

# CARMEL MAJIDI

ASSISTANT PROFESSOR

Department of Mechanical Engineering  
Carnegie Mellon University

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## Education

### University of California Berkeley, California

Ph.D. in Electrical Engineering & Computer Sciences May 2007  
M.S. in Electrical Engineering & Computer Sciences December 2004  
Major: Controls, Robotics & Biosystems, Minor: Applied Mathematics & Mechanics  
Dissertation: *Mechanics of Natural & Synthetic Gecko Adhesives*

### Cornell University Ithaca, New York

B.S. in Civil & Environmental Engineering May 2001  
Major: Structural Engineering

## Employment

### Carnegie Mellon University

*Assistant Professor*

August 2011 - Present  
Department of Mechanical Engineering

### Harvard University

*Postdoctoral Fellow*

December 2009 - July 2011  
School of Engineering & Applied Sciences (SEAS)

### Princeton University

*Postdoctoral Fellow*

December 2007 - December 2009  
Princeton Institute for the Science & Technology of Materials (PRISM)

## Journal Publications

- (35) Rapid Prototyping for Soft-Matter Electronics  
T. Lu, L. Finkenauer, J. Wissman, C. Majidi  
*Advanced Functional Materials in press* (2014).
- (34) 3D Structures of Liquid-Phase Galn Alloy Embedded in PDMS with Freeze Casting  
A. Fassler, C. Majidi  
*Lab on a Chip* **13** 4442-4450 (2013).
- (33) Liquid-Phase Gallium-Indium Alloy Electronics with Microcontact Printing

- A. Tabatabai, A. Fassler, C. Usiak, C. Majidi  
*Langmuir* **29** 6194-6200 (2013).
- (32) Soft Robotics – A Perspective: Current Trends and Prospects for the Future  
C. Majidi  
*Soft Robotics* **1** 5-11 (2013).
- (31) Thermal analysis and design of a multi-layered rigidity tunable composite  
W. Shan, T. Lu, Z.H. Wang, C. Majidi  
*International Journal of Heat and Mass Transfer* **66** 271-278 (2013).
- (30) Soft-matter composites with electrically tunable elastic rigidity  
W. Shan, T. Lu, C. Majidi  
*Smart Materials and Structures* **22** 085005 (2013).
- (29) Influence of Surface Traction on Soft Robot Undulation  
C. Majidi, R. F. Shepherd, R. K. Kramer, G. M. Whitesides, R. J. Wood  
*International Journal of Robotics Research* **32** 1577-1584 (2013).
- (28) Masked Deposition of Gallium-Indium Alloys for Liquid-Embedded Elastomer Conductors  
R. Kramer, C. Majidi, R. J. Wood  
*Advanced Functional Materials* **23** 5292-5296 (2013).
- (27) Soft-matter capacitors and inductors for hyperplastic strain sensing and stretchable electronics  
A. Fassler and C. Majidi  
*Smart Materials and Structures* **22** 055023 (2013).
- (26) Bifurcations and Instability in the Adhesion of Intrinsically Curved Rods  
C. Majidi, O. M. O'Reilly, J. A. Williams  
*Mechanics Research Communications* **49** 13-16 (2013).
- (25) Collapse of triangular channels in a soft elastomer  
D. Tepayotl-Ramirez, Tong Lu, Y.-L. Park, C. Majidi  
*Applied Physics Letters* **102** 044102 (2013).
- (24) Influence of cross-sectional geometry on the sensitivity and hysteresis of liquid-phase electronic pressure sensors  
Y.-L. Park, D. Tepayotl-Ramirez, R. J. Wood, C. Majidi  
*Applied Physics Letters* **101** 191904 (2012).
- (23) Nonlinear geometric effects in mechanical bistable morphing structures  
Z. Chen, Q. Guo, C. Majidi, W. Chen, D. J. Srolovitz, M. P. Haataja  
*Physical Review Letters* **109** 114302 (2012).
- (22) On the stability of a rod adhering to a rigid surface: Shear-induced stable adhesion and the instability of peeling  
C. Majidi, O. M. O'Reilly, J. A. Williams  
*Journal of the Mechanics and Physics of Solids* **60** 827-843 (2012).
- (21) A non-differential elastomer curvature sensor for softer-than-skin electronics  
C. Majidi, R. Kramer, R. J. Wood  
*Smart Materials and Structures* **20** 105017 (2011).
- (20) Tunable Helical Ribbons  
Z. Chen, C. Majidi, D. J. Srolovitz, M. Haataja  
*Applied Physics Letters* **98** 0011906 (2010).
- (19) Hyperelastic pressure sensing with a liquid-embedded elastomer

