CONTACT INFORMATION
mahnoosh.babaei at gmail.com
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Google Scholar

RESEARCH INTERESTS
Multifunctional Materials, Sensing and Actuation, Integrated Systems, Bioinspired Designs, Programmable Materials, Soft Materials, Micro Robotics, Nonlinear Finite Elements, Multiscale Modeling, Structural Instability, Small UAVs, Biomedical Devices

EDUCATION

Carnegie Mellon University, Pittsburgh, PA
Ph.D. in Computational Mechanics — May 2019
Dissertation: *Instability-Induced Rapid Shape Change in Heat- and Photo-Responsive Materials*
Advisor: Kaushik Dayal (Advisor), M. Ravi Shankar (Co-advisor)

M.Sc. in Civil and Environmental Engineering — May 2018

Sharif University of Technology, Tehran, Iran
M.Sc. in Civil Engineering - Structural — Sep 2013
Thesis: *Molecular Dynamics Simulation of Metal and Ceramic Nano-powder Compaction and Investigation on Effective Factors.*
Advisor: Amir Reza Khoei

Ferdowsi University of Mashhad, Mashhad, Iran
B.Sc. in Civil Engineering — June 2010

RESEARCH EXPERIENCE

Postdoctoral Research Associate — June 2019 to Present
Department of Mechanical Engineering
Carnegie Mellon University
Supervisor: Sarah Bergbreiter

Graduate Research Assistant — Aug 2014 to June 2019
Department of Civil and Environmental Engineering
Carnegie Mellon University
Supervisor: Kaushik Dayal

Graduate Research Assistant — Feb 2012 to Feb 2014
Department of Civil and Environmental Engineering
Sharif University of Technology
Supervisor: Amir Reza Khoei

Undergraduate Research Assistant — Mar 2008 to May 2009
Department of Civil and Environmental Engineering
Ferdowsi University of Mashhad

PUBLICATIONS

JOURNAL ARTICLES

[**J10**] **M. Babaei**, M. Grasinger, J. Gao, M. R. Shankar, K. Dayal, "Separation of Energy Scales in Entropic Photoelasticity Drives Equilibrium Symmetry Breaking and Multiscale Evolution" [**In preparation**].

[**J9**] A. Clement, **M. Babaei**, J. Phadikar, D. W. Lee, M. R. Shankar, "Complexity from Simplicity: Confinement Directs Morphogenesis and Motility in Nematic Polymers" [**Under Revision**].

[**J8**] Y. Tao, Y. Lee, H. Liu, X. Zhang, J. Cui1, C. Mondoa, **M. Babaei**, J. Santillan, G. Wang, D. Luo, D. Liu, H. Yang, Y. Do1, L. Sun, W. Wang, T. Zhang, L. Yao, "Morphing Pasta and Beyond" [**Accepted for Publication in Science Advances**].

[**J7**] **M. Babaei**, J. Gao, A. Clement, K. Dayal, M. R. Shankar, "Torque-Dense Photomechanical Actuation", *Soft Matter*, DOI: 10.1039/d0sm01352h, 2020

[**J6**] C. Velez, D. K. Patel, S. Kim, **M. Babaei**, C. R. Knick, G. L. Smith, S. Bergbreiter, "Hierarchical Integration of Thin-Film NiTi Actuators Using Additive Manufacturing for Microrobotics", *Journal of Microelectromechanical Systems*, vol. 29, no. 5, pp. 867-873, Oct. 2020.

[**J5**] **M. Babaei**, S. Kim, C. Velez, D. K. Patel, S. Bergbreiter, "Increasing the Energy Efficiency of NiTi Unimorph Actuators With a 3D-Printed Passive Layer", *Journal of Microelectromechanical Systems*, vol. 29, no. 5, pp. 797-803, Oct. 2020.

[**J4**] A. R. Carotenuto, L. Lunghi, V. Piccolo, **M. Babaei**, K. Dayal, N. Pugno, M. Zingales, L. Deseri, M. Fraldi, "Mechanobiology predicts raft formations triggered by ligand-receptor activity across the cell membrane", *Journal of the Mechanics and Physics of Solids*, vol. 141, 103974, Aug. 2020.

[**J3**] **M. Babaei**, J. A. Clement, K. Dayal, M. R. Shankar, "Steering with light: indexable photomotility in liquid crystalline polymers", *RSC Advances*, vol. 7, pp. 52510-52516, Nov. 2017.

[**J2**] **M. Babaei**, I. C. Jones, K. Dayal, M. S. Mauter, "Computing the diamagnetic susceptibility and diamagnetic anisotropy of membrane proteins from structural subunits", *Journal of Chemical Theory and Computation*, vol. 13, no. 6, pp. 2367-3076, Apr. 2017 [**Featured on the cover**].

