JAKE BUZHARDT

jbuzhar@g.clemson.edu | (803)-940-3405 | jbuzhar.github.io | LinkedIn

CURRENT ADDRESS:
854 Issaqueena Trail, Apt. 604
Central, SC 29630

PERMANENT ADDRESS:
6064 SC Highway 395
Newberry, SC 29108

EDUCATION

Clemson University **Clemson, SC**

Ph.D. in Mechanical Engineering (Pursuing) *January 2018 – December 2023 (Expected)*
Research: Controlled density transport with applications in Stokes flows and uncertain control systems
Advisor: Phanindra Tallapragada
GPA: 4.00

Bachelor of Science in Mechanical Engineering *August 2013 - December 2017*
Minor in Mathematical Sciences
GPA: 3.75

Research Interests:

Nonlinear dynamics & control for locomotion, optimal control and trajectory optimization, uncertainty propagation and quantification, low Reynolds number hydrodynamics, offroad vehicle navigation and control.

PUBLICATIONS

Journal Papers:

J1. **Buzhardt, J.**, Fedonyuk, V., and Tallapragada, P. "Pairwise controllability and motion primitives for micro-rotors in a bounded Stokes flow." International Journal of Intelligent Robotics and Applications. 2018. DOI: 10.1007/s41315-018-0075-5

J2. **Buzhardt, J.** and Tallapragada, P. "Dynamics of groups of magnetically driven artificial microswimmers." Physical Review E. 2019. DOI: 10.1103/PhysRevE.100.033106
** Figures featured in PRE Kaleidoscope and APS calendar **

J3. **Buzhardt, J.** and Tallapragada, P. "Magnetically actuated microswimmers as mobile microparticle manipulators" ASME Letters in Dynamic Systems and Control. 2021. DOI: 10.1115/1.4046581
** Finalist for Best Student Paper at the 2019 ASME DSCC **

Peer-reviewed Conference Papers:

C1. **Buzhardt, J**., Fedonyuk, V., Sudarsanam, S., and Tallapragada, P. "Controllability of a pair of swimming microrotors in a bounded domain at low Reynolds number." Proceedings of the ASME Dynamic Systems and Control Conference (DSCC), 2018. DOI: 10.1115/DSCC2018-9013

C2. Tallapragada, P., **Buzhardt, J.,** and Seney, R. "A passive jumping mechanism" Proceedings of the ASME Dynamic Systems and Control Conference, 2019. DOI: 10.1115/DSCC2019-9194

C3. **Buzhardt, J.** and Tallapragada, P. "Optimal trajectory tracking for a magnetically driven microswimmer" American Control Conference, 2020. DOI: 10.23919/ACC45564.2020.9147973

C4. Salvi, A., **Buzhardt, J.** , Tallapragada, P., Krovi, V., Brudnak, M., Smereka, J.M. "Deep reinforcement learning for simultaneous path planning and stabilization of offroad vehicles." 2021 NDIA Ground Vehicle System Engineering and Technology Symposium (GVSETS).

C5. **Buzhardt, J.** and Tallapragada, P. "Terrain parameter estimation from proprioceptive sensing of the suspension dynamics in offroad vehicles. American Control Conference, 2022. DOI: 10.23919/ACC53348.2022.9867793

C6. **Buzhardt, J.** and Tallapragada, P. "A Koopman operator approach for the vertical stabilization of an off-road vehicle." Proceedings of the Modeling, Estimation and Control Conference, 2022. DOI: 10.1016/j.ifacol.2022.11.260

C7. Salvi, A., Coleman, J., **Buzhardt, J**., Krovi, V., and Tallapragada, P.. "Stabilization of vertical motion of a vehicle on bumpy terrain using deep reinforcement learning." Proceedings of the Modeling, Estimation and Control Conference, 2022. DOI: 10.1016/j.ifacol.2022.11.197

C8. Rodwell, C., **Buzhardt, J.** and Tallapragada, P. "A Koopman operator approach for the pitch stabilization of a hydrofoil in an unsteady flow field." Accepted to American Control Conference 2023

Submitted:

C9. **Buzhardt, J.** and Tallapragada, P. "Controlled density transport using Perron Frobenius generators." Submitted to IEEE Conference on Decision and Control, 2023. Preprint: arXiv2304.13829

C10. Loya, K., **Buzhardt, J**. and Tallapragada, P. "Koopman operator based predictive control with a data archive of observables" Submitted to Modeling, Estimation and Control Conference, 2023

C11. **Buzhardt, J.,** Chivkula, P., and Tallapragada, P. A Pendulum-Driven Legless Rolling Jumping Robot. Submitted to IEEE/RSJ International Conference on Intelligent Robots and Systems, 2023. Preprint: arXiv2304.11527

PRESENTATIONS

1. "A singularity model for the dynamics of externally driven microswimmers."
   Annual Meeting of the APS Division of Fluid Dynamics. 19 November 2018.
2. "Modeling of externally driven magnetic micro-robots."
   Mechanical Engineering Graduate Student Research Seminar Series. 8 October 2018.
3. "Modeling of magnetically driven micro-robots."
   ME Graduate Student Government Research Poster Competition. October 29 – November 2 2018.
4. "Agile Modular Cyber-Physical Vehicle Platforms"
   Poster/lightning talk at 2021 Automotive Research Center (ARC) Annual Program Review. 10 May 2021.
   DOI: 10.26226/morressier.608c2248dc2fa1af562471ce
5. "Embodied Sensing and Control for Agile Motion of Unmanned Ground Vehicles."
   Mechanical Engineering Graduate Student Research Seminar Series. 27 September 2021.
6. "Control strategies for magnetically driven artificial microswimmers"
   Annual Meeting of the APS Division of Fluid Dynamics. 22 November 2023.
7. "Reinventing the wheel: a pendulum-driven robot that can roll and jump"
   Clemson Mechatronics Forum. 21 April 2023.

