

# JONGMIN SHIM, PH.D.

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## 1 Professional Interests

### • Research

- Solid Mechanics: nonlinear constitutive modeling, geometry-induced damping
- Dynamic Analysis: impact analysis/test, waves in solids, phononic crystals
- Large Deformation Analysis: pattern transformation, foldable structures, instability, mechanical metamaterials

### • Teaching

- Solid mechanics, Continuum mechanics, Finite element analysis
- Engineering mathematics, Numerical methods
- Wave motion in elastic solids, Structural stability

## 2 Professional Preparation

Korea Adv. Inst. of Sci. & Tech. [KAIST]	Civil Eng.	B.S.	1998
Korea Adv. Inst. of Sci. & Tech.	Civil Eng.	M.S.	2001
Massachusetts Institute of Technology [MIT]	Civil & Env. Eng.	M.S.	2005
Massachusetts Institute of Technology	Eng. Mech.	Ph.D.	2010

## 3 Appointments

University at Buffalo [UB]	Assistant Professor	2013-present
Harvard University	Post-Doc.	2010-2012

## 4 Student Advisement

□ *Summary: 2 Ph.D. students in progress.*

### • Current Students

- A.B.M.T. Haque (Ph.D.) Amplitude-dependent nonlinear behavior of viscoelastic mechanical metamaterials (Expected graduation in 05/2017)
- Seoyoung Heo (Ph.D.) Adaptive facade (Expected graduation in 05/2018)
- Bodhi Rudra (M.S.) Deformation-induced pattern transformations in soft granular crystals (01/2016-present)
- Anurag Bura (M.S.) Snapping-induced damping (01/2016-present)
- Mohamed Diaby (Undergraduate, UB Space Grant Fellow) Snapping honeycomb structures (05/2015-present)

## 5 Research Grant Proposals

□ **Summary:** total funding of \$300K approximately as the PI.

### • Externally Funded Grants

- (PI, 70%) EAGER: Tuning granular phononic crystals through pattern transformations  
NSF-MOMS (\$150,000, Sep. 2016 - Feb. 2018)  
PIs: J. Shim, M.A. Karami
- (PI, 70% of UB\$) Spectral band-structure identification of amplitude-dependent viscoelastic mechanical metamaterials  
QNRN-NPRP (UB: \$269,870, Qatar U: \$526,162, Feb. 2016 - Feb. 2019)  
PIs: J. Shim, A. Aref, W. Alnahhal (Qatar U)

### • Internally Funded Grants

- (co-PI, 33%) Zero energy adaptive facade for energy efficient buildings  
UB-SMART Exploratory Grant (\$34,981, Feb. 2016 - Feb. 2017)  
PIs: H. Lin, J. Song, J. Shim
- (co-PI) New applications for waste fibres in architecture  
UB-SMART Exploratory Grant (\$5,000, Feb. 2016-Feb. 2017)  
PIs: S. Davidson, J. Shim
- (co-PI) Elastomeric balloon based transfer printing of conformal sensors  
UB-SMART Exploratory Grant (\$17,500, Feb. 2016 - Feb. 2017)  
PIs: R. Rai, J. Shim, A. Aref, G. Dargush
- (co-PI, completed) Offshore wind energy in the great lakes: Technological, ecological, socio-economic and policy factors to create a comprehensive modeling and simulation framework  
UB-RENEW Seed Grant (\$46,500, Sep. 2014 - Aug. 2015)  
PIs: M. Sivaselvan, J. Shim, A. Tessari, S. Delavan, K. Friedman, J. Hall, S. Das

## 6 Journal Publications

□ **Summary:** 15 peer-reviewed journal publications, 426 citations, h-index 10.