[**J1**] S. S. Klara, P. O. Saboe, I. T. Sines, **M. Babaei**, P. Chiu, R. DeZorzi, K. Dayal, T. Walz, M. Kumar, M. S. Mauter, "Magnetically directed two-dimensional crystallization of OmpF membrane proteins in block copolymers", *Journal of the American Chemical Society*, vol. 138, no. 1, pp. 28-31, Dec. 2015.

CONFERENCE PROCEEDINGS AND PRESENTATIONS

[**C9**] B. Boyacıoğlu, **M. Babaei**, A. H. Mamo, S. Bergbreiter, T. L. Daniel, K. A. Morgansen, *2021 IEEE Control Systems Society Conference (CDC 2021)*, Austin, Texas, Dec 13-15, 2021 [**Submitted**].

[**C8**] R. Kubicek, **M. Babaei**, S. Bergbreiter, "Keeping It Simple: Bio-Inspired Threshold-Based Strain Sensing for Micro-Aerial Vehicles", *2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS 2021)*, Prague, Czech Republic, Sep 27-Oct 1, 2021 [**Submitted**].

[**C7**] A. H. Mamo, A. I. Weber, T. L. Mohren, **M. Babaei**, T. L. Daniel, "Finite Element Analyses of Flapping Wings Meets Inertial Sensing", *The Society for Integrative & Comparative Biology Virtual Annual Meeting 2021 (SICB 2021)*, Online, January 3-7, 2021.

[**C6**] C. Velez, S. Kim, **M. Babaei**, D. K. Patel, C. R. Knick, G. L. Smith, S. Bergbreiter, "Rapid Prototyping of Microactuators by Integrating 3D Printed Polymeric Structures with NiTi Thin Film", *2020 IEEE 33rd International Conference on Micro Electro Mechanical Systems (MEMS)*, Vancouver, Canada, January 18-22, 2020.

[**C5**] **M. Babaei**, A. J. Clement, J. Gao, M. R. Shankar, K. Dayal, "Amplifying Photoresponsive Actuation in Liquid Crystal Polymeric Shells Using Instabilities", *ASME 2019 Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS 2019)*, Louisville, KY, September 9-11, 2019.

[**C4**] **M. Babaei**, A. J. Clement, K. Dayal, M. R. Shankar, "Creating Photoactuation Pathways Using Boundary Conditions", *ASME 2018 Smart Materials, Adaptive Structures, and Intelligent Systems (SMASIS 2018)*, San Antonio, TX, September 10-12, 2018.

[**C3**] **M. Babaei**, A. J. Clement, K. Dayal, M. R. Shankar, "Indexable Photomotility in Liquid Crystalline Polymers", *2017 International Liquid Crystal Elastomers Conference (ILCEC 2017)*, Houston, TX, October 16-18, 2017.

[**C2**] A.R. Khoei, A. Rezaei Sameti, H. Mofatteh, **M. Babaei**, "Compaction Simulation of Nano-Crystalline Metals with Molecular Dynamics Analysis", *The 12th International Conference on Numerical Methods in Industrial Forming Processes (NUMIFORM 2016)*, Troyes, France, July 4-7, 2016.

[**C1**] **M. Babaei**, A. R. Khoei, "Molecular Dynamics Simulation of Nickel Nano-Powder Compaction", *5th International Conference on Nanostructures (ICNS5 2014)*, Kish Island, Iran, February, 2014.

INVITED TALKS

[**IT6**] *Shedding Light on Boundary Conditions*, University of Washington, Seattle, WA, February 2021.

[**IT5**] *Computational Analysis of Energy Barriers in the Bottom-Up Design of Small Scale Smart Material Systems*, MIT CEE Rising Stars Workshop, Massachusetts Institute of Technology, Cambridge, MA, October 2019.

[**IT4**] *Photomechanical Actuation in Liquid Crystalline Polymers*, Microrobotics Lab, Carnegie Mellon University, Pittsburgh, PA, June 2019.

[**IT3**] *Creating Photoactuation Pathways Using Boundary Conditions*, Mechanics, Materials, and Computing Seminar, Carnegie Mellon University, Pittsburgh, PA, January 2019.

[**IT2**] *Photomechanical Actuation in Liquid Crystalline Polymers*, Cornell University, Ithaca, NY, December 2018.

[**IT1**] *Indexable Photomotility in Liquid Crystalline Polymers*, Mechanics, Materials, and Computing Seminar, Carnegie Mellon University, Pittsburgh, PA, October 2017.

POSTER PRESENTATION

[**P6**] R. Kubicek, **M. Babaei**, S. Bergbreiter, "Bio-Inspired Strain Sensor for Application in Micro-Aerial Vehicles", *Robotics-Inspired Biology Workshop - International Conference on Intelligent Robots and Systems (IROS) 2020*, Online, October 2020.

[**P5**] S. Kim, **M. Babaei**, C. Velez, D. K. Patel, S. Bergbreiter, "Increasing the Energy Efficiency of NiTi Unimorph Actuators", *CMU Energy Week*, Pittsburgh, PA, March 2020.

