Advances in Space Research
- IEEE Transactions on Aerospace and Electronic Systems
- Journal of Optimization Theory and Applications
- Journal of Nonlinear Science (Springer)
- The Journal of Space Safety Engineering
- Astrodynamics (Springer)
- Acta Astronautica
- The Journal Celestial Mechanics and Dynamical Astronomy

PUBLICATIONS:**Referred Journal Publications**

- J14. G. Lavezzi, M. Lifton, **S. Servadio**, and R. Linares, “Orbital Tolerance and Intrinsic Orbital Capacity for Electric Propulsion Constellations,” *Journal of Spacecraft and Rockets*, Articles in Advance. <https://doi.org/10.2514/1.A35875>
- J13. J. Pasiiecznik, **S. Servadio**, and Richard Linares, “Koopman Operator theory applied to Lambert’s problem with a spectral behavior analysis,” *Acta Astronautica*, in Press, March 2024. <https://doi.org/10.1016/j.actaastro.2024.03.021>
- J12. D. Gusmini, A. D’Ambrosio, **S. Servadio**, P. Siew, P. Di Lizia, and R. Linares, “Effects of Orbit Raising and Deorbiting in Source-Sink Evolutionary Models,” *Journal of Spacecraft and Rockets*, Articles in Advance, pp. 1-12, January 2024. <https://doi.org/10.2514/1.A35849>
- J11. **S. Servadio**, N. Simha, D. Gusmini, D. Jang, T. St. Francis, A. D’Ambrosio, G. Lavezzi, and R. Linares, “Risk Index For The Optimal Ranking Of Active Debris Removal Targets,” *Journal of Spacecraft and Rockets*, vol. 61, no. 2, pp. 407-420, October 2023. <https://doi.org/10.2514/1.A35752>
- J10. A. D’Ambrosio, **S. Servadio**, P. Siew, and Richard Linares, “Novel Source–Sink Model for Space Environment Evolution with Orbit Capacity Assessment,” *Journal of Spacecraft and Rockets*, vol. 60, no. 4, pp. 1112-1126, February 2023. <https://doi.org/10.2514/1.A35579>
- J9. **S. Servadio**, R. Armellin, and R. Linares, “Koopman-Operator Control Optimization for Relative Motion in Space,” *Journal of Guidance Control and Dynamics*, vol. 46, no. 11, pp. 2121-2132, October 2023

- <https://doi.org/10.2514/1.G007217>
- J8. **S. Servadio**, W. Parker, and R. Linares, “Uncertainty Propagation and Filtering via the Koopman Operator in Astrodynamics,” *Journal of Spacecraft and Rockets*, vol. 60 no. 5, pp. 1639-1655, June 2023.
<https://doi.org/10.2514/1.A35688>
- J7. **S. Servadio**, D. Arnas, and R. Linares, “Dynamics Near the Three-Body Libration Points via the Koopman Operator Theory,” *Journal of Guidance Control and Dynamics*, vol. 45, no.10, pp. 1800-1814, July 2022.
<https://doi.org/10.2514/1.G006519>
- J6. **S. Servadio**, R. Zanetti, and R. Armellin, “Maximum A Posteriori Estimation of Hamiltonian Systems with High Order Series Expansions,” *Journal of the Astronautical Sciences*, vol. 69, pp. 511–536, April 2022.
<https://doi.org/10.1007/s40295-022-00304-4>
- J5. **S. Servadio**, F. Cavenago, P. Di Lizia, and M. Massari, “Nonlinear Prediction in Marker-Based Spacecraft Pose Estimation with Polynomial Transition Maps,” *Journal of Spacecraft and Rockets*, vol. 59, no. 2, pp. 511-523, 2022.
<https://doi.org/10.2514/1.A35068>
- J4. **S. Servadio**, and R. Zanetti, “Estimation Of The Conditional State And Covariance With Taylor Polynomials,” *Journal of Advances in Information Fusion*, vol. 16, no. 2, pp. 126–142, December 2021.
- J3. **S. Servadio**, and R. Zanetti, “Differential Algebra-Based Multiple Gaussians Particle Filter for Orbit Determination,” *Journal of Optimization Theory and Applications*, vol. 191, pp. 459–485, December 2021.
<https://doi.org/10.1007/s10957-021-01934-8>
- J2. **S. Servadio**, R. Zanetti, and B. A. Jones, “Nonlinear Filtering with a Polynomial Series of Gaussian Random Variables,” *IEEE Transactions on Aerospace and Electronic Systems*. vol. 57. No. 1 pp: 647-658. 2020
<https://doi.org/10.1109/TAES.2020.302848>
- J1. **S. Servadio**, and R. Zanetti, “Recursive Polynomial Minimum Mean Square Error Estimation With Applications To Orbit Determination,” *Journal of Guidance Control and Dynamics*, vol. 43, no. 5, pp: 939-954. 2020
<https://doi.org/10.2514/1.G004544>