□ ORCID ID: 0000-0001-5485-160X, ResearcherID: D-3420-2014, Scopus ID: 164-1800-9700

### • Peer Reviewed Journal Publications Completed at UB (7)

- A.B.M.T. Haque\* and J. Shim#, On spatial aliasing in the phononic band-structure of layered composites, *International Journal of Solids and Structures*, **96**(1):380-392, 2016. (Citation: 0, IF: 2.2)
- D. Kwon, T. Lee, J. Shim, S. Ryu, M. Kim, S. Kim, T. Kim, and I. Park, Highly sensitive, flexible and wearable pressure sensor based on a giant piezocapacitive effect of three-dimensional microporous elastomeric dielectric layer, *ACS Applied Materials & Interfaces*, **8**(26):16922-16931, 2016. (Citation: 0, IF: 6.72)
- J. Shim#, P. Wang and K. Bertoldi+, Harnessing instability-induced pattern transformation to design tunable phononic crystals, *International Journal of Solids and Structures*, **58**(1):52-61, 2015. (Citation: 2, IF: 2.2)

- B. Mosadegh, P. Polygerinos, C. Keplinger, S. Wennstedt, R.F. Shepherd, U. Gupta, J. Shim, K. Bertoldi<sup>+</sup>, C.J. Walsh, and G.M. Whitesides, Pneumatic networks for soft robotics that actuate rapidly, *Advanced Functional Materials*, **24**(15):2163-2170, 2014. (Citation: 44, IF: 11.8)
- J. Shim<sup>#</sup>, S. Shan, A. Kosmrlj, S.H. Kang, E.R. Chen, J.C. Weaver and K. Bertoldi<sup>+</sup>, Harnessing instabilities for design of soft reconfigurable auxetic/chiral materials, *Soft Matter*, **9**(34):8198-8202, 2013. (Citation: 18, IF: 4.0)
- S. Babaee, J. Shim<sup>#</sup>, J. Weaver, E.R. Chen, N. Patel and K. Bertoldi<sup>+</sup>, 3-D soft metamaterials with negative Poissons ratio, *Advanced Materials*. **25**(36):5044-5049, 2013. (Citation: 43, IF: 17.5)
- P. Wang, J. Shim and K. Bertoldi<sup>+</sup>, Effects of geometric and material nonlinearities on tunable band gaps and low-frequency directionality of phononic crystals, *Physical Review B*, **88**(1):014304, 2013. (Citation: 27, IF: 3.7)

• **Peer Reviewed Journal Publications Completed in Previous Positions (8)**

- J. Li, J. Shim, J. Deng, J.T.B. Overvelde, X. Zhu, K. Bertoldi<sup>+</sup>, S. Yang, Switching photonic membranes via pattern transformation and shape memory effect, *Soft Matter*. **8**(40):10322-10328, 2012. (Citation: 23, IF: 4.0)
- J. Shim<sup>#</sup>, C. Perdigou, E.R. Chen, K. Bertoldi<sup>+</sup>, P.M. Reis, Buckling-induced encapsulation of structured elastic shells under pressure, *Proceedings of the National Academy of Sciences of the USA*, **109**(16):5978-5983, 2012. (Citation: 45, IF: 9.7)
- J. Shim<sup>#</sup>, A. Grosberg, J.C. Nawroth, K.K. Parker, K. Bertoldi<sup>+</sup>, Modeling of cardiac muscle thin films: pre-stretch, passive and active behavior, *Journal of Biomechanics*, **45**(5):832-841, 2012. (Citation: 20, IF: 2.8)
- F. Goncu, S. Willshaw, J. Shim, J. Cusack, S. Luding, T. Mullin, K. Bertoldi<sup>+</sup>, Deformation induced pattern transformation in a soft granular crystal, *Soft Matter*, **7**(6):2321-2324, 2011. (Citation: 5, IF: 4.0)
- J. Shim<sup>#</sup>, D. Mohr<sup>+</sup>, Punch indentation of polyurea at different loading velocities: Experiments and numerical simulations, *Mechanics of Materials*, **43**(7):349-360, 2011. (Citation: 3, IF: 2.3)
- J. Shim<sup>#</sup>, D. Mohr<sup>+</sup>, Rate dependent finite strain constitutive model of polyurea. *International Journal of Plasticity*, **27**(6):868-886, 2011. (Citation: 25, IF: 5.6)
- J. Shim<sup>#</sup>, D. Mohr<sup>+</sup>, Using split Hopkinson pressure bars to perform large strain compression tests on polyurea at low, intermediate and high strain rates, *International Journal of Impact Engineering*, **36**(9):1116-1128, 2009. (Citation: 47, IF: 2.2)
- J.W. Lee, J.D. Kim, C.B. Yun<sup>+</sup>, J.H. Yi, J. Shim, Health-monitoring method for bridges under ordinary traffic loadings, *Journal of Sound and Vibration*, **257** (2):247-264, 2002. (Citation: 116, IF: 1.8)

