

## Evgueni T. Filipov, Ph.D.

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### PROFESSIONAL PREPARATION

University of Illinois at Urbana-Champaign (UIUC)	Urbana, IL	Civil Engineering	Ph.D.	2016
University of Illinois at Urbana-Champaign	Urbana, IL	Civil Engineering	M.S.	2012
Rensselaer Polytechnic Institute (RPI)	Troy, NY	Civil Engineering	B.S.	2009

### APPOINTMENTS

2017-Present: Assistant Professor - Civil and Environmental Engineering - University of Michigan, Ann Arbor, MI

2017-Present: Affiliate Faculty - Michigan Institute for Computational Discovery and Engineering - University of Michigan, Ann Arbor, MI

### SELECTED AWARDS AND HONORS

UM Nominee for Gordon and Betty Moore Foundation Inventors Fellowship	2018
ZF Automotive Award	2018
ASCE Excellence in Civil Engineering Education (ExCEED) Fellowship	2017
Cozzarelli Prize - National Academy of Sciences	2015
National Science Foundation - Grad Research Opportunities Worldwide (GROW) Fellow	2014
Japanese Society for the Promotion of Science (JSPS) - Visiting Scholar Fellowship	2014
National Science Foundation - Graduate Research Fellowship Program (GRFP)	2010-2015
Mavis Future Faculty Fellows Award, UIUC (Awarded Twice)	2012 & 2013
Structural Engineers Foundation Scholarship, Chicago, IL	2010-2011
Page Fellowship, Karol Fellowship and Sargent & Lundy Fellowship, UIUC	2009-2010
Howard N. Blitman P.E. Patroon Scholar, RPI	2005-2009
Alumni Scholarship, RPI	2005-2009

### RESEARCH INTERESTS

My research interests lie in the field of *deployable, reconfigurable, and adaptable structures*. Folding and adaptable structures based on the principles of origami can have practical applications ranging in scale and discipline from biomedical robotics to deployable architecture. I am interested in exploring the *fundamental mechanics of thin sheet systems* and creating *analytical tools* that can simulate mechanical and multi-physical phenomena in such structures. The analytical models incorporate folding kinematics along with various local and global phenomenological models. Understanding how the geometry affects stiffness and other properties can allow for the optimization

and discovery of new reconfigurable and adaptable systems. My research also deals with the design and manufacturing of deployable structures using 3D printing and other fabrication techniques. Multi-material additive manufacturing can be used in intermediate scales to create cellular metamaterials with unique and adaptable characteristics (e.g. high stiffness-weight ratios and variable thermal conductivity). I am also exploring large-scale folding systems where thick panels are connected with hinges, and are deployed by mechanical devices.

## FUNDING PORTFOLIO

1. **Office of Naval Research.** “Curved folded sheets for stiff, anisotropic, and adaptable structures,” \$322,181, January 2018 – December 2020, **PI.** Evgueni Filipov.
2. **ZF Group - 2018 ZF Automotive Award,** “Energy Dissipation in Cellular Origami: From Passive to Active Crash Protection,” \$35,000, January 2018 – December 2018, **PI.** Evgueni Filipov.

