Alan Nguyen Pham

Soft Robotics R&D | Morphing Surfaces | Computational Design
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Mechanical engineering Ph.D. candidate developing soft robotic morphing surfaces that transform flat sheets into 3D forms with overhangs and wave-like profiles. Work combines computational design, compliant mechanisms, pneumatic actuation, modular surface architectures, and physical prototyping to turn target shapes into buildable hardware.

Research Focus

Soft robotic morphing surfaces; overhang formation; wave-like geometry; computational design; compliant mechanism design; pneumatic actuation and routing; modular surface architectures; snap-fit pneumatic-mechanical connections; simulation-guided prototyping; physical hardware iteration.

Education

Doctor of Philosophy, Mechanical Engineering — **Expected 2027**
Worcester Polytechnic Institute, Worcester, MA — Advisors: Dr. Pratap Rao and Dr. Cagdas Onal

Master of Science, Mechanical Engineering — **2022**
California State University, Long Beach, Long Beach, CA — Advisor: Dr. Allen Teagle-Hernandez

Bachelor of Science, Mechanical Engineering — **2019**
California State University, Maritime Academy, Vallejo, CA — Advisor: Dr. Tomas Oppenheim

Awards

NSF NRT Future of Robots in the Workplace – Research and Development (FORW-RD) Fellowship — 2024
WPI Intercollegiate Soft Robotics Competition – 1st Place — 2024

Research Experience

Worcester Polytechnic Institute, Worcester, MA — **Aug 2023 – Present**
Graduate Researcher – NanoEnergy Lab and Soft Robotics Lab — *Advisors: Dr. Pratap Rao and Dr. Cagdas Onal*

- Developing soft robotic morphing surfaces that turn flat cell arrays into overhangs, waves, domes, and moving 3D contours by tuning cell geometry, displacement, and connector layout.
- Built monolithically printed Sarrus/PneuNet-inspired cells with cross-cell air channels, bending bias, snap-fit connectors, and planar-to-cylinder assembly paths.
- Demonstrated single/double domes, object transport/capture, peristaltic crawling, and self-rolling locomotion from the same cell architecture.
- Created Wavevis, a computational design tool that maps target overhang/wave shapes to double-layer Sarrus lattice topology, cell displacements, connector geometry, and prototype dimensions.
- Developing FluxCell around one shared air inlet, self-sealing snap-fit pneumatic connections, and magnet/EPM valves that route manifold pressure into printed PneuNets.

NASA L' SPACE (NPWEE), Tempe, AZ — **Aug 2025 – Present**
Soft Robotics Graduate Researcher – Project SELENE

- Contributed to Project SELENE, a NASA NPWEE effort developing soft robotic arms for lunar terrain traversal and regolith sample collection.
- Developed a SpiRobs-inspired modular arm with logarithmic-spiral segments, triple-cable actuation, and an elastic braided-steel backbone for curling and grasping motions.
- Iterated CAD from two-cable unit concepts to a three-cable spiral architecture, sizing cable/core passages, support strategy, and motor-spool packaging around printable segments.
- Prototyped 25% and full-scale PLA/PETG arm segments, fit-tested actuation cables and elastic cores, and adjusted hole sizes, tolerances, and support placement for assembly.
- Produced a full-scale ten-segment PETG arm with inserted cables; evaluated hand actuation, cable rigidity, spool fit, and motorized-test constraints while coordinating with teammates and NASA subject matter experts.

Sandia National Laboratories, Albuquerque, NM **June 2025 – Aug 2025**
Graduate Research Intern – Nonlinear Mechanics and Dynamics (NOMAD) Research Institute

- Co-developed NOMAD finite-element sweeps for an electromechanical ratcheting mechanism with intermittent contact, friction, springs, and pawl-gear interactions.
- Built comparable analytical, MATLAB multibody, and finite-element submodels for pin-spring-pawl, pin-pawl, and pawl-gear interactions under haversine shock and sinusoidal vibration.
- Ran structured sweeps across momentum-balance iterations (1–100), mesh density, and processor count (50–250%) to separate physical mechanism response from solver and modeling sensitivity.
- Identified sensitivity regimes in which pin-spring-pawl models converged while pin-pawl and pawl-gear cases showed contact/friction divergence, mesh-related lock-up, and environment-dependent sensitivity.
- Presented final results showing submodel-scale simulation sensitivity, informing mesh, contact/friction, iteration, and compute-resource choices before full assembly-level ratcheting models.

