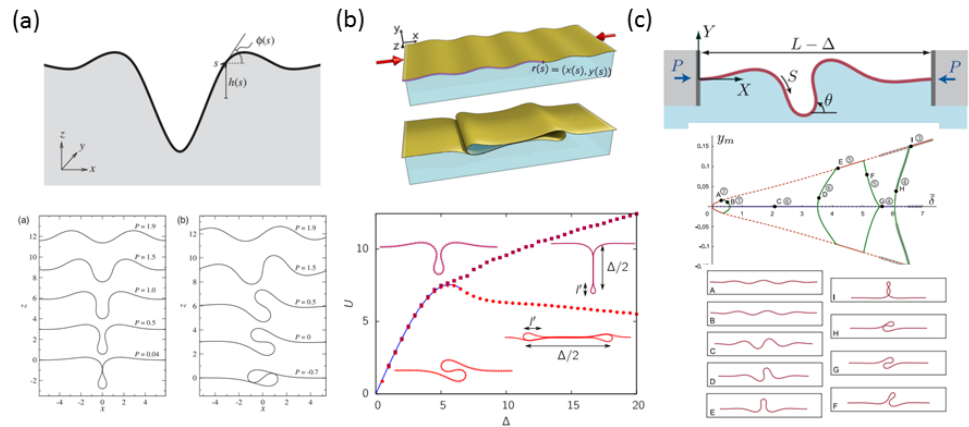




Professor Teng Zhang



From: Teng Zhang, “Ruga mechanics of thin sheets: wrinkling, crumpling, and folding”, <https://imechanica.org/node/22701> (iMechanica web of mechanics and mechanics), Journal Club of October 2018, Teng Zhang’s blog

See:

- <http://biomaterials.syr.edu/research/zhang/>
- http://biomaterials.syr.edu/news/tengzhang_career_award/
- <https://scholar.google.com/citations?user=sTvwiocAAAAJ&hl=en>
- <https://www.linkedin.com/in/teng-zhang-59192516>

Department of Mechanical and Aerospace Engineering
Biomaterials Institute, Syracuse University

Research Interests:

Solid mechanics; Mechanics of multi-physics of soft materials; Nano mechanics; Bio-inspired design

NSF Career Award:

The Faculty Early Career Development Program (CAREER) project will support fundamental research on the mechanics of interfaces in soft materials by establishing a novel multiscale and multiphysics modeling and simulation platform. Interfaces between soft and hard materials (soft-hard) or soft and soft (soft-soft) materials are ubiquitous in nature and engineering applications, such as tendon on bone for load-bearing, mucus on tongue for prey capture, growing tissues on scaffolds, and bonding silicon on elastomers for stretchable electronics. A fundamental understanding of mechanics of soft material interfaces will help diagnose failures of biological joints and design underwater adhesive patches, flexible electronics, and strong, tough and lightweight composites, which are urgently needed to advance the national health, prosperity, and welfare. The integrated education plan includes an interactive teaching module for outreach programs, participations in summer research intern programs for high school students, and integration of computational tools in the graduate and undergraduate curriculums at Syracuse University. A “Science and Play” outreach program for K-12 students and the general public will be organized annually to promote STEM education. Furthermore, the students in the Women in Science and Engineering program at Syracuse University will be leveraged to encourage the participation of students from underrepresented populations. A major challenge in the mechanics of interfaces in soft materials is that their mechanical behaviors are intrinsically multiscale and multiphysics interactions, which are determined not only by microstructures at interfaces but also the nonlinear strong coupling of surface and bulk deformations. This challenge will be tackled by seamlessly integrating model techniques at different scales in a unified framework with high parallel computation efficiency. Specific tasks include: (1) to bridge coarse-grained models and finite element methods through lattice models and implement the model in the large-scale atomic/molecular massively parallel simulator (LAMMPS), (2) to link deformed configurations of soft-soft interfaces with their molecular structures and nonlinear deformation and surface stress at macroscale levels and study how multiscale couplings govern forces in wet adhesion with large deformation of soft solids, (3) to investigate how macroscale deformation confinement and energy dissipation, mesoscale cavitation, fibrillation

and instabilities and microscale molecular and polymer structures synergistically determine the strength and toughness of soft-hard interfaces and derive microstructures informed interfacial force-separation law for soft adhesives.