## PUBLICATIONS AND PRESENTATIONS

### Refereed Papers in Journals

1. Filipov, E.T., Tachi, T., and Paulino, G.H. (2017) “Deployable Surfaces and Canopies with High Out-of-Plane Stiffness,” (Submitted)
2. Filipov, E.T., Liu, K., Tachi, T., Schenk, M., and Paulino, G.H. (2017) “Bar and Hinge models for Scalable Analysis of Origami,” *International Journal of Solids and Structures*, Vol. 124, No. 1, pp. 26-45.
3. Filipov, E.T., Paulino, G.H., and Tachi, T. (2016) “Origami Tubes with Reconfigurable Polygonal Cross-Sections,” *Proceedings of the Royal Society – A*, Vol. 472, No. 2185, 20150607.
4. Filipov, E.T., Tachi, T., and Paulino, G.H. (2015) “Origami Tubes Assembled Into Stiff, yet Reconfigurable Structures and Metamaterials,” *Proceedings of the National Academy of Sciences USA*, Vol. 112, No. 40, pp. 12321-12326. Highlighted in [PNAS commentary by Reis et al. 2015](#). Reported by: [WXYZ TV – ABC News](#), [The Wall Street Journal](#), [Civil + Structural Engineer](#), [Discovery News](#), [Motherboard](#), [City Lab](#), [Fast Company](#), [Gizmag](#), [Phys.org](#), [Science Daily](#), [Space Daily](#), [Gizmodo](#), [Sydney Morning Herald](#), and [more](#).
5. Filipov, E.T.\*, Chun, J.\*, Paulino, G.H., and Song, J. (2015) “Polygonal Multiresolution Topology Optimization (PolyMTOPT) for Structural Dynamics,” *Structural and Multidisciplinary Optimization*, Vol. 53, No. 4, pp. 673-694 \* Equal contribution authors.
6. O’Rourke, M.J., Filipov, E.T., and Uçkan, E. (2015). “Towards Robust Fragility Relations for Buried Segmented Pipe in Ground Strain Areas,” *Earthquake Spectra*, Vol. 31, No. 3, pp. 1839-1858.
7. Steelman, J.S., Filipov, E.T., Fahnestock, L.A., Revell, J.R., LaFave, J.M., Hajjar, J.F., and Foutch, D.A. (2014). “Experimental Behavior of Steel Fixed Bearings and Implications for Seismic Bridge Response,” *Journal of Bridge Engineering*, Vol. 19, No. 8, SPECIAL ISSUE: Recent Advances in Seismic Design, Analysis, and Protection of Highway Bridges, A4014007.
8. Filipov, E.T., Revell J.R., Fahnestock L.A., LaFave J.M., Hajjar, J.F., Foutch D.A., and Steelman J.S. (2013). “Seismic Performance of Highway Bridges with Fusing Bearing

Components for Quasi-Isolation,” *Earthquake Engineering and Structural Dynamics*. Vol. 42, No. 9, pp. 1375-1394.

9. Filipov, E.T., Fahnestock L.A., Steelman J.S., Hajjar, J.F., LaFave J.M., and Foutch D.A. (2013). “Evaluation of Quasi-Isolated Seismic Bridge Behavior Using Nonlinear Bearing Models,” *Engineering Structures*, Vol. 49, No. 14, pp. 168-181.
10. Steelman, J.S., Fahnestock L.A., Filipov E.T., LaFave J.M., Hajjar, J.F., and Foutch D.A. (2013). “Shear and Friction Response of Non-Seismic Laminated Elastomeric Bridge Bearings Subject to Seismic Demands,” *Journal of Bridge Engineering*, Vol. 18, No. 7, pp. 612-623.

### **Book Chapters and Technical Reports**

1. Filipov, E.T., Tachi, T., and Paulino, G.H. (2016). “Toward Optimization of Stiffness and Flexibility of Rigid, Flat-Foldable Origami Structures,” *Origami<sup>6</sup>* pp. 409-419, American Mathematical Society, Providence, RI.
2. LaFave, J.M., Fahnestock, L.A., Foutch, D.A., Steelman, J.S., Revell, J.R., **Filipov, E.T.**, and Hajjar, J.F. (2013). *Experimental Investigation of the Seismic Response of Bridge Bearings*, Report No. FHWA-ICT-13-002. Illinois Center for Transportation, Springfield, IL.
3. LaFave, J.M., Fahnestock, L.A., Foutch, D.A., Steelman, J.S., Revell, J.R., **Filipov, E.T.**, and Hajjar, J.F. (2013). *Seismic Performance of Quasi-Isolated Highway Bridges in Illinois*, Report No. FHWA-ICT-13-015. Illinois Center for Transportation, Springfield, IL.

### **Patent Applications**

1. Filipov, E.T., Tachi, T., Yamaguchi, Y., and Paulino, G.H. (2015). “Foldable Structures and their Manufacturing Method, Manufacturing Device and Program,” Japanese Patent Application No. 2015-160229, filed August 14, 2015 (Patent Pending). International Patent - In Preparation.