Worcester Polytechnic Institute, Worcester, MA **Aug 2023 – Present**
NSF NRT FORW-RD Fellow and Trainee

- Selected as an NSF NRT FORW-RD trainee in an interdisciplinary program on robotic interfaces and assistants for future workplaces spanning robotics, mechanical engineering, computer science, materials, business, humanities, and social sciences.
- Connected doctoral research to virtual training, soft robotic teleoperation, compliant interaction, and robotic systems for high-skill physical tasks.
- Wrote broader-impact material for robotics and AI systems that operate near people, emphasizing workplace adoption, trust, training, and responsible deployment.
- Secured a $1,000 grant supporting equipment, travel, and professional-development costs.

Worcester Polytechnic Institute, Worcester, MA **Aug 2023 – Dec 2023**
Research Assistant – Cognitive Medical Technology Laboratory

- Fabricated and assembled low-cost open-source actuation hardware for concentric tube continuum robots, a miniaturized robot class for precise navigation in constrained spaces and minimally invasive surgery.
- Contributed to accessible CTR hardware with easy-to-source components, bills of materials, assembly instructions, and guided learning materials for early graduate students.
- Integrated actuation hardware, MATLAB forward kinematics, and optical-tracking experiments to validate end-effector displacement.
- Coordinated sourcing, fabrication, and assembly across WPI's Cognitive Medical Technology Lab, PracticePoint, and Innovation Studio for two complete CTR systems.

California State University, Long Beach, Long Beach, CA **Sept 2022 – Aug 2023**
Research Assistant – Multiscale Mechanics of Materials Group *Advisor: Dr. Mortaza Saeidi-Javash*

- Built a literature foundation for a flexible-electronics research program covering printed and conformal sensors, 2D nanomaterial inks, and wearable human-machine-interface devices.
- Synthesized fabrication approaches across inkjet, screen, aerosol-jet, extrusion, and direct-ink-write printing using graphene, MXene, MoS2, thermoelectric, and piezoelectric material systems.
- Evaluated sensitivity, selectivity, response time, mechanical compliance, and durability of flexible physical, chemical, and biosensors for soft robotics, structural health monitoring, and wearable systems.
- Collaborated with graduate researchers on a direct-ink-write temperature sensor printed on a flexible PET substrate.

California State University, Long Beach, Long Beach, CA **April 2021 – July 2022**
Graduate Researcher – Violin Acoustics and Structural Dynamics *Advisor: Dr. Allen Teagle-Hernandez*

- Completed a master's thesis translating perceived violin quality into measurable vibroacoustic features, linking structural design, harmonic balance, frequency response, and performer/listener perception.
- Designed a controlled comparison of high- and low-cost modern violins, standardizing strings and fittings while documenting top plate, bridge, f-hole, bass bar, sound post, and tailpiece variables.
- Built a LabVIEW/NI data-acquisition workflow with PCB accelerometers, an array microphone, and an impulse modal hammer; collected 67-point top-plate maps and anechoic-chamber acoustic measurements.
- Linked FFT-derived violin response features to modal balance and perceived tone.

California State University, Maritime Academy, Vallejo, CA **Sept 2018 – May 2019**
Undergraduate Researcher – Cross-Flow Tidal Turbine *Advisor: Dr. Tomas Oppenheim*

- Conceptualized a Darrieus cross-flow tidal turbine, defined rotor geometry and build constraints, and selected 3D-printed blades with fiberglass coating as the manufacturing approach.
- Verified performance through water-tunnel power assessment and ANSYS structural analysis, evaluating blade and hub stresses under hydrodynamic loading and documenting operation around 25 rpm.
- Fabricated a full-scale prototype using additive manufacturing and sheet-metal forming informed by scaled water-tunnel experiments.

Publications and Research Outputs

- Pham, A. N., Rao, P., & Onal, C. D. (2026). *A monolithic cellular architecture for topology-programmable soft robotics*. Manuscript in preparation.
- Pham, A. N., Rao, P., & Onal, C. D. (2025). *Development of a Morphing Soft Robotic Structure Based on Tiled Sarrus Linkages*. Poster presentation, WPI Graduate Research Innovation Exchange (GRIE) and 3-Minute Thesis (3MT), Worcester Polytechnic Institute, Worcester, MA.
- Winston, S., Pham, A., Bahr, B., Singh, A., Schumann, C., Flicek, R., Grutzik, S., Kuether, R. J., & Vemaganti, K. (2025). *Quantifying the Effect of Non-Physical Parameters on the Nonlinear Dynamics of an Electromechanical Ratcheting Mechanism*. Accepted to IMAC, A Conference and Exposition on Structural Dynamics.
- Bonofiglio, K. (2023). *Making Concentric Tube Robots More Accessible: An Open-Source Platform with Easy-to-Source Components and Guided Learning Materials* [Master's thesis, Worcester Polytechnic Institute]. Research contributor to open-source CTR hardware assembly and validation support.
- Pham, A., & Teagle Hernandez, A. (2022). *Structural Properties and Perceived Acoustic Quality of Modern Violins* (Publication No. 29065875) [Master's thesis, California State University, Long Beach]. ProQuest Dissertations and Theses Global.