Honors & Awards

2022	Award of Excellence – Doctoral Student. (Clemson Department of Mechanical Engineering)
2020	Figure from Paper J2 featured on Annual Calendar of American Physical Society (APS)
2019	Departmental Master's Student Award (Clemson Department of Mechanical Engineering)
2019	Finalist for Best Student Paper at 2019 ASME DSCC (Paper J3) Travel grant from ASME DSCC to attend the conference.
2019	Figure from Paper J2 featured in PRE Kaleidoscope online feature
2018	Awarded Graduate Travel Grants (GTG) from Clemson Graduate Student Government to attend 2018 ASME DSCC and 2018 APS Division of Fluid Dynamics meeting

Graduate Coursework

at Clemson University

2022	Asymptotics and Perturbation Methods in Engineering Science
2021	Autonomy: Science and Systems , Multibody and Robot Dynamics
2020	Hydrodynamic Stability, Advanced Nonlinear Dynamics
2019	Foundations of Fluid Mechanics Advanced Estimation , Theory of Elasticity , Advanced Nonlinear Control
2018	Intermediate Dynamics , Applied Optimal Control Modern Control Engineering , Structural Vibration , Autonomous Driving Technology
2017	Nonlinear Dynamics & Chaos (graduate course taken as undergraduate)

Work Experience

Clemson University – VIPR-GS Center at CU-ICAR
Graduate Research Assistant *January 2021—August 2022*

- Implemented Koopman-based data driven model predictive control for simultaneous path planning and stabilization of an offroad vehicle in simulation
- Analyzed effects of proprioceptive sensing on the capability to estimate unknown terrain parameters
- Developed deep reinforcement learning algorithms for off-road navigation, estimation, and path planning
- Derived lower-order models for simplified analysis of complex suspension systems within RL framework

Clemson University – Department of Mechanical Engineering **Clemson, SC**
Graduate Teaching Assistant *January 2019 – December 2020*

- Instructed class of sophomore mechanical engineering students in ME 222: Mechanical Engineering Laboratory
- Facilitated hands-on learning through experimentation, group projects, and technical writing exercises.
- Developed video lectures for hybrid instruction and a new applied statistics and uncertainty course module

Clemson University – Department of Mechanical Engineering **Clemson, SC**
Graduate Grading Assistant *January 2018 – December 2022 (Intermittent)*

- Served as a point of contact for students, professors, and the grading team on course grading matters
- Managed the course web-page, regulate assignments, and arrange regular grading team meetings

Courses Graded:

- ME 2010: Statics & Dynamics (Lead Grader – Spring 2018)
- ME 6930: Nonlinear Dynamics & Chaos (Fall 2018)
- ME 6930: Mechanical Vibrations (Fall 2022)

Robert Bosch, LLC **Anderson, SC**
Manufacturing Engineering Co-op *August 2015 – May 2017*

- Managed and contributed to multiple long-term projects aimed at reducing scrap costs in production and improving product quality, including multiple projects utilizing Shainin problem solving strategies.
- Implemented digital entry forms and databases for collecting and storing production data, thereby replacing paper forms, developing interactive data visualizations, and implementing Industry 4.0 standards.
- Applied Solidworks and CAD skills to develop custom tooling and gain a broader knowledge of machine design.
- Completed manufacturing engineering apprenticeship program, recognized by the SC Department of Labor, gaining a knowledge of manufacturing topics including Bosch Production Systems, PLC programming, pneumatic systems, and electrical safety.

Clemson University – General Engineering Department **Clemson, SC**
Undergraduate Teaching Assistant *August 2014 – May 2015*

- Attended class meetings of freshman level general engineering courses and assisted course instructors in creating an active learning environment through lab activities and group learning exercises.
- Hosted three-hour study sessions each week to facilitate group learning and assist students in learning course concepts.

Other Project & Leadership Experience

ME 4010: Capstone Design **Clemson, SC**
Design of a Six-Rotor Drone *June 2017 – Aug. 2017*

- Worked with a team of five other senior engineering students to redesign an Eagle Pro Six Rotor drone to meet additional requirements and have added functionality, as part of the mechanical engineering capstone design program.
- Modified the drone to meet a smaller size constraint, land and launch from water, retrieve and carry a payload, and deliver this payload to a receptacle.
- Carried out a thorough design process, including conceptualization, functional analysis, design, prototyping, requirement validation, and documentation.

Clemson Undergraduate Student Government **Clemson, SC**
Freshman Council Member *Sept. 2013 – May 2014*

- Served as a member of a group of Clemson University freshmen that places an emphasis on leadership and community involvement, while focusing on issues within the Clemson University community.
- Met weekly to discuss issues concerning the Clemson University student body while organizing events on campus, such as Clemson's annual High School Leadership Conference

South Carolina Junior Civitan District **Newberry, SC**
Area Lieutenant Governor *July 2011 - June 2013*

- Monitored and motivated Junior Civitan clubs in district by serving as a line of communication between clubs and organizing joint projects to ensure a stronger district by maintaining regular contact throughout the year

Technical Skills

Programming: MATLAB, Python, Julia

Software: Mathematica, Maple, TensorFlow, PyTorch, Solidworks, ROS

Simulators: MSC Adams, Project Chrono, Gazebo, CoppeliaSim