### **Conference Proceedings and Presentations (Supervised students underlined)**

1. Woodruff S. R., Filipov, E.T. (2018) “Structural Analysis of Curved Folded Deployables,” *ASCE Earth and Space Conference*, April 9-12, 2018, Cleveland, OH. (Accepted paper)
2. Filipov E.T., Redoutey, M., (2018) “Mechanical Instabilities in the Origami Hypar,” *Bulletin of the American Physical Society*, March 5-9, Los Angeles CA. (Accepted for presentation)
3. Filipov, E.T., Liu, K., Tachi, T., Schenk, M., and Paulino, G.H. (2017) “A Bar and Hinge Model for Scalable Analysis of Origami Structures and Metamaterials,” *Society of Engineering Science 2017 Technical Meeting*, July 25-28, 2017, Northeastern University, Boston, MA.
4. Paulino, G.H., Filipov, E.T., and Tachi, T. (2017) “Tubular Origami Assemblages with Tunable Properties,” *Society of Engineering Science 2017 Technical Meeting*, July 25-28, 2017, Northeastern University, Boston, MA.
5. Filipov, E.T., Paulino, G.H., and Tachi, T. (2017) “Origami Tubes Coupled into Reconfigurable Structures and Metamaterials,” *ASCE Engineering Mechanics Institute Conference*, June 5-7, 2017, San Diego, CA.
6. Paulino, G.H., Filipov, E.T., and Tachi, T. (2017) “Tubular Origami Assemblages with Tunable Properties,” *ASCE Engineering Mechanics Institute - International Conference*, March 19-22, 2017, Rio de Janeiro, Brazil.

7. Filipov, E.T., Liu, K., Tachi, T., Schenk, M., and Paulino, G.H. (2017) "A Bar and Hinge Model for Scalable Analysis of Thin Origami," *ASCE Engineering Mechanics Institute - International Conference*, March 19-22, 2017, Rio de Janeiro, Brazil.
8. Filipov, E.T., Paulino, G.H., and Tachi, T. (2015). "Flexible Origami Sheets Assembled into Stiff Reconfigurable Structures," *Society of Engineering Sciences 2015 Technical Meeting*, October 26-28, 2015, College Station, TX.
9. Filipov, E.T., Paulino, G.H., and Tachi, T. (2015). "Reconfiguring Origami Tubes with Polygonal Cross-Sections," *Society of Engineering Sciences 2015 Technical Meeting*, October 26-28, 2015, College Station, TX.
10. Tachi, T., Filipov, E.T., and Paulino, G.H. (2015). "Deployable Folded-core Sandwich Panels Guided by a Generating Surface," *Proceedings of the International Association for Shell and Spatial Structures (IASS)*, August 17-20, 2015, Amsterdam, Netherlands.
11. Filipov, E.T., Paulino, G.H., and Tachi, T. (2015). "Miura Tubes and Assemblages: Theory and Applications," *American Physical Society March Meeting*, March 2-6, 2015, San Antonio, TX.
12. Filipov, E.T., Tachi, T., and Paulino, G.H. (2014). "Toward Optimization of Stiffness and Flexibility of Rigid, Flat-Foldable Origami Structures," *The 6th International Meeting on Origami in Science, Mathematics and Education (6OSME)*, August 10-13, 2014, Tokyo, Japan.
13. Filipov, E.T., Chun, J., Paulino, G.H., and Song, J. (2013). "Topology Optimization for Structural Dynamics: A Polygonal Multiresolution Approach," *Engineering Mechanics Institute (EMI) Conference*, August 4-7, 2013, Evanston, IL.
14. Filipov, E.T., Chun, J., Paulino, G.H., and Song, J. (2013). "Polygonal Multiresolution Topology Optimization for Structural Dynamics," *World Congress on Structural and Multidisciplinary Optimization (WCSMO)*, May 20-24, 2013, Orlando, FL.
15. Steelman, J.S., Filipov, E.T., Revell, J.R., LaFave, J.M., Fahnestock, L.A., Hajjar, J.F., and Foutch, D.A. (2013). "Achieving Bridge Resilience through Economical Seismic 'Quasi-Isolation' Design using Common Bearing Components," *Proceedings of 7<sup>th</sup> National Seismic Conference on Bridges & Highways*, May 20-22, 2013, Oakland, CA.
16. Filipov, E.T., Revell, J.R., Steelman, J.S., Fahnestock, L.A., LaFave, J.M., Foutch, D.A., and Hajjar, J.F. (2012). "Sensitivity of Quasi-Isolated Bridge Seismic Response to Variations in Bearing and Backwall Elements," Paper No. 2978, *Proceedings of the 15th World Conference on Earthquake Engineering*, September 24-28, 2012, Lisbon, Portugal.
17. Filipov, E.T., Hajjar, J.F., Steelman J.S., Fahnestock L.A., LaFave J.M., and Foutch D.A. (2011). "Computational Analyses of Quasi-Isolated Bridges with Fusing Bearing Components," Paper No. 768, *Proceedings of the ASCE/SEI Structures Congress*, April 14-16, 2011, Las Vegas, NV.
18. Steelman J.S., Fahnestock L.A., LaFave J.M., Hajjar, J.F., Filipov, E.T., and Foutch D.A. (2011). "Seismic Response of Bearings for Quasi-Isolated Bridges – Testing and Component Modeling," Paper No. 855, *Proceedings of the ASCE/SEI Structures Congress*, April 14-16, 2011, Las Vegas, NV.
19. Filipov, E.T., Steelman J.S., Hajjar, J.F., LaFave J.M., and Fahnestock L.A. (2010). "Bridge Bearing Fuse Systems for Regions with High-Magnitude Earthquakes at Long Recurrence Intervals," Paper No. 1834, *Proceedings of the 9th US National and 10th Canadian Conference on Earthquake Engineering*, July 25-29, 2010, Toronto, Canada.