Submitted Journal Publications

- SJ6. **S. Servadio**, G. Lavezzi, C. Hofmann, D. Wu, R. Linares, “Propagation of Uncertainty and Filtering with the Koopman Operator,” *Automatica*, 2024.
- SJ5. **S. Servadio**, D. Jang, R. Linares, “Threat Level Estimation From Possible Break-Up Events In LEO,” *Journal of Spacecraft and Rockets*, 2024.
- SJ4. N. Simha, **S. Servadio**, M. Lifton, G. Lavezzi, R. Linares, “Optimal Active Debris Removal Mission Planning to Inform Policy Decisions,” *Acta Astronautica*, 2024.
- SJ3. D. Jang, D. Gusmini, P. Siew, A. D’Ambrosio, **S. Servadio**, P. Machuca, R. Linares, “A New Monte-Carlo Model for the Space Environment and Planned Missions,” *Journal of Spacecraft and Rockets*, 2024.
- SJ2. **S. Servadio**, “Likelihood Scouting Via Map Inversion For A Posterior-Sampled Particle Filter,” *IEEE Transactions on Aerospace and Electronic Systems*, 2024.
- SJ1. C. Hofmann, **S. Servadio**, R. Linares, and F. Topputo, “Bilinearization and Linearization in Space Flight Mechanics Using Koopman Operator Theory,” *Journal of Guidance Control and Dynamics*, 2024.

Conference Publications

- C25. C. Hofmann, G. Lavezzi, D. Wu, **S. Servadio**, and R. Linares, “Comparative Analysis of Analytical and Data-Driven Koopman Operators for the J2 Problem With Atmospheric Drag,” *Proceedings of the 2024 AAS/ALAA Astrodynamics Specialist Conference*, Broomfield, CO, 11-15 August 2024, no. AAS 24-318.

