

Juan Camilo Osorio

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My research explores how mechanics can endow physical systems with intelligence. I design nonlinear structures whose morphology can sense, store memory, compute, and control behavior through multistability, structural instabilities, and path-dependent mechanics. By integrating mechanics-based modeling, computational design, and experiments, I create adaptive structures and robots that embed sensing, computation, memory, and control within their physical architecture.

ACADEMIC APPOINTMENTS

Postdoctoral Research Associate 08/2025–Present

Department of Mechanical Engineering, Purdue University

Developing mechanics-based models and design strategies for morphing structures that encode adaptive responses, embodied control, and mechanical intelligence through structural nonlinearities, multistability, and geometry-programmed behavior.

EDUCATION

Doctor of Philosophy (Ph.D.) in Mechanical Engineering 2017–2025

Purdue University, West Lafayette, IN

Master of Science (M.Sc.) in Mechanical Engineering 2017–2019

Universidad de los Andes, Bogotá, Colombia

Bachelor of Science (B.Sc.) in Mechanical Engineering 2013–2016

Universidad de los Andes, Bogotá, Colombia

RESEARCH EXPERIENCE

Graduate Research Assistant 08/2020–08/2025

Department of Mechanical Engineering, Purdue University

Designed, modeled, and experimentally validated multistable soft robotic structures that embody control, mechanical logic, and programmable functionality through geometry, instability, and path-dependent mechanics. Developed FE-informed reduced-order models for inverse co-design of robot morphology, stiffness, stable-state position, and dynamic response. Demonstrated open-loop grasping, size/weight object classification, pick-and-place behavior, and locomotion using minimal sensing and single-input pneumatic actuation.

Visiting Research Scholar 01/2020–06/2020

Purdue University, Herrick Laboratories

Contributed to an Anheuser-Busch InBev partner project on bistable elements produced by the plastic deformation of metals; performed design and numerical analysis for smart packaging applications.

Researcher 12/2019–11/2020

Universidad de los Andes

Conducted failure analysis of munition systems under prestress and aerodynamic loads, including computational failure prediction under mechanically demanding conditions.

Graduate Research Assistant 06/2017–08/2019

Universidad de los Andes

Performed finite element simulations and optimization of machining processes as part of a Colciencias-funded project on ultra-fine grain size design, connecting process parameters, microstructure evolution, and constitutive response.

PUBLICATIONS

Peer-Reviewed Journal Publications (* Indicates Equal Authorship):

- **Osorio, J. C.**, Rincon, J. S., Morgan, H., & Arrieta, A. F. (2025). *Embodying Control in Soft Multistable Robots from Morphofunctional Co-design*. Advanced Science. doi:10.1002/advs.202503206.
- Riley, K. S.*, Koner, S.*, **Osorio, J. C.***, Yu, Y., Morgan, H., Udani, J. P., Sarles, S. A., & Arrieta, A. F. (2022). *Neuromorphic Metamaterials for Mechanosensing and Perceptual Associative Learning*. Advanced Intelligent Systems. doi:10.1002/aisy.202200158.
- Boddapati, K., **Osorio, J. C.**, & Arrieta, A. F. (2024). *On maintaining bistability of prestressed laminates after clamping*. Composite Structures. doi:10.1016/j.compstruct.2024.118278.
- **Osorio-Pinzon, J. C.**, Abolghasem, S., Marañón, A., et al. (2020). *Cutting parameter optimization of Al-6063-O using numerical simulations and particle swarm optimization*. International Journal of Advanced Manufacturing Technology, 111, 2507–2532. doi:10.1007/s00170-020-06200-1.
- Abedrabbo, A. F., **Osorio, J. C.**, Abolghasem, S., Valencia, C., & Rojas, F. (2022). *Predicting sub-grain size and dislocation density in machining-induced surface microstructure of nickel using supervised model-based learning*. Materials Today Communications, 30, 103162. doi:10.1016/j.mtcomm.2022.103162.
- Montenegro, C., Abolghasem, S., **Osorio-Pinzon, J. C.**, et al. (2020). *Microstructure prediction in low and high strain deformation of Al6063 using artificial neural network and finite element simulation*. International Journal of Advanced Manufacturing Technology, 106. doi:10.1007/s00170-019-04704-z.
- **Osorio-Pinzon, J. C.**, Abolghasem, S., & Casas-Rodriguez, J. P. (2019). *Predicting the Johnson-Cook constitutive model constants using temperature rise distribution in plane strain machining*. International Journal of Advanced Manufacturing Technology, 105. doi:10.1007/s00170-019-04225-9.

