

Ataollah Mesgarnejad

POSTDOCTORAL RESEARCH ASSOCIATE, CENTER FOR INTERDISCIPLINARY RESEARCH IN COMPLEX SYSTEMS

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Summary

I am a postdoctoral research associate at the Center for Interdisciplinary Research in Complex Systems (CIRCS) at the Department of Physics at Northeastern University working with [Prof. Alain Karma](#). My research focuses on modern computational mechanics with emphasis on fracture mechanics. Before joining CIRCS, I received my Ph.D. in Mechanical Engineering under [Prof. B. Bourdin](#) at Louisiana State University.

Education

Louisiana State University

LA, USA

PH.D. IN MECHANICAL ENGINEERING

Jan. 2008 - Dec. 2014

“Applications of the variational approach to fracture mechanics.” Advisor: [Prof. B. Bourdin](#), Co-advisor: [Prof. M.M. Khonsari](#).

Louisiana State University

LA, USA

M.SC. IN APPLIED MATHEMATICS

Jan. 2008 - Dec. 2014

“Development of a Work-controlled Algorithm for the Variational Approach to Fracture Mechanics and Its Application to Sandstone Burst Experiments.” Advisor: [Prof. B. Bourdin](#).

Amirkabir University of Technology

Tehran, Iran

M.SC. IN MECHANICAL ENGINEERING

Aug. 2005 - Oct. 2008

“Development of Constitutive Equations for the High Temperature Plasticity.” Advisor: [Prof. M.R. Eslami](#).

Islamic Azad University, Central Tehran Branch

Tehran, Iran

B.SC. IN MECHANICAL ENGINEERING

Aug. 2001 - Aug. 2005

Publications and Preprint ([Google Scholar](#))

“On the tribological behavior of MoS_2 coated thrust ball bearings operating under oscillating motion”, [A. Mesgarnejad](#), [M.M. Khonsari](#), *Wear*, 2010, Volume 269, Issues 7–8, pp. 547–556. doi.org/10.1016/j.wear.2010.05.010

“A variational approach to the fracture of brittle thin films subject to out-of-plane loading”, [A. Mesgarnejad](#), [B. Bourdin](#), [M. Khonsari](#), *Journal of Mechanics and Physics of Solids*, 2013, Volume 61, Issue 11, pp. 2360-2379. doi.org/10.1016/j.jmps.2013.05.001

“Validation simulations for the variational approach to fracture mechanics”, [A. Mesgarnejad](#), [B. Bourdin](#), [M. Khonsari](#), *Journal of Computer Methods in Applied Mechanics and Engineering*, 2015, Volume 290, pp. 420-437. doi.org/10.1016/j.cma.2014.10.052

“Phase-Field Models for Fatigue Crack Growth”, [A. Mesgarnejad](#), [A. Imanian](#), [A. Karma](#), *Journal of Theoretical and Applied Fracture Mechanics*, 2019, pp. 102282. doi.org/10.1016/j.tafmec.2019.102282

“Phase Field Modeling of Chemomechanical Fracture of Intercalation Electrodes: Role of Charging Rate and Dimensionality”, [A. Mesgarnejad](#), [A. Karma](#), *Journal of Mechanics and Physics of Solids*, 2019, Volume 132, pp. 103696. doi.org/10.1016/j.jmps.2019.103696

“Vulnerable Window of Yield Strength for Swelling-Driven Fracture of Phase-Transforming Battery Materials”, [A. Mesgarnejad](#), [A. Karma](#), Under review at *NPJ Computational Materials*, [arXiv:1908.02175](https://arxiv.org/abs/1908.02175).

“Fracture Toughness of Bone at the Microscale”, [N. Aldegaither](#), [G. Sernicola](#), [A. Mesgarnejad](#), [A. Karma](#), [D. Balint](#), [J. Wang](#), [E. Saiz](#), [S.J. Shefelbine](#), [A.E. Porter](#), [F. Giuliani](#), Under review at *Nature Materials*.

“Crack Path Selection in Orientationally Ordered Composites”, [A. Mesgarnejad](#), [C. Pan](#), [R.M. Erb](#), [S.J. Shefelbine](#), [A. Karma](#), Under review at *Physical Review E*, [arXiv:1811.05891](https://arxiv.org/abs/1811.05891).

Manuscripts Under Preparation ¹

“Role of System Size in Crack Kinking”, [A. Mesgarnejad](#), [C. Pan](#), [R.M. Erb](#), [S.J. Shefelbine](#), [A. Karma](#), To be submitted to *Physical Review Letters*.

¹A private copy can be made available upon request

“Enhanced toughness in ceramic-reinforced polymer composites with herringbone architectures”, *R. Zando, A. Mesgarnejad, C. Pan, S.J. Shefelbine, A. Karma, R.M. Erb*, To be submitted to *Advanced Materials*.

“Spatiotemporal Organization of Electromechanical Phase Singularities During Focal and Re-entrant Cardiac Arrhythmias”, *A. Molavi Tabrizi, A. Mesgarnejad, M. Bazzi, S. Luther, J. Christoph, A. Karma*, To be submitted to *Physical Review X*.

Conference Proceedings

“Constitutive relation for high temperature cyclic plasticity”, *A. Mesgarnejad, M. Sabbaghian, M.R. Eslami*, Proceedings of 7th International Congress on Thermal Stresses, Taiwan.

“Online coated ball bearing health monitoring using degree of randomness and Hidden Markov Model”, *Bo Ling, M.M. Khonsari, A. Mesgarnejad, R. Hathaway*, Proceedings of IEEE Aerospace Conference, 2009, Big Sky, Montana.