• **Submitted Manuscripts**

- A.B.M.T. Haque<sup>\*</sup> and J. Shim<sup>#</sup>, Analytical dispersion relation of multilayered periodic composites (submitted 8/2016)

[**Note 1**] <sup>\*</sup>: graduate student under the direct supervision; <sup>#</sup>: leading or corresponding author; <sup>+</sup>: master/doctoral/postdoctoral advisor.

[**Note 2**] The impact factor [IF] associated with the journals are collected from Web of Science on Oct. 2015.

[**Note 3**] The citation counts and  $h$ -index are collected from Google Scholar on Oct. 2015.

## 7 Research Presentations

□ **Summary:** 12 invited seminars, 2 peer-reviewed conference publications, 19 conference/workshop presentations.

### • Invited Seminars

- Elastomeric materials and beyond, *School of Mechanical Engineering, Gwangju Institute of Science and Technology [GIST]*, Gwangju, South Korea, Aug 3, 2016.
- Soft mechanical metamaterials harnessing instabilities, *School of Urban and Environmental Engineering, Ulsan National Institute of Science and Technology [UNIST]*, Ulsan, South Korea, May 26, 2015.
- Soft mechanical metamaterials harnessing instabilities, *School of Mechatronics, GIST*, Gwangju, South Korea, May 22, 2015.
- Soft mechanical metamaterials harnessing instabilities, *School of Mechanical and Aerospace Engineering, KAIST*, Daejeon, South Korea, May 19, 2015.
- Buckling-induced functionality of porous elastomeric structures, *Department of Civil Engineering and Engineering Mechanics, Columbia University*, New York, NY, Mar. 30, 2012.
- Buckling-induced functionality of porous elastomeric structures, *Department of Civil and Environmental Engineering, University of Washington*, Seattle, WA, Mar. 26, 2012.
- Buckling-induced functionality of porous elastomeric structures, *Department of Mechanical and Energy Engineering, University of North Texas*, Denton, TX, Mar. 16, 2012.
- Buckling-induced functionality of porous elastomeric structures, *Department of Civil, Structural and Environmental Engineering, University at Buffalo*, Buffalo, NY, Mar. 5, 2012
- Buckling-induced functionality of porous elastomeric structures, *School of Engineering, University of Vermont*, Burlington, VT, Feb. 24, 2012
- Modeling of cardiac muscle thin films: pre-stretch, passive and active behavior, *Kavli Meeting, Kavli Institute for Bionano Science and Technology, Harvard University*, Cambridge, MA. May 19, 2011.
- Finite strain behavior of polyurea for a wide range of strain rates, *Division of Material System Technologies, GE Global Research*, Niskayuna, NY. Dec. 15, 2009.
- Finite strain behavior of polyurea for a wide range of strain rates, *Division of Material Science and Technology, Oak Ridge National Laboratory*, Oak Ridge, TN. Oct. 29, 2009.

### • Peer-reviewed Conference Publications

- J. Song, H. Lin and J. Shim, Low energy adaptive facade, *Proceedings of Facade Tectonics 2016 World Congress*, Los Angeles, CA, Oct. 10-11, 2016.
- J. Shim<sup>#</sup> and T. Wierzbicki<sup>+</sup>, Failure of an impulsively-loaded composite steel/polymer plate, *Proceedings of 2006 ASME International Mechanical Engineering Congress and Exposition*, Paper No. IMECE2006-16224, pp. 587-598, Chicago, IL, Nov. 5-10, 2006. (doi:10.1115/IMECE2006-16224)