[**P4**] **M. Babaei**, J. Gao, A. Clement, M. R. Shankar, K. Dayal, "Instability-Induced Torque-Dense Actuation in Photoresponsive Liquid Crystal Elastomer Shells", *2019 International Mechanical Engineering Congress Exposition (IMECE 2019)*, Salt Lake City , UT, November 11-14, 2019.

[**P3**] J. Gao, **M. Babaei**, A. Martinez, A. Clement, M. R. Shankar, "Low Voltage, High Power-Density, Molecularly-Ordered Drivers for Untethered Microrobotics", *2019 International Mechanical Engineering Congress Exposition (IMECE 2019)*, Salt Lake City , UT, November 11-14, 2019.

[**P2**] **M. Babaei**, K. Dayal, M. R. Shankar, "Torque-Dense Photomechanical Actuation", *Society of Engineering Science, 56th Annual Technical Meeting (SES 2019)*, St. Louis, MO, October 13-15, 2019.

[**P1**] **M. Babaei**, A. Clement, J. Gao, M. R. Shankar, K. Dayal, "Photomechanical Kicking and Popping in Liquid Crystalline Polymers", *Center for Nonlinear Analysis (CNA) Workshop 2019: Mathematical Models for Pattern Formation*, Pittsburgh, PA, March 8-10, 2019.

AWARDS AND HONORS

IMECE NSF Travel Award — Sep 2019
NSF

1 of 7 Ph.D. graduates nominated for Schmidt Science Fellowship Program — Aug 2019
Carnegie Mellon University

Civil and Environmental Engineering Rising Stars Workshop Participant — July 2019
Massachusetts Institute of Technology

Outstanding Contribution in Reviewing — Nov 2018
Applied Mathematics and Computation

Fenves Travel Grant — July 2017, Sep 2018
Carnegie Mellon University

Outstanding Teaching Assistant Award — May 2018
Carnegie Mellon University

Outstanding Student Organization Award — May 2017
Office of Student Leadership, Involvement, and Civic Engagement at Carnegie Mellon University

Neil and Jo Bushnell Fellowship — Feb 2016
Carnegie Mellon University

CIT Dean's Fellowship — Aug 2014
Carnegie Mellon University

Ranked 3rd in "Light-Weight Concrete" Competition — May 2008
Ferdowsi University of Mashhad

TEACHING EXPERIENCE

GUEST LECTURER

39-613: Energy Storage and Transport — Fall 2020
Graduate Level, Carnegie Mellon University

TEACHING ASSISTANT

12-231: Solid Mechanics — Spring 2015, 2016, 2017, 2018
Undergraduate Level, Carnegie Mellon University

MENTORING

Amanuel Mamo, M.Sc. Student — Aug 2020 - Present
Advisor: Thomas Daniel — University of Washington
Project: Finite element analyses of flapping wings
Highlights: Publication in preparation

Regan Kubicek, Ph.D. Student — June 2020 - Present
Advisor: Sarah Bergbreiter — Carnegie Mellon University
Project: Bio-Inspired Strain Sensor for Use in Micro-Aerial Vehicles
Highlights: - Submitted paper to *ICRA 2021*

Isaac C. Jones, B.Sc. Student — May 2015 - Apr 2016
Advisor: Meagan S. Mauter — Carnegie Mellon University
Project: Diamagnetic Susceptibility and Anisotropy of Membrane Proteins
Highlights: - Published paper in *Journal of Chemical Theory and Computation*
- Awarded CMU's Small Undergraduate Research Grant (SURG)

PROFESSIONAL SERVICE

LEADERSHIP & SOCIETAL ENGAGEMENT

Judge — Mar 2021
Mechanical Engineering Ph.D. Graduate Research Symposium
Carnegie Mellon University

Session Chair — Oct 2020
Rising Stars in Civil and Environmental Engineering Workshop 2020
Carnegie Mellon University

Organizer — Dec 2019 - Present
Rising Stars in Civil and Environmental Engineering Workshop 2020
Carnegie Mellon University

Member — Jan 2017 - Apr 2017

	Graduate Student Advisory Committee Carnegie Mellon University	
	President Iranian Student Association Carnegie Mellon University	Aug 2016 - Aug 2017
	Vice-President Iranian Student Association Carnegie Mellon University	Aug 2015 - Aug 2016
	Manager Assistant Parallel Computing Center Sharif University of Technology	Mar 2013 - Feb 2014
	Executive Committee Member 1st National Spaghetti Bridge Competition Ferdowsi University of Mashhad	May 2008

JOURNAL REVIEWER

Applied Mathematics and Computation
Fluids
Energies
Materials
Applied Sciences
Biomimetics

PROFESSIONAL AFFILIATIONS	National Center for Faculty Development & Diversity	Jan 2020 - Present
	Carnegie Mellon Women's Association	Sep 2019 - Present
	American Society of Mechanical Engineers	June 2018 - Present
	American Society of Civil Engineers	Sep 2018 - Present
	Engineers Without Borders USA	Sep 2018 - Present