“Crack paths in anisotropic biomimetic composites”

A. Mesgarnejad, C. Pan, R.M. Erb, S.J. Shefelbine, A. Karma, Proceedings of 14th International Conference on Fracture, 2017, Rhodes, Greece (Vol.1 Part. A).

“Phase-field models of brittle and fatigue crack growth”, *A. Mesgarnejad, A. Karma*, Proceedings of 14th International Conference on Fracture, 2017, Rhodes, Greece (Vol.1 Part. A).

Research Experience

Northeastern University

Boston, MA

POSTDOCTORAL RESEARCH ASSOCIATE

July. 2015 - PRESENT

- Theoretical development and numerical implementation of a phase-field model for fracture in Li-ion batteries (DOE,BSE). Also participated in preparation and writing of the grant proposals in 2016 and 2019.
- Theoretical development and numerical implementation of an anisotropic fracture of biomimetic composites (NSF, MOMS) in collaboration with Prof. R. Erb (MIE, NEU) and Prof. S.J. Shefelbine (MIE & BIOE, NEU). This model was further used for the development a new tough composite architecture in conjunction with Prof. R. Erb (MIE, NEU). This model was also used for interpretation of experiments on micro DCB samples of bone in collaboration with Prof. G. Finn. at Imperial College London
- Theoretical development and numerical implementation of a novel class of phase-field models for fatigue crack propagation (STTR grant with *TDA Inc.* funded by US Navy Office of Small Business Programs). Also contributed to preparation and writing of grant proposals in 2016, 2017, and 2018.
- Supervised and participated in development of a electro-mechanical simulation framework to explain the origin of mechanical phase singularities during heart fibrillation.

Louisiana State University

Baton Rouge, LA

RESEARCH ASSISTANT

Jan. 2008 - Exp. Dec. 2014

- Theoretical development and numerical implementation of a phase-field model for the fracture of thin films (plates) under out-of-plane loading.
- Numerical validation of phase-field models of fracture against well-documented experimental observations.
- Theoretical development and numerical implementation of a work-controlled phase-field model for fracture.
- Performed numerical experiments to enhance the functionality of double-torsion experiments in collaboration with *Corning Inc.*

Teaching & Mentoring Experience

Louisiana State University

Baton Rouge, LA

TEACHING ASSISTANT

Jan. 2008 - Exp. Dec. 2014

- Taught machine design lab, dynamics, and thermodynamics.

Northeastern University

Boston, MA

POSTDOCTORAL RESEARCH ASSOCIATE

July. 2016 - May. 2017

- Managed and helped mentor Maher Bazzi, an M.Sc. degree student in Bioengineering and Physics.

Conference Presentations

“Phase-field Models for Brittle and Ductile Fatigue”, SES, St. Louis, MO, October 2019.

“Numerical Simulation of Lithiation-Driven Phase-Change and Fracture in Silicon”, IMECE, Pittsburgh, PA, November 2018.

“Phase-field Modeling of Anisotropic Phase-change and Fracture in Silicon Anodes in Li-ion Batteries”, WCCM13, New York, NY, July 2018.

“Phase-field modeling of Anisotropic Phase-Change and Fracture in Silicon Anode Materials for Li-ion batteries”, SES, Boston, MA, July 2017.

“Crack Kinking in Anisotropic Bio-mimetic Composites”, SES, Boston, MA, July 2017.

“Validation Experiments for Variational Approach to Fracture”, SCALA, New Orleans, LA, March 2015.

“A Variational Approach to the Fracture of Brittle Thin Films”, USNCCM 11, Raleigh, NC, July 2013.

Invited Talks

“Phase-Field Models for Anisotropic & Fatigue Crack Growth”, Phase-field models of fracture, Banff International Research Station for Mathematical Innovation and Discovery, Banff, AB, Canada, March 2019.

“Crack Deflection in Orientationally Ordered Composites”, USACM, Nonlocal methods in fracture, University of Texas, Austin, TX, January 2018.

“Crack Deflection in Orientationally Ordered Composites”, MIE Mechanics seminar series, Northeastern University, Boston, MA, December 2017.

“A Variational Approach to the Fracture of Brittle Thin Films”, SIAM seminar series, Louisiana State University, Baton Rouge, LA, March 2014.

Awards

2016 **XSEDE MSS160013 allocation**, Obtained 1.43 MSUs (≈ \$77000) from XSEDE

2016 **Travel award**, Obtained \$1200 for NYU-Oxford Pyre workshop

New York City, NY

2018 **Travel award**, Obtained \$555 for USACM, Nonlocal methods in fracture

Austin, TX

References

- **Prof. Alain Karma** (a.karma@northeastern.edu) Department of Physics, 110 Dana, 360 Huntington Avenue Boston, MA 02115. Tel. +1 (617) 373-2929.
- **Prof. Blaise Bourdin** (bourdin@lsu.edu) Department of Mathematics, 344 Lockett Hall, Louisiana State University, Baton Rouge, LA 70803. Tel. +1 (225) 578-1612.
- **Prof. Sandra J. Shefelbine** (s.shefelbine@northeastern.edu) Department of Mechanical and Industrial Engineering, Department of Biomechanics, 222 ISEC 360 Huntington Avenue Boston, MA 02115. Tel +1 (617) 373-3199.
- **Prof. Corrado Maurini** (corrado.maurini@upmc.fr) Institut Jean Le Rond d'Alembert (UMR 7190) Université Pierre et Marie Curie 4 Place Jussieu, case 162, Tour 55-65, 75252 Paris Cedex 05, 4th floor, Office 424, Paris. Tel +33 1 44 27 87 19.
- **Prof. Randall Erb** (r.erb@northeastern.edu) Department of Mechanical and Industrial Engineering, Northeastern University, 360 Huntington Avenue Boston, 334 Snell Engineering Center, MA 02115. Tel. +1 (617) 373-4649.