STEVEN R. WOODRUFF, PH.D.

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EDUCATION

Ph.D., Civil Engineering, the University of Michigan **2022**
Graduate certificate in Science, Technology, and Public Policy

M.S., Civil Engineering, the University of Michigan **2019**

B.S., Civil Engineering, Tufts University **2017**
Study abroad, the University of Hong Kong

PROFESSIONAL APPOINTMENTS

Assistant professor **Aug. 2023 – Present**
James Madison University – Department of Engineering

Visiting assistant professor **Jul. 2022 – Jun. 2023**
Washington and Lee University – Department of Physics and Engineering

Graduate student research assistant **Jun. 2017 – Jun. 2022**
The University of Michigan – Department of Civil and Environmental Engineering

Adjunct faculty **Jan. 2022 – May 2022**
James Madison University – Department of Engineering

Graduate student instructor **Jan. 2021 – May 2021**
The University of Michigan – Department of Civil and Environmental Engineering

SELECTED AWARDS AND HONORS

Graduate research fellowship program (GRFP) fellow **2018 – 2022**
National Science Foundation (NSF)

Honored Instructor Award **2021**
The University of Michigan

AISC/GLFEA scholarship **2017**
American Institute of Steel Construction and Great Lakes Fabricators and Erectors Association

SEAMASS scholarship **2017**
Structural Engineering Association of Massachusetts

Max O. Urbahn scholarship **2016**
Society of American Military Engineers, New York City Post

INSTRUCTIONAL EXPERIENCE

Instructor of record, James Madison University (2023 – Present)

Taught core engineering courses spanning design, mechanics, and fluids. Across courses, emphasized hands-on laboratory experiences, project-based learning, and data-driven analysis.

ENGR 112: Engineering Skills and Decisions

Flipped-course model integrating CAD (SolidWorks), Arduino-based sensing, and Excel computation. Led a multi-instructor team and developed multiple new term projects.

ENGR 112: Engineering Decisions

Introduced students to foundational skills in engineering, including CAD (SolidWorks), Arduino-based sensing, and MATLAB scripting.

ENGR 212: Statics and Introductory Solid Mechanics

Introduced students to rigid-body statics and strength of materials. Integrated hands-on lab activities and reinforced conceptual understanding through structured problem-solving and interteaching methods.

ENGR 212: Statics and Dynamics

Introduced students to rigid-body statics and dynamics. Integrated weekly hands-on lab activities and reinforced conceptual understanding through structured problem-solving.

ENGR 314: Materials and Mechanics

Taught introductory materials science and mechanics, incorporating laboratory testing and application-centered instruction.

ENGR 311: Fluid Mechanics

Delivered an applications-focused introduction to fluid mechanics with supporting laboratory experiments.

Instructor of record, Washington and Lee University (2022 – 2023)

Designed and taught a broad range of engineering courses with emphasis on design processes, community-engaged learning, and mathematically grounded problem-solving.

ENGN 250: Introduction to Engineering Design

Project-focused course emphasizing human-centered design. Advised teams on origami-inspired acoustic panel projects.

ENGN 378 & 379: Capstone Design (Fall/Winter)

Advised student teams completing community-facing engineering projects. Guided project management, prototyping, technical communication, and client interactions.

ENGN/PHYS 225: Mathematical Methods for Physics and Engineering

Flipped-classroom format with project-based assignments using Python for numerical, symbolic, and graphical verification.

ENGN 178: Introduction to Engineering

Introduced engineering fundamentals, ethics, policy, and computational tools (MATLAB, Inventor) using a flipped-classroom model. Designed individual and team term projects and supervised a teaching assistant.

Graduate student instructor, University of Michigan (Winter 2021)

CEE 303: Computational Methods

Designed and graded weekly labs, created instructional videos and Jupyter notebooks, held office hours, and supported numerical-methods instruction in civil and environmental engineering. Recipient of U-M's Honored Instructor Award.