**• Conference/Workshop Presentations**

- B. Rudra<sup>\*</sup>, A.B.M.T. Haque<sup>\*</sup>, Y. Li and J. Shim<sup>#</sup>, Instability-induced pattern transformation in diatomic soft granular crystals, *2016 ASME International Mechanical Engineering Congress and Exposition*, Phoenix, AZ, Nov. 17, 2016.
- A.B.M.T. Haque<sup>\*</sup> and J. Shim<sup>#</sup>, Generalized spatial aliasing solutions for dispersion analysis of multilayered periodic composites, *2016 ASME International Mechanical Engineering Congress and Exposition*, Phoenix, AZ, Nov. 17, 2016.
- S. Heo<sup>\*</sup>, A.B.M.T. Haque<sup>\*</sup> and J. Shim<sup>#</sup>, Investigation on the mechanism of pattern transformation in diatomic soft granular crystals, *2015 ASME International Mechanical Engineering Congress and Exposition*, Houston, TX, Nov. 19, 2015.
- A.B.M.T. Haque<sup>\*</sup> and J. Shim<sup>#</sup>, Investigation of phononic band-structure analysis subjected to spatial aliasing in the finite element framework, *2015 ASME International Mechanical Engineering Congress and Exposition*, Houston, TX, Nov. 18, 2015.
- J. Shim<sup>#</sup>, P. Wang and K. Bertoldi<sup>+</sup>, Tunable phononic band-gap structures undergoing pattern transformation, *2013 ASME International Mechanical Engineering Congress and Exposition*, San Diego, CA, Nov. 20, 2013.
- J. Shim<sup>#</sup>, S. Babae, J. Weaver, N. Patel, E.R. Chen and K. Bertoldi<sup>+</sup>, 3-D soft auxetic metamaterials, *2013 APS March Meeting*, Baltimore, MD, Mar. 21, 2013.
- J. Shim<sup>#</sup>, S. Babae, J. Weaver, N. Patel, E.R. Chen and K. Bertoldi<sup>+</sup>, Buckliball and beyond: 3-D soft auxetic metamaterials, *2012 ASME International Mechanical Engineering Congress and Exposition*, Houston, TX, Nov. 13, 2012.
- J. Shim<sup>#</sup>, S. Shan, S.H. Kang, P. Wang, E.R. Chen, J. Aizenberg and K. Bertoldi<sup>+</sup>, Buckling-induced planar chirality of porous elastomeric structures, *2012 APS March Meeting*, Boston, MA, Feb. 28-Mar.1, 2012.
- J. Shim<sup>#</sup>, C. Perdigou, E.R. Chen, K. Bertoldi<sup>+</sup> and P.M. Reis, Buckliball: buckling-induced encapsulation of elastic spherical shells under pressure, *48th Annual Technical Conference of Society of Engineering Sciences*, Evanston, IL, October 12-14, 2011.
- J. Shim<sup>#</sup>, C. Perdigou, E.R. Chen, P.M. Reis, K. Bertoldi<sup>+</sup>, Pressure induced pattern transformation of a structured elastic shell. *Mech&Mat Harvard SEAS*. Cambridge, MA, May 20, 2011.
- J. Shim<sup>#</sup>, C. Perdigou, K. Bertoldi<sup>+</sup> and P.M. Reis, Pressure induced pattern transformation of a structured elastic shell, *2011 APS March Meeting*, Dallas, TX, Mar. 21-25, 2011.
- J. Shim<sup>#</sup>, A. Grosberg, J. Nawroth, K. Parker and K. Bertoldi<sup>+</sup>, Modeling of bio-hybrid cardiac muscular thin films, *2010 MRS Fall Meeting*, Boston, MA, Nov. 29-Dec. 3, 2010.
- J. Shim<sup>#</sup>, D. Mohr<sup>+</sup> and T. Wierzbicki<sup>+</sup>, Large deformation of polyurea under intermediate strain rates, *ONR Program Review*, Arlington, VA, April 13, 2010.
- J. Shim<sup>#</sup> and D. Mohr<sup>+</sup>, Constitutive modeling of polyurea with application to impact protection, *6th MIT Fracture Workshop*, Cambridge, MA. Nov. 19-20, 2009.
- J. Shim<sup>#</sup> and D. Mohr<sup>+</sup>, Modified SHPB tests for large deformation of polyurea under intermediate strain rates, *2009 SEM Annual Conference and Exposition on Experimental and Applied Mechanics*, Albuquerque, NM, Jun. 1-4, 2009.
- J. Shim<sup>#</sup> and T. Wierzbicki<sup>+</sup>, Parametric study on mesh sensitivity with flat tensile specimen, *5th MIT Fracture Workshop*, Cambridge, MA. Oct. 9-10, 2008.