## Invited Lectures

1. “Analysis of Origami Structures and Metamaterials,” Department of Civil & Environmental Engineering & Earth Sciences Structures Seminar Series, University of Notre Dame, September 28, 2017.
2. “Structural Analysis of Tubular Origami Systems,” Workshop on Origami Design for Integration of Self-Assembling Systems for Engineering Innovation (ODISSEI), Florida International University, April 27, 2017.
3. “Using Origami for Deployable Structures and Adaptable Metamaterials,” Structural Engineering and Geomechanics Graduate Student Seminar, Stanford University, November 18, 2016.
4. “Tailoring the Stiffness of Deployable Origami Structures,” Structural Engineering Seminar, Department of Civil and Environmental Engineering, University of Michigan, November 15, 2016.
5. “Reconfigurable Origami Tubes with Tunable Stiffness,” National Center for Supercomputing Applications (NCSA) Materials and Manufacturing Seminar Series, UIUC, November 12, 2015.
6. “Origami Tube Structures with Reconfigurable Geometry and Tunable Stiffness,” School of Civil and Environmental Engineering, Georgia Institute of Technology, Atlanta, GA, August 27, 2015.
7. “Eigenfrequency Band-gaps in Topology Optimization and Origami,” Department of Civil Engineering and Architecture, Hiroshima University, Hiroshima, Japan, April 14, 2014.
8. “Topology Optimization for Structural Dynamics Using Multiresolution Polygons,” Materials Group Seminar, Civil and Environmental Engineering at UIUC, February 5, 2014.
9. “Multiresolution Polygonal Elements for Topology Optimization in Structural Dynamics,” NSF Graduate Research Fellows Lightning Talks, UIUC, February 28, 2013.
10. “Ground Strain Fragility Relations for Segmented Buried Pipelines,” Kandilli Observatory and Earthquake Research Institute, Boğaziçi University, Istanbul, Turkey, July 27, 2011.
11. “Seismic Behavior of Quasi-Isolated Bridge Systems and Components,” Kandilli Observatory and Earthquake Research Institute, Boğaziçi University, Istanbul, Turkey, July 14, 2011.
12. “Damage to Large Segmented Buried Pipe due to PGD from the 1999 Izmit, Turkey Earthquake,” Indo-US Research Academy, Pune, India, October 9, 2008.

## Poster Presentations

1. “A Bar and Hinge Model for Scalable Structural Analysis of Origami”, *Society of Engineering Sciences 2015 Technical Meeting*, College Station, TX, October 26-28, 2015.
2. “Tailoring Structural Dynamic Behavior through Topology Optimization with Multiresolution Polygons”, *Computational Science and Engineering Annual Meeting*, UIUC, April 24-25, 2013.
3. “Seismic Behavior of Quasi-Isolated Bridge Systems and Components & Topology Optimization Design of High-rise Buildings Subjected to Dynamic Loading”, *DCAMM advanced course on Topology Optimization*, Lyngby, Denmark, June 29-July 5, 2011.
4. “Seismic Behavior of Quasi-Isolated Bridge Systems and Components,” *NEES & MCEER Annual Meeting - Quake Summit 2011*, Buffalo, NY, June 9-11, 2011.
5. “Damage to Segmented Buried Pipe during the 1999 Izmit Earthquake,” *Undergraduate Research Forum and Awards*, RPI, March 28, 2008.