RESEARCH MENTORING EXPERIENCE

Lydia Pelham (undergraduate) **Dec. 2023 – May 2025**
Acoustic control using adaptive, curved-crease origami metamaterials

Nelson Jenkins (undergraduate) **Dec. 2023 – May 2025**
Acoustic control using adaptive, curved-crease origami metamaterials

Valentina Paz-Soldan (undergraduate) **Dec. 2023 – Dec. 2024**
Acoustic control using adaptive, curved-crease origami metamaterials

Hardik Patil (graduate) **Jan. 2021 – Aug. 2022**
Deployable, rapid-assembly ship hulls using curved-crease origami

Jack Riley (undergraduate) **Jan. 2019 – Aug. 2019**
Redistributing corrugation stiffness using curved creases

Bolivar Perez (undergraduate) **Jun. 2018 – Aug. 2018**
Large-scale origami prototype

Ella Yazbeck (undergraduate) **Jun. 2017 – Apr. 2018**
Curved-crease origami arches

RESEARCH EXPERIENCE

Research interests:
- Improving student outcomes through interteaching in an engineering education context
- Simple and rapid modeling of dynamic and adaptive structures
- Exploration of novel and interdisciplinary applications of curved-crease origami
- Computational modeling of highly nonlinear solids and structures

Interteaching in engineering **Jan. 2025 – Present**
Assistant professor
PI: Steven Woodruff *Collaborators:* Ben Blankenship (James Madison University)

- Measured the effect of interteaching on the learning outcomes of students in three sections of ENGR 212: Statics and Introductory Mechanics.

Acoustic control using adaptive, CCO metamaterials **May 2023 – May 2025**
Visiting assistant professor, assistant professor
PI: Steven Woodruff

- Constructed, validated, and implemented a 2D acoustic waveguide to test origami samples
- Implemented acoustic simulations in ANSYS

Complex shape morphing in origami with simple actuation **Sep. 2020 – Nov. 2025**
Graduate research assistant, NSF GRFP fellow, visiting assistant professor
PI: Evgueni Filipov (University of Michigan)

- Identified a unique property of curved-crease origami where local, simple actuations can result in global, complex deformations for use in dynamic deployment or shape morphing.
- Improved the bar and hinge model to accommodate local actuations with greater ability to measure torsional and bending deformations.

Deployable, rapid-assembly ship hulls using CCO **Jan. 2021 – Aug. 2022**
Graduate research assistant and NSF GRFP fellow
PI: Evgueni Filipov *Collaborators:* Zhongyuan Wo and Hardik Patil (University of Michigan)

- Collaborated with a team of origami engineers and the Office of Naval Research to design ship hulls that could be assembled on-site from flat sheets.
- Provided expertise on rapid modeling of curved-crease origami using the bar and hinge model for use alongside fluid-structure analysis in Ansys.

Bar and hinge modeling of curved-crease origami **Jun. 2018 – Aug. 2020**
Graduate research assistant and NSF GRFP fellow
PI: Evgueni Filipov

- Developed a rapid and accurate method of modeling the deformations of thin sheets folded about curved creases for both folding and post-fold loading.
- Calibrated the model stiffness to match theoretical and experimental solutions.
- Explored the stiffness response of curved-crease origami under highly nonlinear, post-fold loading to understand how folding increases global stiffness.

Redistributing corrugation stiffness using curved creases **Jan. 2019 – Jun. 2020**
Graduate research assistant and NSF GRFP fellow
PI: Evgueni Filipov *Collaborator:* Jack Riley (University of Michigan)

- Introduced novel, curved-crease origami designs that give isotropic bending stiffness in corrugated sheets without additional stiffeners or supports.
- Developed two second-moment-of-area-based methods for predicting the bending stiffness anisotropy using deformed shapes from the bar and hinge model.
- Performed load-deflection experiments on polyester sheet prototypes to assess stiffness anisotropy in bending to confirm the prediction methods.

Finite element analysis of curved-crease origami **Jun. 2017 – Apr. 2018**
Graduate research assistant
PI: Evgueni Filipov

- Developed a method for modeling curved-crease origami folding and post-fold loading in Abaqus using shell elements for sheets and a connector scheme to model creases.
- Performed strain energy analysis to compare theoretical, geometry-based predictions for curved-crease origami deformations.
- Identified limitations to existing kinematic theories and unique behaviors of curved-crease origami after folding.

GRANT PROPOSAL WRITING EXPERIENCE

1. **JMU Madison Trust.** "Material-efficient slab systems enabled by curved-crease folding." $22,992. Aug. 2026 - Jul. 2027.