Professional Experience

Worcester Polytechnic Institute, Worcester, MA **Aug 2023 – Present**
Teaching Assistant

- Developed learning activities for Stress Analysis, Statics, and Computer Aided Design with professors and teaching teams.
- Led weekly conference sessions and office hours for 90+ student groups, translating difficult engineering material into interactive problem-solving sessions.
- Designed hands-on learning sessions and guided students in connecting classroom mechanics concepts to physical models and engineering judgment.

NLS Lighting, Carson, CA **April 2022 – July 2023**
Mechanical Engineer

- Led design-to-release luminaire product improvements across thermal testing, IP testing, FEA static simulation, fabrication, assembly, and installation support.
- Produced complete product design packages, including 2D drawings, bills of materials, engineering change orders, installation instructions, and application documentation.
- Collaborated with Washington, DC stakeholders to develop a retrofit kit for upgrading more than 75,000 street and alley lights to energy-efficient LEDs as part of a multi-million-dollar Smart Street Lighting project.

Hubbell, City of Industry, CA **May 2021 – Aug 2021**
Mechanical Engineer Intern

- Managed fixture assembly and DLC V5.1 certification planning, reducing test cost and labor while accounting for SKU quantities and sales volume.
- Performed impact testing and FEA validation on luminaire assemblies, checking bracket, lens, and LED-PCB designs in Solid Edge.
- Supported launch of the Prevent vandal-resistant luminaire series through baseline testing, part sourcing, and assembly coordination with new product design teams.

Academy Inc., Montebello, CA **July 2019 – Aug 2020**
Mechanical Design Engineer

- Implemented parametric product and pricing configurations, reducing design and quoting time.
- Engineered shade sails, awnings, and tensioned fabric structures for manufacturability and field installation.
- Managed projects from site measurements and material specifications through coordination and scope execution.

American Metal Bearing Company, Garden Grove, CA **May 2019 – June 2019**
Mechanical Engineer Intern

- Optimized thrust, line-shaft, stern-tube, and strut bearing components using SolidWorks/Abaqus FEA, reducing material and labor cost.
- Coordinated manufacturing flow for line-shaft spherical bearings from rough casting through inspection, finishing, packaging, and shipment.
- Revised bearing-component drawings under Engineering Change Requests while maintaining GD&T standards.

Technical Skills

Mechanical design	SolidWorks, Onshape, PTC Creo, FEA review, GD&T-aware drawings, BOMs, ECOs, DFM, assembly planning, fixture design, prototype iteration.
Soft robotics	Pneumatic actuation, compliant mechanisms, continuum robots, modular soft robots, morphing surfaces, airflow routing, pneumatic surface prototypes, simulation-guided robotic prototyping.
Software	CUBIT, Sierra/SolidMechanics, ParaView, MATLAB, Simulink Simscape Multibody, Abaqus, Ansys FEA, Python, C/C++, ROS2, LabVIEW, Minitab, MS Office; AI-assisted design and web-tool prototyping.
Experiments	Modal testing, vibroacoustic measurement, FFT-based signal analysis, anechoic-chamber testing, optical tracking, pressure/force/displacement characterization, connector/airflow checks, design of experiments.
Hardware	3D printing, TPU/PETG/PLA prototyping, laser cutting, soldering, Arduino, Raspberry Pi, National Instruments DAQ, strain gages, thermocouples, pressure sensors, force testing (Mecmesin), hand tools.

Relevant Coursework

Soft Robotics; Advanced Dynamics; Ethics and Communication in Robotics and AI Research; Foundations in Robotics; Advanced Mechanics of Deformable Bodies; Mechatronic System Design; Design of Experiments; Engineering Vibrations; Automatic Feedback Control; Instrumentation and Measurement Systems.

Campus and Community Involvement

Member, American Society of Mechanical Engineers	March 2015 – Present
WPI Video Game Orchestra	Nov 2024 – Present
WPI Tennis Club	Aug 2024 – Present
WPI Philharmonic Orchestra, 1st Violinist	Nov 2023 – Present
CSULB Long Beach Lunabotics, Mechanical Engineer	Sept 2020 – May 2022
CSULB Beach Launch Team, Avionics Engineer	Sept 2020 – May 2022
CSULB Bob Cole Symphony Orchestra, 2nd Violinist	Sept 2019 – March 2020
Rebuilding Together Solano County, Volunteer	Aug 2015 – Aug 2016