- C. Majidi, Y.-L. Park (co-1<sup>st</sup> author), R. Kramer, P. Bérard, R. J. Wood  
*Journal of Micromechanics and Microengineering* **20** 125029 (2010).
- (18) Tunable elastic stiffness with micro-confined magnetorheological domains at low magnetic field  
C. Majidi, R. J. Wood  
*Applied Physics Letters* **97** 164104 (2010).
- (17) Analysis and design principles for shear-mode piezoelectric energy harvesting with ZnO nanoribbons  
C. Majidi, M. Haataja, D. J. Srolovitz  
*Smart Materials and Structures* **19** 055027 (2010).
- (16) Adhesion and delamination boundary conditions for elastic plates with arbitrary contact shape  
C. Majidi, G. G. Adams  
*Mechanics Research Communications* **37** 214-218 (2010).
- (15) Shear-mode Contact Splitting for a Microtextured Elastomer Filme  
R. Kramer, C. Majidi, R. J. Wood  
*Advanced Materials* **22** 3700-3703 (2010).
- (14) Spontaneous Bending of Piezoelectric Nanoribbons: Mechanics, Polarization, and Space Charge Coupling  
C. Majidi, Z. Chen, D. J. Srolovitz, M. Haataja  
*Journal of the Mechanics and Physics of Solids* **58** 73-85 (2010).
- (13) Adhesion Between Thin Cylindrical Shells with Parallel Axes  
C. Majidi, K. T. Wan  
*Journal of Applied Mechanics* **77** 041013 (2010).
- (12) A Simplified Formulation of Adhesion Problems with Elastic Plates  
C. Majidi, G. G. Adams  
*Proceedings of the Royal Society A* **465** 2217-2230 (2009).
- (11) Shear Adhesion between an Elastica and a Rigid Flat Surface  
C. Majidi  
*Mechanics Research Communications* **36** 369-372 (2009).
- (10) Adhesion of an elastic plate to a sphere  
C. Majidi, R. S. Fearing  
*Proceedings of the Royal Society A* **464** 1309-1317 (2008).
- (9) Sliding-induced adhesion of stiff polymer microfiber arrays. I. Macroscale behavior  
J. Lee, C. Majidi, B. Schubert, R. S. Fearing  
*Journal of the Royal Society Interface* **5** 835-844 (2008).
- (8) Sliding-induced adhesion of stiff polymer microfiber arrays. II. Microscale behavior  
B. Schubert, J. Lee, C. Majidi, R. S. Fearing  
*Journal of the Royal Society Interface* **5** 845-853 (2008).
- (7) Analysis of Shaft-Loaded Membrane Delamination Using Stationary Principles  
C. Majidi, R. E. Groff, R. S. Fearing  
*Mathematics & Mechanics of Solids* **13** 3-22 (2008).
- (6) Ancestrally high elastic modulus of gecko setal beta-keratin  
A. M. Peattie, C. Majidi, A. Corder, R. J. Full  
*J. Royal Society Interface* **4** 1071-1076 (2007).