- J. Shim<sup>#</sup> and D. Mohr<sup>+</sup>, Dynamic material testing in the intermediate strain rates, *4th MIT Fracture Workshop*, Cambridge, MA. Oct. 17-18, 2007.
- J. Shim<sup>#</sup> and T. Wierzbicki<sup>+</sup>, Mesh size effect on fracture calibration on an example of RHA steel, *3rd MIT Fracture Workshop*, Cambridge, MA, Oct. 16-17, 2006.
- J. Shim<sup>#</sup> and T. Wierzbicki<sup>+</sup>, Deformation and failure of an impulsively-loaded composite plate, *ONR Workshop: Materials & Structures for Advanced Ship Protection*, St. Michaels, MD, Sep. 28-31, 2006.
- J. Shim<sup>#</sup>, C. Walters and T. Wierzbicki<sup>+</sup>, Deformation and fracture of blast-loaded circular composite plate, *2nd MIT Fracture Workshop*, Cambridge, MA, Oct. 12-13, 2005.
- J. Shim<sup>#</sup> and F.-J. Ulm<sup>+</sup>, Nonlinear analysis of architectural structure using model-based simulation approach, *Workshop FURJ-COPPE/MIT*, Rio de Janeiro, Brazil, Mar. 22-24, 2004.

[**Note 1**] <sup>\*</sup>: graduate student under the direct supervision; <sup>#</sup>: presenting author; <sup>+</sup>: master/doctoral/postdoctoral advisor.

## 8 Fellowships and Awards

- UB Faculty Internationalization Fund Award (May 2015)
- SUNY UUP Professional Development Award (May 2014, May 2016)
- ASCE ExCEEEd 2013 Teaching Fellows (Jul. 2013)
- NSF Travel Fellowships for Summer Institute in Additive Manufacturing (May 2013) and Materiomics (May 2012)
- Best Presentation/Poster Award, 2011 Mech&Mat at Harvard SEAS (May 20, 2011)
- KAIST Student Travel Award (Jul. 1997)
- KAIST Merit-Based Scholarships (Mar. 1994 - Feb. 2001)

## 9 Professional Development Workshops

### • Research-Related Workshops

- NSF CMMI and Northeastern University, Boston, MA  
NSF CAREER Proposal Writing Workshop (Apr. 2015)
- 2014 ASME IDET Conference and NSF CMMI, Buffalo, NY  
NSF CAREER Proposal Writing Workshop (Aug. 2014)
- Grant Writers' Seminar & Workshop, Buffalo, NY  
NSF Grant Proposal Seminar (Oct. 2013)
- NSF Summer Institute on Nanomechanics, Nanomaterials, and Micro/Nanomanufacturing, Evanston, IL  
Workshop on Additive Manufacturing (May 2013)  
Workshop on Materiomics (May 2012)
- Korea-American Scientists and Engineers Association [KSEA], Atlanta, GA  
Scientists and Engineers Early Career Development [SEECD] Workshop (Feb. 2013)

### • Teaching-Related Workshops

- American Society of Civil Engineers [ASCE], Fort Myers, FL  
Excellence in Civil Engineering Education [ExCEED] Teaching Workshop (July 2013)
- MIT, Foreign Languages & Literatures, Cambridge, MA  
Workshop in Strategies for Effective Teaching (Jan. 2007)

## 10 Teaching Experiences

### • Instructor

- UB, Department of Civil, Structural and Environmental Engineering
  - CIE411 *Numerical Methods in Civil Engineering*
  - CIE500JS *Wave Motions in Structures*
  - CIE516 *Advanced Mathematics for Civil Engineers*