Manuscripts in Preparation / Under Review :

- **Osorio, J. C.**, & Arrieta, A. F. (2026). *Modeling and Design of Non-Abelian Multistable Soft Metas-structures*.
- Rincon, J. S., **Osorio, J. C.**, & Arrieta, A. F. (2026). *Curvature Adaptable Robotic End Effector*.
- **Osorio, J. C.**, Rincon, J. S., & Arrieta, A. F. (2026). *Embodied Hybrid Automata for Control in Soft Machines*.

Conference Papers:

- Kosterit, G., **Osorio, J. C.**, Boston, D. M., Grasinger, M., Buskohl, P., Hertlein, N., & Arrieta, A. F. (2026). *Surface Morphing from Pneumatically Actuated Metastrips*. AIAA SCITECH 2026 Forum, Orlando, Florida. doi:10.2514/6.2026-0903.
- **Osorio, J. C.**, Tinsley, C., Tinsley, K., & Arrieta, A. F. (2023). *Manta Ray inspired multistable soft robot*. 2023 IEEE International Conference on Soft Robotics (RoboSoft), Singapore, pp. 1–6. doi:10.1109/RoboSoft55895.2023.10122038.

- Morgan, H., **Osorio, J. C.**, & Arrieta, A. F. (2023). *Towards open loop control of soft multistable grippers from energy-based modeling*. 2023 IEEE International Conference on Soft Robotics (RoboSoft), Singapore, pp. 1–6. doi:10.1109/RoboSoft55895.2023.10121986.
- Boddapati, K., **Osorio, J. C.**, & Arrieta, A. F. (2024). *On the Loss of Stability of Bistable Laminates due to Clamping*. AIAA SCITECH 2024 Forum, Orlando, FL, January 7–12, 2024. doi:10.2514/6.2024-1333.
- **Osorio, J. C.**, Morgan, H., & Arrieta, A. F. (2022). *Programmable Multistable Soft Grippers*. 2022 IEEE 5th International Conference on Soft Robotics (RoboSoft), Edinburgh, United Kingdom, pp. 525–530. doi:10.1109/RoboSoft54090.2022.9762120.
- **Osorio, J. C.**, Abolghasem, S., & Casas-Rodriguez, J. P. (2018). *Determination of Microstructure-Based Constitutive Models Using Temperature Rise Distribution in Plane Strain Machining. Characterization of Minerals, Metals, and Materials 2018*, pp. 227–237. Springer, Cham. doi:10.1007/978-3-319-72484-3_25.

PATENTS

11/2025	<i>Conformable vacuum gripper with series-triggered pneumatic actuators</i> . (Application)
11/2025	<i>Conformable vacuum gripper with parallel-triggered pneumatic actuator array</i> . (Application)
04/2025	<i>Interactive surface reconfiguration device and methods of using same</i> . PRF Ref.: 70976-01. (Provisional)

HONORS

09/2025	SMASIS Conference Best Student Hardware Competition, 1st Place, <i>Curvature Adaptable Robotic End-Effector</i> .
07/2025	Trailblazers in Engineering Fellow.
03/2025	APS DSOFTEMERGING Soft Matter Excellence Award Finalist.
01/2025	Complex Active and Adaptive Material Systems Gordon Research Conference Best Poster Award, <i>Finite-state mechanologic from geometrical frustration in soft machines</i> .
09/2024	SMASIS Conference Best Student Hardware Competition, 3rd Place, <i>Multistable Morphing Surface for Interactive Reconfiguration</i> .
05/2024	Future Leaders in Aerospace Symposium 2024.
01/2024	AIAA American Society for Composites Student Paper Award, <i>On the loss of stability of bistable laminates due to clamping</i> .
01/2024	Bilsland Dissertation Fellowship, Purdue University, 2024–2025.
09/2023	SMASIS Division Level Best Paper Award in Mechanics and Material Systems, <i>Neuromorphic Metamaterials for Mechanosensing and Perceptual Associative Learning</i> .
09/2023	SMASIS Division Best Paper in Bioinspired Materials and Structures, <i>Neuromorphic Metamaterials for Mechanosensing and Perceptual Associative Learning</i> .
03/2022	APS March Meeting DSOFTEMERGING Division Best Poster Award, <i>Exploiting Geometrical Frustration in Multistable Soft Robots Part 2: Finite-State Mechanologic</i> .