- (5) Remarks on formulating an adhesion problem using Euler's elastica  
C. Majidi  
*Mechanics Research Communications* **34** 85-90 (2007).
- (4) Towards Friction and Adhesion from High Modulus Microfiber Arrays  
B. Schubert, C. Majidi, R. E. Groff, S. Baek, B. Bush, R. Maboudian, R. S. Fearing  
*Journal of Adhesion Science & Technology* **21** 1297-1315 (2007).
- (3) High Friction from a Stiff Polymer using Micro-Fiber Arrays  
C. Majidi, R. E. Groff, Y. Maeno, B. Schubert, S. Baek, B. Bush, R. Maboudian, N. Gravish,  
M. Wilkinson, K. Autumn, R. S. Fearing  
*Physical Review Letters* **97** 076103 (2006).
- (2) Effective elastic modulus of isolated gecko setal arrays  
K. Autumn, C. Majidi, R. E. Groff, A. Dittmore, R. Fearing  
*Journal of Experimental Biology* **209** 3558-3568 (2006).
- (1) Attachment of fiber array adhesive through side contact  
C. Majidi, R. E. Groff, R. S. Fearing  
*Journal of Applied Physics* **98** 103521 (2005).

## Conferences (Peer-Reviewed)

- (8) Soft-Matter Capacitive Sensor for Measuring Shear and Pressure Deformation  
P. Roberts, D. D. Damian, W. L. Shan, T Lu, C Majidi  
*IEEE International Conference on Robotics and Automation*  
Karlsruhe, Germany (2013).
- (7) Active modular elastomer sleeve for soft wearable assistance robots  
Y.-L. Park, B.-R. Chen, C. Majidi, R. J. Wood, R. Nagpal, E. Goldfield  
*IEEE International Conference on Intelligent Robots and Systems*  
Vilamoura, Portugal (2012).
- (6) Soft Curvature Sensors for Joint Angle Proprioception  
R. Kramer, C. Majidi, R. Sahai, R. J. Wood  
*IEEE International Conference on Intelligent Robots and Systems*  
San Francisco, CA (2011).
- (5) Wearable Tactile Keypad with Stretchable Artificial Skin  
R. Kramer, C. Majidi, R. J. Wood  
*IEEE International Conference on Robotics and Automation*  
Shanghai, China (2011).
- (4) Mechanics of a Novel Shear-activated Microfiber Array Adhesive  
C. Majidi, R. S. Fearing  
*MRS 2008 Spring Meeting* San Francisco, CA (2008).
- (3) Foot design and integration for bioinspired climbing robots  
M. Spenko, M. Cutkosky, C. Majidi, R. S. Fearing, R. E. Groff, K. Autumn  
*Proc. of SPIE, Unmanned Systems Tech. VIII* **623019** (2006).
- (2) Compressive Properties of Dense Vertically Aligned Multi-walled Carbon Nanotube Arrays  
T. Tong, Y. Zhao, L. Delzeit, C. Majidi, R. E. Groff, P. Reddy, A. Majumdar, A. Kashani,  
M. Meyyappan  
*ASME NANO Conference* Berkeley, CA (2005).

- (1) Clumping and Packing of Hair Arrays Manufactured by Nanocasting  
C. Majidi, R. E. Groff, R. S. Fearing  
*ASME IMECE Conference Anaheim, CA (2004).*