- C24. R. M. Tian, K. Xi, G. Lavezzi, M. Lifson, **S. Servadio**, and R. Linares “Optimizing Active Debris Removal Strategies with Feedback Control for a Sustainable Space Environment,” *Proceedings of the 2024 AAS/AIAA Astrodynamics Specialist Conference*, Broomfield, CO, 11-15 August 2024, no. AAS 24-354.
- C23. B. Candan, and **S. Servadio**, “Markers Identification for Relative Pose Estimation of an Uncooperative Target,” *Proceedings of the 2024 AAS/AIAA Astrodynamics Specialist Conference*, Broomfield, CO, 11-15 August 2024, no. AAS 24-378.
- C22. E. Ashley, C. S. Sanz, and **S. Servadio**, “Parameters Estimation in Source-Sink Space Population Evolutionary Models,” *Proceedings of the 2024 AAS/AIAA Astrodynamics Specialist Conference*, Broomfield, CO, 11-15 August 2024, no. AAS 24-315.
- C21. **S. Servadio**, G. Lavezzi, C. Hofmann, D. Wu, R. Linares, “Propagation of Uncertainty with the Koopman Operator,” *Proceedings of the 27th Conference of Information Fusion*, Venice, ITA, 7-11 July 2024.
- C20. **S. Servadio**, D. Jang, and R. Linares, “Threat Level Estimation From Possible Break-Up Events In LEO,” *Proceedings of the 2024 AIAA SciTech Forum*, Orlando, FL, 8-12 January 2024.
<https://doi.org/10.2514/6.2024-1065>
- C19. N. Simha, **S. Servadio**, M. Lifson, G. Lavezzi, and R. Linares, “Optimal active debris removal mission planning to inform policy decisions,” *Proceedings of the 2024 10th Annual Space Traffic Management Conference*, Austin, TX, 27-28 February 2024.
- C18. G. Lavezzi, M. Lifson, **S. Servadio**, and R. Linares, “An Analysis of Orbital Separation Distances to Support Space Traffic Management,” *Proceedings of the 2023 AAS/AIAA Astrodynamics Specialist Conference*, Big Sky, MT, 13-17 August 2023, no. AAS 23-228.
- C17. **S. Servadio**, R. Armellin, and R. Linares, “A Koopman-Operator Control Optimization for Relative Motion in Space,” *Proceedings of the 2023 AIAA SciTech Forum*, National Harbor, MD, 23-27 January 2023.
<https://doi.org/10.2514/6.2023-0873>
- C16. **S. Servadio**, T. St. Francis, N. Simha, D. Gusmini, D. Jang, A. D’Ambrosio, and R. Linares, “Optimal Target Selection for an Active Debris Removal Mission,” *Proceedings of the 2023 AAS/AIAA 33rd Space Flight Mechanics Meeting*, Austin, TX, 15-19 January 2023, no. AAS 23-164.
- C15. D. Gusmini, A. D’ambrosio, **S. Servadio**, P. Siew, P. Di Lizia, and R. Linares, “The Effects Of Raising And Decay In Orbital Capacity Models,” *Proceedings of the 2023 AAS/AIAA 33rd Space Flight Mechanics Meeting*, Austin, TX, 15-19 January 2023, no. AAS 23-156.
- C14. D. Jang, D. Gusmini, P. Siew, A. D’ambrosio, **S. Servadio**, and R. Linares, “Monte Carlo methods to model the evolution of the LEO population,” *Proceedings of the 2023 AAS/AIAA 33rd Space Flight Mechanics Meeting*, Austin, TX, 15-19 January 2023, no. AAS 23-240.
- C13. Q. Al Shidi, A. Ridley, S. Peng, E. Sutton, **S. Servadio**, C. Wu, J. Vila-Perez and F. Holtorf, “Space Weather Simulations Summer School,” *Proceedings of the AGU Fall Meeting 2022*, Chicago, IL, 12-16 December 2022, id. SA22E-1916.
- C12. J. Pasicznic, **S. Servadio**, and R. Linares, “A Lambert’s Problem Solution via the Koopman Operator with Orthogonal Polynomials,” *Proceedings of the 73rd International Astronautical Congress*, Paris, FRA, 18-22 September 2022.
- C11. C. Hofmann, **S. Servadio**, R. Linares, and F. Topputo, “Advances in Koopman Operator Theory for Optimal Control Problems in Space Flight,” *Proceedings of the 2022 AAS/AIAA Astrodynamics Specialist Conference*, Charlotte, NC, 7-11 August 2022, AAS 22-259.
- C10. A. D’Ambrosio, **S. Servadio**, P. Siew, D. Jang, M. Lifson, and R. Linares, “Analysis of the LEO orbital capacity via probabilistic evolutionary model,” *Proceedings of the 2022 AAS/AIAA Astrodynamics Specialist Conference*, Charlotte, NC, 7-11 August 2022, AAS 22-158.
- C9. **S. Servadio**, W. Parker, and R. Linares, “Uncertainty Propagation and Filtering via the Koopman Operator in Astrodynamics,” *Proceedings of the 2022 AAS/AIAA Astrodynamics Specialist Conference*, Charlotte, NC, 7-11 August 2022, no. AAS 22-019.

