Prashanth Chivkula

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Education

Ph.D. in Electrical Engineering — **Completed Aug 2025**
Clemson University — GPA 3.51/4.00
Dissertation title: "Motion Primitives in an Underactuated Fish-Like Robot"
Advisor: Phanindra Tallapragada

B.E. in Mechanical Engineering — **Aug 2017**
University of Mumbai — GPA 6.96/10.00

Research Interests
Robotics, Bio-inspired Robotics, Nonlinear Dynamics

Research & Academic Experience

Applied Dynamical Systems Lab — Clemson, SC
Graduate Research Assistant — **Jan 2021 - Aug 2025**

1. Swimming Robots
   - Bistable Swimmer
     - Developed a novel underactuated fish-like robot with a passive bistable tail. This robot design combines a hydrofoil with a bistable tail that features a double-well elastic potential and is controlled by a single actuator— the internal rotor.
     - The robot uses periodic forcing of the internal rotor to exploit frequency-dependent bistable dynamics for achieving multiple gaits. By tuning the amplitude and frequency of the input to the rotor, the robot transitions between distinct gaits, enabling both straight-line swimming and powered turning, the latter arising from oscillations about a deflected tail position.
   - Spin Swimmer
     - Developed a novel underactuated fish-like robot based on the concept of parametric resonance. The robot design consists of a hydrofoil attached to a flexible tail, and is powered by a single actuator— an unbalanced internal rotor.
     - The constant spin of this unbalanced rotor generates centripetal reaction forces on the body, which induces oscillations in the flexible tail.
     - This robot is one of the most efficient bio-inspired swimming robots with a cost of transport (CoT) of 1.02 at a fast swimming speed of 2.4 body lengths/s and, with the addition of an actuator at the tail joint, exhibits excellent maneuverability with a tight turning radius of 0.3 body lengths.
2. Jumping Robot
   - Developed a novel pendulum-driven rolling, jumping wheel robot in a compact, lightweight, 3D printed design based on Littlewood's classical model of a heavy eccentric mass on a light hoop leading to a loss of contact. The robot consists of a single actuator and can achieve jumps of up to 2.5 body lengths vertically, and clear horizontal distances of over 6 body lengths.
3. Reinforcement Learning
   - Formulated a reinforcement-learning control framework for a reduced-order model of a bio-inspired swimming robot with a passive appendage.
   - Used a Chaplygin sleigh with a passive appendage as the surrogate model and trained a policy gradient agent for path tracking.

– To accelerate learning and embed prior structure, pre-trained the actor network from known system physics and used it to initialize training of the agent.

Graduate Grading Assistant **Aug 2020 - Dec 2020**

– Graded homework assignments for an undergraduate modeling and controls course, and provided feedback to students.

Graduate Coursework

2025	Embedded Computing
2024	Machine Learning
2023	Advanced Kinematics in Robotics, Pattern Recognition
2022	Analysis of Tracking Systems, Nonlinear Dynamics & Chaos
2021	Autonomy: Science & Systems, Multibody and Robot Dynamics, Advanced Calculus
2020	Modern Control, Advanced Nonlinear Dynamics, Finite Element Analysis, Applied Optimal Control, Manufacturing Optimization
2019	Intermediate Dynamics, Control Systems, Advanced Design Methodologies

Publications

[1] **Chivkula, Prashanth** and Tallapragada, P., "Spin swimmer: A fast, efficient and agile fish-like robot," *IEEE Robotics and Automation Letters*, vol. 10, pp. 10942–10949, 2025.

[2] **Chivkula, Prashanth**, Rodwell, C., and Tallapragada, P., "Hopping potential wells and gait switching in a fish-like robot with a bistable tail," *Extreme Mechanics Letters*, vol. 72, p. 102239, 2024.

[3] Buzhardt, Jake, **Chivkula, P.**, and Tallapragada, P., "A pendulum-driven legless rolling jumping robot," *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, pp. 2493–2498, 2023.

[4] **Chivkula, Prashanth**, Rodwell, C., and Tallapragada, P., "Curriculum-based reinforcement learning for path tracking in an underactuated nonholonomic system," *Proceedings of the Modeling, Estimation and Control Conference (MECC)*, vol. 55, no. 37, pp. 339–344, 2022.

[5] Dalvi, Girish, **Chivkula, P.**, Trivedi, J., Mathew, A., and Thomas, G., "Experimental and simulation study to control stiffness of an air spring," *International Journal of Mechanical and Production Engineering (IJMPE)*, vol. 5, no. 7, pp. 21–24, 2017.

Presentations & Posters

1. "Spin Swimmer: A fast, efficient and agile swimming robot," *International Conference on Robotics and Automation (ICRA)*, May 2025. (Poster)
2. "Spin is all you need for fast and efficient swimming," *American Physical Society Division of Fluid Dynamics*, November 2024.
3. "A vibration-driven slender elastic swimmer," *Clemson Graduate Research Seminar Series (GSR)*, November 2024.

4. "Bistability and gait switching in an underactuated swimming robot," *International Conference on Intelligent Robots and Systems (IROS)*, October 2023. (Poster)

5. "Underactuated gaits in a fish-like robot with a bistable tail," *Clemson Graduate Research Seminar Series (GSR)*, September 2023.

Industrial Experience

Primetals Technologies India Pvt. Ltd. Navi Mumbai, India
Manufacturing Engineer **July 2017 - Jun 2019**

- Supported manufacturing projects with production planning, assembly, and quality control.
- Provided technical support via 3D models using Siemens NX to operators for machining processes.
- Prepared operation process sheets for vendors as well as for products machined in-house.
- Coordinated with the design team to improve product design and manufacturability.

Other Project Experience

Senior Design Project Navi Mumbai, India
Active Suspension System Test Stand

- Worked with a team of three other senior engineering students to develop a test stand for a quarter car air active suspension system (with sprung and unsprung masses) that actively responds to road disturbances generated by a pneumatic piston that can be programmed to simulate different road profiles.
- Designed the rig in CAD, integrated proximity sensors, simulated the pneumatic subsystem for different road profiles, and modeled the system dynamics in Simulink.

Robotics Competitions Navi Mumbai, India

- Worked with the mechanical team at Agnel's Robotics Club to design a badminton-playing robot for ABU Robocon (Asia–Pacific) 2015, "Robominton."
- Worked with two fellow junior engineering students to design a pick-and-place robot to compete in "Technocrane 2014" at IIT Bombay's annual Techfest.

Honors & Awards

- Awarded Clemson University Doctoral Dissertation Completion Grant (Spring 2025).
- Awarded 1st Prize for Senior Design Project from the Department of Mechanical Engineering at Fr. Conceicao Rodrigues Institute of Technology, Navi Mumbai.

Technical Skills

Programming Languages:	MATLAB, Python
Software:	Maple, TensorFlow, PyTorch, SolidWorks, Siemens NX, ROS
Certifications:	Lean Six Sigma Green Belt, Siemens Certified Mechatronics Systems Assistant

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