## Conference Abstracts

- (26) Adhesion and Peeling Instability of an Elastic Rod  
C. Majidi, O. M. O'Reilly  
*Society of Engineering Science Annual Meeting Providence, RI (2013).*
- (25) Electrically Powered Soft-Matter Composites with Tunable Elastic Rigidity  
W. Shan, T. Lu, C. Majidi  
*Society of Engineering Science Annual Meeting Providence, RI (2013).*
- (24) Reversible Rigidity Control Using Low Melting Temperature Alloys  
W. Shan, T. Lu, C. Majidi  
*APS March Meeting Baltimore, MD (2013).*
- (23) Soft-Matter Resistive Sensor for Measuring Shear and Pressure Stresses  
D. Tepayotl-Ramirez, P. Roberts, C. Majidi  
*APS March Meeting Baltimore, MD (2013).*
- (22) Highly Deformable Liquid Embedded Soft-Matter Capacitors and Inductors for Stretchable Electronics  
A. Fassler, C. Majidi  
*APS March Meeting Baltimore, MD (2013).*
- (21) Manufacturing of Liquid-Embedded Elastomers for Stretchable Electronics  
R. Kramer, C. Majidi, J. Weaver, R. Wood  
*APS March Meeting Baltimore, MD (2013).*
- (20) Collapse of Non-Rectangular Microchannels in an Elastic Halfspace: Theory, Simulation, and Experiment  
D. Tepayotl-Ramirez, T. Lu, C. Majidi  
*Society of Engineering Science Annual Meeting, Atlanta, GA (2012).*
- (19) Continuum Elasticity Theory Approach for Spontaneous Bending and Twisting of Ribbons Induced by Mechanical Anisotropy  
Z. Chen, C. Majidi, D. J. Srolovitz, M. Haataja  
*Society of Engineering Science Annual Meeting Atlanta, GA (2012).*
- (18) Bistable Morphing Structures: Geometric and Mechanical Determinations  
Z. Chen, Q. Guo, C. Majidi, W. Chen, D. J. Srolovitz, M. Haataja  
*Society of Engineering Science Annual Meeting Atlanta, GA (2012).*
- (17) Soft Robots: Manipulation, Mobility, and Fast Actuation  
R. F. Shepherd, F. Ilievski, W. Choi, A. Stokes, S. Morin, A. D. Mazzeo, R. Kramer, C. Majidi, R. J. Wood, G. M. Whitesides  
*APS March Meeting Boston, MA (2012).*
- (16) Liquid-Embedded Elastomer Electronics  
R. Kramer, C. Majidi, Y.-L. Park, J. Paik, R. J. Wood  
*APS March Meeting Boston, MA (2012).*
- (15) Engineering Shapes in Nanotechnology: Helicity on Demand

- Z. Chen, C. Majidi, D. J. Srolovitz, M. Haataja  
*TMS Annual Meeting & Exhibition* San Diego, CA (2011).
- (14) Theory for the Spontaneous Bending and Helicity of Ribbons  
Z. Chen, Q. Guo, C. Majidi, W. Chen, D. J. Srolovitz, M. Haataja  
*Society of Engineering Science Annual Meeting* Evanston, IL (2011).
- (13) Ultrasoft Electronics for Hyperelastic Strain, Pressure, and Direct Curvature Sensing  
C. Majidi, R. Kramer, R. J. Wood  
*APS March Meeting*, Dallas TX (2011).
- (12) Highly Compliant Pressure Sensor Using Conductive Fluid in an Elastomeric Sheet  
R. Kramer, Y.-L. Park, C. Majidi, P. Bérard, R. J. Wood  
*MRS 2010 Fall Meeting* Boston, MA (2010).
- (11) Elastomers Embedded with Liquid Filled Microchannels for Robotics and Sensing  
C. Majidi, Y.-L. Park, P. Bérard, R. J. Wood  
*Society of Engineering Science Annual Meeting* Ames, IA (2010).
- (10) Adhesion Boundary Conditions for Elastic Plates  
C. Majidi, G. G. Adams  
*The Adhesion Society Annual Meeting* Daytona Beach, FL (2010).
- (9) Adhesion of Compliant Cylinders  
J. Shi, S. Muftu, C. Majidi, K. T. Wan  
*The Adhesion Society Annual Meeting* Daytona Beach, FL (2010).
- (8) Design Principles for Nanopiezoelectric Energy Harvesting  
C. Majidi, M. Haataja, D. J. Srolovitz  
*MRS 2009 Fall Meeting* Boston, MA (2009).
- (7) Energy Harvesting with Piezoelectric Nanobrushes: Analysis & Design Principles  
C. Majidi, M. Haataja, D. J. Srolovitz  
*ASME/STLE Int. Joint Tribology Conf. (IJTC)* Memphis, TN (2009).
- (6) Adhesion Between Similar and Dissimilar Thin-Walled Micro-Structures  
C. Majidi, K. T. Wan  
*ASME Int. Conf. on Micro- and Nanosystems (MNS)* San Diego, CA (2009).
- (5) A Simplified Formulation of Adhesion Problems with Elastic Plates (poster accepted)  
C. Majidi, G. G. Adams  
*Gordon Conf. on the Science of Adhesion* New London, NH (2009).
- (4) Theoretical Analysis for the Spontaneous Bending of Piezoelectric Nanoribbons (poster)  
C. Majidi, D. J. Srolovitz, M. P. Haataja  
*MRS 2008 Fall Meeting* Boston, MA (2008).
- (3) Effect of Surface Roughness on Adhesion and Friction of Microfibers in Side Contact  
M. Teodorescu, C. Majidi, H. Rahnejat, R. S. Fearing  
*ASME/STLE Int. Joint Tribology Conf. (IJTC)* Miami, FL (2008).
- (2) Friction and Adhesion of Micro-Fiber Arrays (poster)  
C. Majidi, R. Groff, S. S. Baek, B. Schubert, R. S. Fearing  
*Gordon Conference on the Science of Adhesion* Tilton, NH (2009).
- (1) Design and construction of a wildfire instrumentation system using networked sensors (poster)  
M. M. Chen, C. Majidi, D. M. Doolin, S. Glaser, N. Sitar  
*Network Embedded Systems Technology Retreat* Oakland, CA (2003).