- C8. **S. Servadio**, D. Arnas, and R. Linares, “Dynamics Near the Three-Body Libration Points via the Koopman Operator Theory,” *Proceedings of the 2021 AAS/AIAA Astrodynamics Specialist Conference*, Big Sky, Virtual, 9-11 August 2021, no. AAS 21-688.
- C7. **S. Servadio**, and R. Zanetti, “Uncertainty Estimation Through Polynomial Map Inversion,” *Proceedings of the 2021 AAS/AIAA Astrodynamics Specialist Conference*, Big Sky, Virtual, 9-11 August 2021, no. AAS 21-659.
- C6. **S. Servadio**, and R. Zanetti, “Estimation Of The Conditional State And Covariance With Taylor Polynomials,” *Proceedings of the 2021 AAS/AIAA 31st Space Flight Mechanics Meeting*, Virtual, 1-3 February 2021, no. AAS 21-416.
- C5. **S. Servadio**, R. Zanetti, and B. A. Jones, “Nonlinear Filtering with a Polynomial Series of Gaussian Random Variables,” *Proceedings of the 23rd Conference of Information Fusion*, Virtual, 6-9 July 2020.
- C4. **S. Servadio**, and R. Zanetti, “DA-Based Multiple Gaussians Particle Filter For Orbit Determination,” *Proceedings of the 2020 AAS/AIAA Astrodynamics Specialist Conference*, South Lake Tahoe, CA, (Virtual), 9-13 August 2020, no. AAS 20-417.
- C3. **S. Servadio**, R. Zanetti, and R. Armellin, “Maximum A Posteriori Estimation of Hamiltonian Systems with High Order Series Expansions,” *Proceedings of the 2019 AAS/AIAA Astrodynamics Specialist Conference*, Portland, ME, 11-15 August 2019, no. AAS 19-875.
- C2. **S. Servadio**, and R. Zanetti, “Recursive Polynomial Minimum Mean Square Error Estimation With Applications To Orbit Determination,” *Proceedings of the 2019 AAS/AIAA 29th Space Flight Mechanics Meeting*, Maui, HI, 13–17 January 2019, no. AAS 19-445.
- C1. F. Cavenago, M. Massari, P. Di Lizia, **S. Servadio**, and A. Wittig, “DA-Based Nonlinear Filters for Spacecraft Relative Space Estimation,” *Proceedings of the 2018 AIAA SciTech Forum*. Kissimmee, FL, 8-12 January 2018.
<https://arc.aiaa.org/doi/abs/10.2514/6.2018-1964>.

Poster Presentations

- S2. “*Spacecraft Marker Detection Using Convolutional Neural Network*,” S. Mollenhauer, B. Candan, **S. Servadio**, 2024 Engineering Students Project Showcase, 10 April 2024, Ames, IA.
- S1. “*Development of a Temporal Space Debris Population Calculator*,” J. Bhagawati, S. Chiramana, **S. Servadio**, 2024 National Conference on Undergraduate Research, April 8-10, Long Beach, CA.

ORAL PRESENTATIONS:

- P13. “*High Order Filters for Relative Pose Estimation of an Uncooperative Target*,” Sigma Gamma Tau Aerospace Engineering Honor Society, Iowa State University, 17 April 2024.
- P12. “*Likelihood Scouting Via Map Inversion For A Posterior-Sampled Particle Filter*,” Uncertainty Quantification in Astrodynamics Mini-Symposium at UQSIAM2024, Trieste, ITA, 28 February 2024.
- P11. “*The Koopman Operator in Astrodynamics: Estimation, Control, and Optimization*,” Seminar, Politecnico di Milano, PhDAER Aerospace Polimi (Pierluigi Di Lizia), 23 Febbraio 2024.
- P10. “*Astrodynamics via the Koopman Operator Theory with Estimation and Control Applications*,” Seminar, Università degli Studi di Perugia, Automation and Robotics Group (Mario Fravolini) 20 December 2023.
- P9. “*New Developments in Nonlinear Filtering using Differential Algebra: The Polynomial Update*,” Seminar, Iowa State University, Ames, IA, March 2023.
- P8. “*A Koopman Operator Tutorial with Orthogonal Polynomials*,” Virtual Seminar, Politecnico di Milano. Milano. ITA, June 2022.
- P7. “*A Koopman Operator Tutorial with Orthogonal Polynomials*,” Virtual Seminar, The University of Auckland, Auckland, NZ. January 2022.
- P6. “*A Koopman Operator Tutorial with Orthogonal Polynomials*,” Virtual Seminar, The University of Texas at Austin. December 2021.