## TEACHING EXPERIENCE

### **Structural Dynamics (CEE 511) – University of Michigan** **Winter 2017; Fall 2017**

Course Topics: Dynamic equilibrium of structures. Response of a single degree of freedom system to dynamic excitation: free vibration, harmonic loads, pulses and earthquakes. Response spectra. Response of multi-degree of freedom systems. Seismic behavior of buildings and the basis of seismic building codes.

### **Structural Engineering (CEE 360) – University of Illinois** **Aug. – Dec. 2013**

Course Topics: Analysis, behavior, and design of trusses and framed structures under static loads; member forces in trusses, shear and moment diagrams, deflections, simple applications of the force method and slope-deflection; computer applications.

### **Finite Element Methods (CEE 570) – as TA at University of Illinois** **Jan. – May 2012**

Course Topics: Theory and application of the finite element method; stiffness matrices for triangular, quadrilateral, and isoparametric elements; two- and three-dimensional elements; algorithms necessary for the assembly and solution; direct stress and plate bending problems for static, nonlinear buckling and dynamic load conditions; displacement, hybrid, and mixed models together with their origin in variational methods.

### **Design of Structural Systems (CEE 465) - as TA at University of Illinois** **Aug. – Dec. 2010**

Course Topics: Examination of the whole structural design process including definition of functional requirements, selection of structural scheme, formulation of design criteria, preliminary and computer-aided proportioning, and analysis of response, cost, and value.

## PROFESSIONAL EXPERIENCE

### **Wiss, Janney, Elstner Associates**, New Haven, CT - Structural Engr. Intern **2008 & 2009**

- Performed destructive and nondestructive testing, field investigations and condition surveys on steel, concrete, masonry, and wood structural systems.
- Analyzed and designed structural & architectural components, and worked with clients, architects and contractors to develop plans and specifications for reconstruction projects.

### **CG Power Solutions**, Albany, NY - Structural Engr. Intern 2007-2008 (Formerly MSE Power Systems, Inc.)

- Drafted and designed structures that carry electrical equipment in mid-sized substations.

## SERVICE ACTIVITIES

### *External*

#### 1. **Mini-Symposium organizer:**

- “Origami/Kirigami Based Systems and Adaptive Structures” at the ASCE Engineering Mechanics Institute (EMI) 2018 Conference, Boston, MA, June 4-7, 2018.
- “Thin Shelled and Adaptive Structures” at the ASCE 3<sup>rd</sup> Engineering Mechanics Institute (EMI) International Conference, Rio de Janeiro, Brazil, March 19-22, 2017.

2. **Journal Reviewer:** • *Physical Review Letters*; • *Soft Matter*; • *J. Royal Society Interface*; • *Int. J. Numerical Methods in Engineering*; • *Extreme Mechanics Letters*; • *Int. J. Solids and Structures*; • *SIGGRAPH - ACM Transactions on Graphics*; • *ASME J. Applied Mechanics*; • *ASCE J. Structural Engineering*; • *ASME J. Mechanical Design*; • *J. Structural and Multidisciplinary Optimization*; • *Automation in Construction*; • *Mechanics Research Communications*; • *J. Constructional Steel Research*; • *Structure and Infrastructure Engineering*; • *Computational and Applied Mathematics*; • *Int. J. Spatial Structures*.
3. **Committee Member:** • Elasticity Committee ASCE Engineering Mechanics Institute. 2017 – Present. • Computational Mechanics Committee ASCE Engineering Mechanics Institute. 2017 – Present.
4. **Committee Chair:** Earthquake Engineering Research Institute (EERI) National Student Leadership Council – Transition Working Group on Membership, Participation, and Long-term Goals 2012-2013.
5. **Library Outreach Activities:** Organized public workshop on origami for adults and children with presentation about the potential applications of origami in engineering, and hands-on activity for making origami models and structures. • Ann Arbor District Library – December 2, 2017; • Champaign Public Library June 11, 2016.

#### ***Internal at University of Michigan***

1. CEE Master's Committee 2017-2018
2. CEE Undergraduate Recruitment Committee 2017-2018
3. CEE Graduate Committee 2017W

#### **PROFESSIONAL MEMBERSHIPS**

American Physical Society (APS)  
 American Society of Civil Engineers (ASCE)  
 American Society of Mechanical Engineering (ASME)  
 Chi Epsilon – National Civil Engineering Honor Society  
 Engineering Mechanics Institute (EMI) of ASCE  
 Society of Engineering Sciences (SES)  
 Tau Beta Pi – National Engineering Honor Society

(Last Updated - January 25, 2018)