<i>Course</i>	<i>Semester</i>	<i>Students Responded</i>	<i>Course Rating</i>	<i>Instructor Rating</i>
CIE411	Spring 2016	11/22 (50%)	3.64/5	3.91/5
	Spring 2015	9/12 (75%)	4.33/5	5.00/5
CIE500JS	Spring 2014	0/2 (0%)	-	-
CIE516	Fall 2015	17/33 (52%)	3.94/5	4.00/5
	Fall 2014	24/44 (55%)	3.46/5	3.58/5
	Fall 2013	17/36 (47%)	3.65/5	3.35/5
	Spring 2013	30/48 (63%)	2.47/5	2.50/5

### • Teaching Certificate/Teaching Assistant/Guest Lecturer

- MIT, Teaching & Learning Laboratory
  - TAs@MIT -- Graduate Students Teaching Certificate (Fall 2008-Spring 2009)
- MIT, Department of Mechanical Engineering
  - Guest Lecturer for *Plates and Shells* and *Structural Impact* (Spring 2007, Spring 2008, Spring 2009)
  - Teaching Assistant for *Plates and Shells* (Spring 2006)
- KAIST, Department of Civil and Environmental Engineering
  - Teaching Assistant for *Introduction to Structural Engineering* (Fall 2000)

## 11 Professional Activities and Service

### • Professional Activities

- Journal Reviewer  
Advanced Materials (1); Advanced Engineering Materials (2); ASME IMECE Conference Proceedings (10); Biomaterials (1); Extreme Mechanics Letters (1); Journal of Vibration and Acoustics (1); Journal of Mechanics of Materials and Structures (1); Computer Methods in Biomechanics and Biomedical Engineering (1); International Journal of Impact Engineering (2); Journal of Nanomechanics and Micromechanics (1); Journal of Structural Engineering (2); Materials (1); Soft Matter (3).
- Topic Organizer

- Mechanics and Design of Cellular Materials, 2016 ASME IMECE
- Mechanics and Design of Cellular Materials, 2015 ASME IMECE
- Conference Session Chair/Discussion Leader
  - Mechanical Metamaterials Technical Session, 2015 ASME IMECE
  - Tunable Materials Technical Session, 2013 APS March Meeting
  - Mechanical Metamaterials, 2013 April Journal Club of *iMechanica* ([www.imechanica.org](http://www.imechanica.org))
- Professional Committee Member
  - ASME Composite Materials Technical Committee
  - ASME Mechanics of Soft Materials Technical Committee
  - ASCE EMI Dynamics Technical Committee
- Professional Community Service
  - Judge for International Undergraduate Research and Design Exposition, 2015 ASCE IMECE
- Professional Society Memberships
  - ASCE; ASME

#### • University Activities

- CSEE Materials/Structures Faculty Search Committee Member (2016 Spring)
- CSEE Graduate Studies Committee Member (2014-present)
- Academic Mentor
  - Collegiate Science & Technology Entry Program [CSTEP]: Mohamed Diaby, UB Space Grant Fellow (June, 2015-present)
  - Center for Undergraduate Research & Creative Actives [CRUCA]: Yenghao Yap, UB undergraduate (Feb. 2016-present).
- Judge, Annual CSTEP Research Poster Symposium (July, 2016)
- Doctoral Dissertation Committee Member
  - Fangbo Wang (Chair: Prof. K. Sett); Ji Zhang (Chair: Prof. C. Basaran); Jun Wang (Chair: Prof. R. Rai); Tingyue Lan (Chair: Prof. C. Basaran); Pierre Gautreau (Chair: Prof. C. Basaran, Completed on Dec. 20, 2013); Yongchang Lee (Chair: Prof. C. Basaran, Completed on May 15, 2013)

#### • Community Activities

- Academic Mentor
  - Buffalo-area Engineering Awareness for Minorities [BEAM] Summer Honors Research Program: Elizabeth Pogorzelski, Hutch-Tech High School student (July-August, 2015)
- Guest Lecturer
  - Engineering Expression at Transit Middle School, ASCE Buffalo Section (March 19, 2015)
  - National Summer Transportation Institute at UB (July 10, 2013)