TEACHING

Instructor of Record

Basic Mechanics I, Department of Mechanical Engineering, Purdue University

08/2026–Present

Introduction to engineering mechanics, with an emphasis on statics, including force systems, equilibrium, and structural analysis.≈100 students

Instructor of Record

08/2025–12/2025

Basic Mechanics I, Department of Mechanical Engineering, Purdue University

Introduction to engineering mechanics, with an emphasis on statics, including force systems, equilibrium, and structural analysis;≈100 students

Graduate Teaching Assistant

05/2025

Bioinspired Materials and Structures, Study Abroad Program, Department of Mechanical Engineering, Purdue University

Graduate Teaching Assistant

08/2018–06/2019

Manufacturing Processes and Systems, Universidad de los Andes

I taught manufacturing processes and CAD tools to engineering students.

Graduate Teaching Assistant

01/2017–06/2017

Basic Mechanics of Materials, Universidad de los Andes

Taught stress analysis and basic design concepts to sophomore mechanical engineering students.

RESEARCH MENTORING

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| 2026 | Mentor, Summer Undergraduate Research Fellowship (SURF), Purdue University. Camila Uribe, <i>Fluid-Powered Autonomy: Embedded Fluidic Oscillators for Pneumatic and Hydraulic Soft Robots</i> . |
| 2026 | Mentor, Summer Undergraduate Research Fellowship (SURF), Purdue University. Juan Pablo Monge, <i>Pressure-Triggered Contact Sensing for Fully Mechanical Soft Robotic Response</i> . |
| 2024 | Mentor, Summer Undergraduate Research Fellowship (SURF), Purdue University. Paul Loughlin, <i>Flexible Mechanical Sensors</i> . |
| 2023 | Mentor, Master of Science research project, Purdue University. Harith Morgan, <i>Towards open loop control of soft multistable grippers from energy-based modeling</i> . |
| 2022 | Mentor, undergraduate research project, Purdue University. Chelsea Tinsley and Kendal Tinsley, <i>Manta Ray inspired multistable soft robot</i> . |
| 2019 | Mentor, undergraduate degree project, Universidad de los Andes. Carlos Andres Montenegro, <i>Finite element modeling of microstructural changes in Al6063-O based on BP neural network</i> . |

PROFESSIONAL SERVICE

2026	Reviewer: Nature Communications.
2026	Reviewer: International Journal of Solids and Structures.
2025	Reviewer: Advanced Materials Technologies.
2024–2025	Treasurer, Official Mechanical Engineering Graduate Association at Purdue (OMEGA).

SELECTED CONFERENCE PRESENTATIONS

- Multifunctional Materials and Structures Gordon Research Seminar (01/2026): *Embodied Hybrid Automata for Control in Soft Machines.*
- SES Annual Technical Meeting (10/2025): *Finite-State Mechanologic for Embodied Control in Soft Machines.*
- IEEE International Conference on Soft Robotics (RoboSoft) (04/2025): *Embodying Control in Soft Multistable Robots from Morphofunctional Co-design.*
- American Physical Society March Meeting (03/2025): *Modeling and Design of Non-Abelian Multistable Soft Metastructures.*
- Future Leaders in Aerospace Symposium (05/2024): *Embodying Mechanical Intelligence from Mechanical Instabilities.*
- SIAM 2024 (05/2024): *Programmable Metastructures from Combinatorial Stable States.*
- SES Annual Technical Meeting (10/2023): *Multistable Soft Gripper with Embedded Mechanical Logic.*
- American Physical Society March Meeting (03/2023): *Reduced-Order Modeling of Soft Hierarchical Multistable Metasheets with Applications.*
- SES Annual Technical Meeting (10/2022): *Computing with Multistable Metastructures.*
- American Physical Society March Meeting (03/2022): *The Role of Symmetry and Patterning in Hierarchical Multistable Metasheets.*

SELECTED POSTER PRESENTATIONS

- Multifunctional Materials and Structures Gordon Research Conference (01/2026): *Embodied Hybrid Automata for Control in Soft Machines.*
- SES Annual Technical Meeting, Future Faculty Symposium (10/2025): *Modelling and Design of Multistable Soft Metastructures.*
- Complex Active and Adaptive Material Systems Gordon Research Conference (01/2025): *Finite-State Mechanologic from Geometrical Frustration in Soft Machines.*
- Complex Active and Adaptive Material Systems Gordon Research Conference (01/2025): *Embodying Control in Soft Multistable Grippers from Morphofunctional Co-design.*
- Multifunctional Materials and Structures Gordon Research Conference (01/2024): *Computation from Geometrical Frustration: Metamaterials for Tactile Sensing and Object Classification.*
- Multifunctional Materials and Structures Gordon Research Conference (07/2022): *Programmable Multistable Soft Grippers with Embedded Logic.*
- American Physical Society March Meeting (03/2022): *Exploiting Geometrical Frustration in Multistable Soft Robots Part 2: Finite-State Mechanologic.*