## Invited Talks

Soft-Matter Electronics, Multifunctional Materials, and Fabrication Methods for Soft Robots

*Department of Mechanical Engineering*

Yale University, September 2013.

Soft-Matter Electronics, Multifunctional Materials, and Fabrication Methods for Soft Robots

*International Workshop on Soft Robotics and Morphological Computation*

Ascona, Switzerland, July 2013.

Adhesion and Spontaneous Deformation of Thin Elastic Sheets

*New England Complex Fluids Symposium*

New Haven, CT, March 2013.

Extreme Mechanics in Soft Pneumatic Robots and Soft Microfluidic Electronics and Sensors

*APS March Meeting*

Boston, MA, March 2012.

Mechanics of Soft Robots

*ETH-Zurich Robotics Summer School*

Zurich, Switzerland, June 2012. Soft Multifunctional Materials for Electronics, Robotics, &

Medicine

*Department of Mechanical Engineering*

Carnegie Mellon University, February 2011.

Soft Active Materials for Electronics, Robotics, & Medicine

*Department of Mechanical Science & Engineering*

University of Illinois at Urbana-Champaign, January 2011.

Functionality of Active Micro/Nanostructured materials through Mechanics and Surface Effects

*Department of Engineering Science & Mechanics*

Virginia Tech, February 2010.

Functionality of Active Micro/Nanostructured materials through Mechanics and Surface Effects

*Department of Mechanical Engineering*

Johns Hopkins University, January 2010.

Bio-inspired Grasping and Locomotion on Rough Surfaces

*Machines & Organisms Seminar*

Cornell University, September 2009.

Nanostructured Surfaces and Interfaces for Smart Adhesion and Energy Harvesting

*Department of Mechanical Engineering*

University of British Columbia, September 2009.

Nanostructured Surfaces and Interfaces for Smart Adhesion and Energy Harvesting

*Department of Mechanical & Industrial Engineering*

Northeastern University, July 2009.

Spontaneous Bending of Piezoelectric Nanoribbons

*Department of Engineering Science & Mechanics*

Virginia Tech, April 2009.

Spontaneous Bending of Piezoelectric Nanoribbons

*Computational Materials Science Network*

Princeton University, September 2008.