Selected Publications:

Xiaoxiao Zhang, Patrick T. Mather, Mark J. Bowick and Teng Zhang, “Non-uniform curvature and anisotropic deformation control wrinkling patterns on tori”, *Soft Matter*, Vol. 15, No. 26, pp 5204-5210, 29 May 2019

Jianjun Sui, Junbo Chen, Xiaoxiao Zhang, Guohua Nie and Teng Zhang, “Symplectic analysis of wrinkles in elastic layers with graded stiffnesses”, *Journal of Applied Mechanics*, Vol. 86, No. 1, 011008, Paper No. JAM-18-1467, January 2019, doi: 10.1115/1.4041620

Teng Zhang, “Ruga mechanics of thin sheets: wrinkling, crumpling, and folding”, <https://imechanica.org/node/22701> (iMechanica web of mechanics and mechanicians), Journal Club of October 2018, Teng Zhang’s blog

Teng Zhang, “Symplectic analysis for wrinkles: A case study of layered neo-Hookean structures”, *ASME Journal of Applied Mechanics*, Vol. 84, No. 7, July 2017, doi: 10.1115/1.4036613

Shaoting Lin, Tal Cohen, Teng Zhang, Hyunwoo Yuk, Rohan Abeyaratne and Xuanhe Zhao, “Fringe instability in constrained soft elastic layers”, *Soft Matter*, Vol. 12, No. 43, pp 8899-8906, 2016

Yuk, Hyunwoo, Teng Zhang, Shaoting Lin, German Alberto Parada, and Xuanhe Zhao. Tough bonding of hydrogels to diverse non-porous surfaces. *Nature materials* 15, no. 2 (2016): 190-196.

Wu, Y.; Yi, N.; Huang, L.; Zhang, T.; Fang, S.; Chang, H.; Li, N.; Oh, J.; Lee, J.A.; Kozlov, M. Three-dimensionally bonded spongy graphene material with super compressive elasticity and near-zero Poisson’s ratio. *Nat. Commun.* 2015, 6, 6141.

Zhao, R. , Zhang, T. , Diab, M. , Gao, H. , and Kim, K.-S. , 2015, “ The Primary Bilayer Ruga-Phase Diagram I: Localizations in Ruga Evolution,” *Extreme Mech. Lett.*, 4, pp. 76–82.

Teng Zhang, Shaoting Lin, Hyunwoo Yuk, and Xuanhe Zhao. Predicting fracture energies and crack-tip fields of soft tough materials. *Extreme Mechanics Letters* 4 (2015): 1-8.

Razavi, M. J.; Zhang, T.; Li, X.; Liu, T.; Wang, X. Role of Mechanical Factors on the Cortical Folding Development. *Phys. Rev. E* 2015, 92, 032701.

Teng Zhang, Xiaoyan Li, and Huajian Gao. Designing graphene structures with controlled distributions of topological defects: a case study of toughness enhancement in graphene ruga. *Extreme Mechanics Letters* 1 (2014): 3-8.

Teng Zhang, Xiaoyan Li, and Huajian Gao. Defects controlled wrinkling and topological design in graphene. *Journal of the Mechanics and Physics of Solids* 67 (2014): 2-13.

Diab, M. Z., Zhang, T., Zhao, R. K., Gao, H. J., and Kim, K. S., 2013, “Ruga Mechanics of Creasing: From Instantaneous to Setback Creases,” *Proc. R. Soc. London, Ser. A*, 469(2157), p. 20120753.

Teng Zhang, Xiaoyan Li, Sara Kadkhodaei, and Huajian Gao. Flaw insensitive fracture in nanocrystalline graphene. *Nano Letters*, Vol. 12(9) (2012): 4605-4610.