2. **Virginia Space Consortium Grant.** "NASA Student Launch Initiative Capstone Project." $3,000 (**funded**). Dec. 2025 - Feb. 2026.
3. **JMU CISE Faculty Development Grant.** "Folding for strength: Origami-inspired slabs for sustainable concrete construction." $1,600. Jan. 2026 - May 2026.
4. **JMU CISE Mini-grant.** "Arduino sensors for ENGR 112 term project." $750 (**funded**). May 2025. PI: Steven Woodruff.
5. **JMU CISE Faculty Development Grant.** "Development of an origami-inspired metamaterial for active acoustic control." $2,650 (**funded**). Jan. 2025 - May 2025. PI: Steven Woodruff.
6. **JMU CISE Mini-grant.** "Arduino sensors for ENGR 112 term project." $734 (**funded**). Apr. 2024. PI: Steven Woodruff, Shraddha Joshi, Kyle Gipson.
7. **JMU CISE Faculty Development Grant.** "Development of an origami-inspired metamaterial for active acoustic control." $3,200 (**funded**). Jan. 2024 - May 2024. PI: Steven Woodruff.
8. **Washington and Lee University Lenfest Grant.** "Characterization of curved folding using digital image correlation." $6,500 (**funded**), May 2023 - Jul. 2023. PI: Steven Woodruff.
9. **Washington and Lee University Spring Term Course Enhancement Funding.** "Origami-inspired, acoustic panel design course." $2,027 (**funded**), May 2023. PI: Steven Woodruff.
10. **Washington and Lee University Dean's Office.** "Prototyping materials for capstone projects." $750 (**funded**), Jan. 2023 - Apr. 2023. PI: Steven Woodruff.
11. **Washington and Lee University Dean's Office.** "Arduino board and environmental sensor kits for hands-on education." $750 (**funded**), Sep. 2022 - Dec. 2022. PI: Steven Woodruff.
12. **Office of Naval Research.** "Rapid assembly of continuous surfaces by adhesion of curved-crease origami." $120,000 (**funded**), Jan. 2021 - Dec. 2021. PI: Evgueni Filipov.
13. **National Science Foundation.** "A multi-physical framework for curved-crease deployable structures," $138,000 (**funded**), May 2018 - May 2023. PI: Evgueni Filipov.
14. **Office of Naval Research.** "Curved folded sheets for stiff, anisotropic, and adaptable structures," $322,181 (**funded**), Jan. 2018 - Dec. 2020. PI: Evgueni Filipov.

PUBLICATIONS

Peer-reviewed journal articles

1. Woodruff, S. R. & Filipov, E. T. (2026). Tailored motion of folded ribbons: An algorithmic approach to singly curved-crease origami. *Computers & Structures, 320*, 108038. https://doi.org/10.1016/j.compstruc.2025.108038.
2. Woodruff, S. R. & Filipov, E. T. (2022). Bending and twisting with a pinch: Shape morphing of creased sheets. *Extreme Mechanics Letters, 52*, 101656. https://doi.org/10.1016/j.eml.2022.101656.
3. Woodruff, S. R. & Filipov, E. T. (2020). Bar and hinge model formulation for structural analysis of curved-crease origami. *International Journal of Solids and Structures, 204-205*, 114-127. https://doi.org/10.1016/j.ijsolstr.2020.08.010
4. Woodruff, S. R. & Filipov, E. T. (2020). Curved creases redistribute global bending stiffness in corrugations: Theory and experimentation. *Meccanica, 56*(6), 1613-1634. https://doi.org/10.1007/s11012-020-01200-7

Peer-reviewed conference proceedings

1. Woodruff, S. R. & Filipov, E. T. (2018). Structural analysis of curved folded developables. *16th Biennial International Conference on Engineering, Science, Construction, and Operations in Challenging Environments, 9780784481899*, 793-803. https://doi.org/10.1061/9780784481899.075

PRESENTATIONS

Plenary presentations

1. Woodruff, S. R. (2024, October). *Unlocking shape and stiffness: How curved creases enhance thin-sheet structures* [Conference presentation]. IX Virginia Soft Matter Workshop, Harrisonburg, VA, United States.
2. Woodruff, S. R. & Filipov, E. T. (2018, April). *Structural analysis of curved folded developables* [Conference presentation]. ASCE International Conference on Engineering, Science, Construction, and Operations in Challenging Environments, Cleveland, OH, United States. ***Student paper award finalist***.