Shear-Activated Array Adhesive

*Lindbergh Lecture, Department of Mechanical Engineering  
University of Wisconsin at Madison, February 2007.*

## Unpublished Works

- Enhanced Friction and Adhesion with Biologically Inspired Fiber Arrays  
C. Majidi, Ph.D. Thesis, University of California, Berkeley, May 2007
- Mechanics of Gecko Adhesion  
C. Majidi, M.S. Thesis, University of California, Berkeley, May 2005

## Grants

- Energy Harvesting for Soft-Matter Machines and Electronics  
PI: Carmel Majidi  
*AFOSR 2013 Young Investigator Program 2013-2016.*
- Soft Active Materials and Electronics for Bioinspired & Biomechanically-Compatible Robotics  
PI: Carmel Majidi  
*ONR 2012 Young Investigator Program 2012-2015.*
- Soft Machines and Electronics for Bio-inspired Robots and Wearable Assistive Technologies  
PI: Carmel Majidi  
*DARPA Young Faculty Award 2012-2014.*

## Patents

- Enhanced Friction of Micropatterned Surfaces Immersed in Magnetorheological Fluid  
C. Majidi, R. J. Wood  
*US Patent & Trademark Office 8,579,842 November 12, 2013.*
- Stretchable Two-Dimensional Pressure Sensor  
C. Majidi, Y.-L. Park, R. J. Wood  
*US Patent & Trademark Office 8,316,719 November 27, 2012.*
- Symmetric, Spatular Attachments for Enhanced Adhesion of Micro- and Nano-fibers  
C. Majidi, R. E. Groff, R. S. Fearing  
*US Patent & Trademark Office 8,309,201 November 13, 2012.*
- Actively switchable nano-structured adhesive  
R. S. Fearing, A. Bachrach, R. E. Groff, C. Majidi  
*US Patent & Trademark Office 7,914,912 March 29, 2011*
- Nanostructured friction enhancement using fabricated microstructure  
C. Majidi, R. E. Groff, R. S. Fearing  
*US Patent & Trademark Office 7,799,423 Sept. 21, 2010.*
- Compliant base to increase contact for micro- or nano-fibers  
C. Majidi, R.E. Groff, R.S. Fearing, S. D. Jones  
*US Patent & Trademark Office 7,709,087 May 4, 2010.*

## Professional Activities

**Journal Editorial Board** Soft Robotics; Mary Ann Liebert, Inc.; 2013 - present

**Conference Organizer** APS March Meeting; 2012, 2013

**Journal Reviewer** Proceedings of the National Academy of Sciences; Advanced Materials; Journal of the Royal Society Interface; IEEE Transactions on Systems, Man and Cybernetics; International Journal of Robotics Research; International Journal of Solids and Structures; Journal of Applied Mechanics; Journal of Applied Physics; Langmuir; Sensors; Sensors and Actuators

**Conference Reviewer** IEEE International Conference on Intelligent Robots and Systems; IEEE International Conference on Robotics and Automation; Dynamic Systems and Control Conference; IEEE International Conference on Intelligent Robots and Systems

**Grant Reviewer** National Science Foundation; American Chemical Society; Department of Energy Office of Science Graduate Fellowship Program; ETH-Zurich Fellowship; 2012

## Awards, Prizes, & Honors

2014 National Academy of Engineering, Frontiers of Engineering; Session Organizer

2013 PopTech Science Fellow

2013 National Academy of Engineering, Frontiers of Engineering; Invited Attendee

2013 Air Force Office of Scientific Research, Young Investigator Program; Award Recipient

2012 Defense Advanced Research Projects Agency, Young Faculty Award

2012 Office of Naval Research, Young Faculty Award

2001 Merrill Presidential Scholar, Cornell University

*Awarded to seniors with a GPA in the top 1 percentile of the graduating class.*

2001 Banner Bearer, Cornell University Graduation Ceremony

*Honor bestowed to seniors with a GPA among the top 3 in the College of Engineering.*

## Media Interviews and Articles

Katherine Harmon, "Will the Robot Uprising Be Squishy?" Scientific American Online, July 2013.

Adam Hadhzy, "Soft Bots," Popular Science, March 2013.

Jennifer Hicks, "Soft Robotics Takes Shape," Forbes, April 2012.

Neil Savage, "Soft Robots for Hard Problems," IEEE Spectrum, May 2012.

Alicia Chang, "Gumby-like flexible robot crawls in tight spaces," Associated Press, November 2011.

"High-Friction Microfibers," Physics Today, October 2006.