Wenqiang Fang

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I am a Ph.D. candidate in Mechanical Engineering at Brown University. I have strong background in computational mechanics and broad interest in engineering design and optimization. I am a dependable and organized team player with the ability to communicate effectively and efficiently. I am also a quick learner who is proficient in programming and numerical simulation softwares.

Education

School of Engineering, Brown University Sep.2015-Aug.2021 (expected)

- Research Assistant in Applied Mechanics Lab (Advisor: Haneesh Kesari)
- Teaching Assistant:
  - ENGN 1950 Advanced Engineering Optimization Fall.2017, Fall.2018
  - ENGN 1370 Advanced Engineering Mechanics Spring.2019, Spring.2020
  - ENGN 2210 Continuum Mechanics Fall.2020
- Minor in Applied Math & Material Science.

School of Aerospace Engineering, Tsinghua University, Beijing, China Sept.2011-Jul.2015

- B.S. in Mechanical Engineering (Tsien Hsue-shen Elite Class in Mechanics)
- **GPA** : 3.83/4.0 or 90.3/100

Research Experience

"In situ force probes for the study of cell-dense neotissues"

- Mechanical forces generated by cells are critical for regulating tissue formation. Using hyper-compliant microparticles (HCMPs) as force sensors, we are able to quantify microenvironmental forces during tissue assembly and morphogenesis.
- I developed an integrated 3D cell traction estimation program using the Wolfram Language. This user-friendly program is able to process confocal z-slice images of HCMPs, perform Finite Element Analysis and generate the time series of the HCMP's average internal pressure and elastic energy.

"An accelerometer-only algorithm for determining the acceleration field of a rigid body"

- The acceleration field is an important quantity in bio-mechanics problems, especially in the study of mild Traumatic Brain Injury (mTBI)
- We proposed an algorithm to determine acceleration field of a rigid body undergoing any complicated motion using only four tri-axial accelerometers.
- I implemented the accelerometer-only algorithm and validated it using virtual accelerometer data.

"Non-linear bending-sliding model for explaining the sawtooth patterns in flexural force curves of structural biological materials"

- We performed flexural test on spicules of marine sponges and found sawtooth patterns in the force-displacement curves, which were due to the slipping of the spicules on the test apparatus.

- I proposed a non-linear bending-sliding model to quantitatively characterize the sawtooth patterns. The prediction of the model matches our experimental measurements.

"Asymptotic analysis of sponge spicules' sensitivity to geometric imperfection regarding buckling instability"

- The tapered shape of spicules from *Tethya aurantia* resembles the Clausen column, which is optimal shape against buckling.
- I conducted asymptotic analysis on the buckling strength of Clausen column to predict the effects of geometric imperfection using perturbation method.
- I performed numerical experiments using Rayleigh-Ritz method to verify my theoretical prediction and found the optimal column profile that is least sensitive to imperfection regarding buckling instability.

"Vibration analysis of a collapsed microbeam for measuring the work of adhesion"

- At the scale of micro-devices, adhesion is one of the most important forces that engineers need to contend with.
- I developed an analytical formula for measuring the work of adhesion between an adhered microbeam and a substrate using a geometrically nonlinear beam theory.
- I showed that the results obtained from analytical formulation are in excellent agreement with those obtained from nonlinear Finite Element Analysis.

Publications

- Sayaka Kochiyama, **Wen-Qiang Fang**, Michael A. Monn, Haneesh Kesari. "Sawtooth patterns in flexural force curves of structural biological materials are not signatures of toughness enhancement." *J Mech Behav Biomed Mater* (Accepted)
- Robert A. Gutierrez, **Wen-Qiang Fang**, Haneesh Kesari, Eric M. Darling. "Force sensors for measuring microenvironmental forces during mesenchymal condensation." *Biomaterials* (2021): 120684.
- Rahaman M. Masiur, **Wen-Qiang Fang**, Alice L. Fawzi, Yang Wan, and Haneesh Kesari. "An accelerometer-only algorithm for determining the acceleration field of a rigid body, with application in studying the mechanics of mild traumatic brain injury." *J. Mech. Phys. Solids* (2020): 104014.
- **Wen-Qiang Fang**, Joyce Mok, and Haneesh Kesari. "Effects of geometric nonlinearity in an adhered microbeam for measuring the work of adhesion." *Proc. R. Soc. A* 474.2211 (2018): 20170594.
- Bin Yuan, Zhi-Zhu He, **Wen-Qiang Fang**, Xin Bao, and Jing Liu. "Liquid Metal Spring: Oscillating Coalescence and Ejection of Contacting Liquid Metal Droplets." *Sci. Bull* 60.6 (2015): 648-653.
- **Wen-Qiang Fang**, Zhi-Zhu He, and Jing Liu. "Electro-hydrodynamic shooting phenomenon of liquid metal stream." *Appl. Phys. Lett.* 105.13 (2014): 134104.

Technical skills

- **Programming Languages**
  Wolfram Mathematica, Matlab, Fortran, Python, C++
- **Numerical Simulation Softwares**
  Abaqus, ANSYS, FEniCS, LAMMPS
- **Other Skills**
  Machine Learning, SolidWorks, statistics, LaTeX, Git