- P5. “*High-Order Nonlinear Filtering in Aerodynamics with Differential Algebra: MAP vs MMSE Estimation,*” 2022 Seminar Series Space System Lab (SSL), Massachusetts Institute of Technology, Cambridge, MA. 2022.
- P4. “*A Koopman Operator Tutorial with Orthogonal Polynomials,*” ARClab, Massachusetts Institute of Technology, Cambridge, MA. November 2021.
- P3. “*New Developments in Nonlinear Filtering using Differential Algebra: The Polynomial Update,*” 2021 Seminar Series Space System Lab (SSL), Massachusetts Institute of Technology, Cambridge, MA. 2021.
- P2. “*Recursive Polynomial Minimum Mean Square Error Estimation With Applications To Orbit Determination,*” 2019 Texas System Day, Texas A&M, College Station, TX.
- P1. “*Rendezvous and Approaching Maneuvers with Differential Algebra,*” Aerospace Department, Estimation and Control Group, The University of Texas at Austin, Austin, TX. 10 June 2018.

GRANTS AND CONTRACTS:

Active

- AG3. **S. Servadio (PI)**, Vast Space Collaboration. Details TBD.
- AG2. Dr. D. Lee (PI), Dr. O. Abdelkhalik (Co-PI), and **S. Servadio (Co-PI)**, *Non-GPS Navigation System Using Dual Star/Planetary Cameras for Lunar and Deep-Space CubeSat Missions*, NASA Office of STEM Engagement award number NNH24ZHA001C, 08/15/2024 – 08/14/2027.
This work creates a complete pipeline for Guidance, Navigation, and Control in cislunar and deep space without the help of GPS and using star trackers and planetary cameras as measurements.
- AG1. **S. Servadio (PI)**, *Iowa NASA EPSCoR Partnership Development Travel Grant*, Iowa NASA EPSCoR Partnership Development Travel Grant PDTG-RFP-FY24, 09/22/2023 – 08/23/2024.
This grant promotes travel to start new projects connected with NASA centers and NASA personnel.

Completed

NA

PH.D. SUPERVISION IN PROGRESS:

- David Knapick, completed Qualifying Exam.
- Batu Candan.
- Erin Ashley.
- Mohammed Atallah.
- Ali Davoodi.

M.S. SUPERVISION IN PROGRESS:

- Chiran Binu Cherian, “Polynomial Update Kalman Filters.”
- Samuel Mollenhauer, “Neural Networks for Active Debris Removal Mission.”
- Lalit Deshmukh, “Reachable Set and Maneuver Identification with Differential Algebra.”

M.S. SUPERVISION COMPLETED:

- Nihal Simha, Imperial College London.
- Davide Gusmini, Politecnico di Milano, Thesis Title: “A New Source-Sink Space Environment Evolution Model Including the Effects of Orbit Transfer Maneuvers.” May 2023. Co-advised with Dr. Linares, Dr. Peng, Dr. D’Ambrosio, Dr Di Liiza. Following graduation joined SDF as a System Engineer.
- Julia Pasiiecznik, Massachusetts Institute of Technology, Thesis Title: “Koopman Operator Theory Applied to Lambert’s Problem with a Spectral Behavior Analysis.” May 2023. Co-advised with Dr. Linares. Following graduation pursued her PhD at the University of Toronto, CAN.

- William Parker, Massachusetts Institute of Technology, Thesis Title: “Learning-Based Methods for Spacecraft Dynamics Modeling, Filtering, and Predictive Control,” May 2022. Co-advised with Dr. Linares. Following graduation pursued his PhD, staying in the ARC Lab with Dr. Linares.

OTHER STUDENT COMMITTEES:

- David Knapick, Doctorate Committee. Completed the Qualifying exam. Iowa State University.
- Alexander Perrucci, Doctorate Committee. Completed the Qualifying exam. Iowa State University.
- Lim Cai Min, Doctorate Committee.
- Gage Harris, Doctorate Committee.
- Andrea De Vittori, Ph.D External Evaluator, Politecnico di Milano. Thesis Title “Enhanced Collision Avoidance Strategies in the Near-Earth Environment.”

CURRENT COURSE WORKLOAD:

- AERE 3510 Astrodynamics I, undergraduate course.
- AERE 5730 Random Signals Analysis and Kalman Filtering, graduate course.
- AERE 6900 Advanced Estimation, graduate course.

PREVIOUS COURSE WORKLOAD:

- 16.07 Dynamics, Massachusetts Institute of Technology, undergraduate course.
- 16.346 Astrodynamics, Massachusetts Institute of Technology, undergraduate course.
- ASE 372K Attitude Dynamics, The University of Texas at Austin, undergraduate course.