Symposium presentations

1. Jenkins, N. W. & Paz-Soldan, V. & Pelham, L. G. & Woodruff, S. R. (2024, October). *Building a 2D waveguide to assess an active, origami-inspired acoustic metamaterial* [Conference presentation]. IX Virginia Soft Matter Workshop, Harrisonburg, VA, United States.
2. Woodruff, S. R. (2024, February). *The power of Excel in engineering* [Conference presentation]. 2024 KEEN National Conference, Austin, TX, United States.
3. Filipov, E. T., Woodruff, S. R. & Patil, H. (2022, August). *Functional shape-morphing origami* [Conference presentation]. 16^{th} International Symposium on Functionally Graded Materials, Hartford, CT, United States.
4. Woodruff, S. R. & Filipov, E. T. (2022, May). *Shape-fitting origami with curved creases and pinches* [Conference presentation]. ASCE Engineering Mechanics Institute Conference, Baltimore, MD, United States.
5. Woodruff, S. R. & Filipov, E. T. (2021, March). *Torsion and bending of curved-crease origami: Linking crease pattern geometry to beehavior* [Conference presentation]. ASCE Engineering Mechanics Institute International Conference (online).
6. Filipov, E. T. & Woodruff, S. R. (2020, October). *Curved creases enhance the bending rigidity of folded sheets* [Conference presentation]. Society of Engineering Science Conference (online).
7. Woodruff, S. R. & Filipov, E. T. (2020, April). *Curved creases redistribute global bending stiffness in corrugations* [Conference presentation]. ASCE Engineering Mechanics Institute International Conference (online).
8. Woodruff, S. R. & Filipov, E. T. (2019, June). *Functional anisotropy: Exploiting the mechanics of curved-crease origami systems* [Conference presentation]. ASCE Engineering Mechanics Institute Conference, Pasadena, CA, United States.
9. Filipov, E. T. & Woodruff, S. R. (2019, May). *Mechanics and dynamics of reconfigurable curved-crease origami arrays* [Conference presentation]. Acoustical Society of America Annual Meeting, Louisville, KY, United States.
10. Filipov, E. T. & Woodruff, S. R. (2019, March). *Exploring the mechanics of curved-crease origami with a discrete bar and hinge* [Conference presentation]. Bulletin of the American Physical Society, Boston, MA, United States.
11. Filipov, E. T. & Woodruff, S. R. (2018, May). *The mechanics of folding curved-crease origami* [Conference presentation]. ASCE Engineering Mechanics Institute Conference, Cambridge, MA, United States.

Poster presentations

1. Woodruff, S. R. & Filipov, E. T. (2021, October). *Twisting flat surfaces using curved creases and local pinching* [Conference poster]. Society of Engineering Science Annual Conference (online).

UNIVERSITY SERVICE ACTIVITIES

Secretary of Curriculum and Instruction (C&I) Committee **2025 – Present**
Department of Engineering, James Madison University

Co-Chair of Assessment Committee **2025 – Present**
Department of Engineering, James Madison University

Search Committee Member **2024 – 2025**
Department of Engineering, James Madison University

Diversity Council member **2024 – 2025**
College of Integrated Science and Engineering, James Madison University

Community-Based Learning Collaborative Fellow **2022 – 2023**
Office of Community-Based Learning, Washington and Lee University

EXTERNAL SERVICE ACTIVITIES

ACCESS (formerly XSEDE) Allocation Review Committee member **2022 – Present**
National Science Foundation, Advanced Cyberinfrastructure Coordination Ecosystem: Services & Support (ACCESS) program

Civil and Environmental Engineering Panel reviewer **2023 – Present**
National Science Foundation

Ad hoc journal reviewer **2022 – Present**
Additive Manufacturing; Cellulose; Frontiers in Physics; International Journal of Mechanical Sciences; International Journal of Solids and Structures; Mechanics Research Communications; Scientific Reports; Technology | Architecture + Design; Thin-Walled Structures; Engineering Research Express.

PROFESSIONAL MEMBERSHIPS AND AFFILIATIONS

American Society for Engineering Education (ASEE) **2023**
Member

Society of Engineering Science (SES) **2021**
Member

Engineering Mechanics Institute (EMI) **2019**
Member

Sigma Xi Honor Society **2018**
Associate member

Out in Science, Technology, Engineering, and Mathematics (oSTEM) **2017**
Member

American Society of Civil Engineers (ASCE) **2014**
Member

NON-ACADEMIC WORK EXPERIENCE

Infrasense, Inc. **2016 – 2018**

Woburn, MA - Junior staff engineer/GIS specialist

- Worked as the GIS expert in a team within a nondestructive testing (NDT) company.
- Designed and managed a database on NDT data for roads and bridges within the Idaho Transportation Department, District 6.
- Worked at the vanguard of a new type of project for both the company and the Idaho state government.
- Aided in decision making about how to represent data for effective use.

Structural Integrity Engineering Group, Inc. **2014 – 2015**

Medford, MA - Engineer's assistant/drafter

- Drafted and checked technical drawings and met with clients.
- Conducted field work investigations of structural projects.
- Experienced in residential and commercial environments on a variety of project sizes.

Fundamentals of engineering exam (engineer in training) **2017**

The National Council of Examiners for Engineering and Surveying

(Last updated on November 20, 2025)