

# Zhangli Peng

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## CONTACT INFORMATION

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## RESEARCH INTERESTS

Multiscale/Multiphysics/Multicomponent Modeling; Cell Biomechanics/Biophysics; Microfluidics; Dissipative Particle Dynamics; FEM/BEM Coupling; Flapping Foil Energy Harvesting; Biomimetics

## EDUCATION & APPOINTMENTS

### **Postdoc, Massachusetts Institute of Technology**, Massachusetts

Materials Science and Engineering, 2011-2014

- Postdoc Advisors: Ming Dao, George Em Karniadakis, and Subra Suresh

### **Ph.D., University of California San Diego**, California

Structural Engineering, 2011

- Thesis Advisor: Qiang Zhu
- Thesis Title: *Multiscale Modeling of a Red Blood Cell and its Fluid-Structure Interaction*

### **M.S., Zhejiang University**, China

Civil Engineering, 2006

- Thesis Advisors: Shilin Dong and Xingfei Yuan
- Thesis Title: *Tensegrity Torus*

### **B.S., Tongji University**, China

Civil Engineering, 2004

## HONORS & AWARDS

- Young Investigators Award of Great Lakes International Imaging/Flow Cytometry Association, 2015
- Best Poster Award from NSF Boundary Element Method Workshop, 2010
- NSF Fellowship from NSF Boundary Element Method Workshop, 2010
- Biophysical Society Education Travel Award from Biophysical Society 56th Annual Meeting, 2012

## ACADEMIC EXPERIENCES

### **Assistant Professor**, Aerospace and Mechanical Engineering, University of Notre Dame, 2014 - present

- Investigating the gating of mechanosensitive ion channels by multiscale simulations.
- Investigating acoustic separation of circulating tumor cells using microfluidics.
- Investigating the melting mechanisms of DNAs by theoretical modeling and molecular dynamics.
- Developing multiscale models of red blood cell transmigration through inter-endothelial slits in spleen.
- Developing predictive multiscale model of extravasation of cancer cells and white blood cells.
- Developing a discrete particle model of a multilayered fiber-reinforced arterial wall.

### **Postdoctoral Associate**, Nanomechanics Lab, MIT, 2011 - 2014

- Developed a two-component model of red blood cells using dissipative particle dynamics (DPD).
- Modeled thermal fluctuations, hemoglobin polymerization and vaso-occlusion in sickle cell anemia.
- Studied spleen retention and micropipette aspiration of malaria-infected red blood cells.

### **Research Assistant**, University of California San Diego, 2006 - 2011

- Explored the feasibility of a flapping foil energy harvester using Finite Difference Method.
- Coupled Finite Element and Boundary Element Methods to simulate red blood cells in blood flow.
- Investigated the biomechanics of nacre shells in red abalones by nano-indentations and simulations.

24. Igor V. Pivkin\*, Zhangli Peng\*, George Em Karniadakis, Pierre A Buffet, Ming Dao, and Subra Suresh. Biomechanics of red blood cells in human spleen and consequences for physiology and disease. *Proceedings of the National Academy of Sciences of the U.S.A.*, 113:7804-7809, 2016
23. Yan Bao, Dai Zhou, J.J. Tao, Zhangli Peng, H.B. Zhu, Z.L. Sun, and H.L. Tong, Dynamic interference of two anti-phase flapping foils in side-by-side arrangement in an incompressible flow. *Physics of Fluids*. Submitted.
22. Szu-Pei Fu, Zhangli Peng, Hongyan Yuan, and Yuan-Nan Young. Lennard-Jones type pair-potential method for coarse-grained lipid bilayer membrane simulations in LAMMPS. *SIAM Journal on Scientific Computing*, resubmitted after revision, 2016
21. Zhangli Peng<sup>‡</sup>, On-Shun Pak, Zhe Feng<sup>†</sup>, Allen Liu, and Yuan-Nan Young. On the gating of mechanosensitive channels by fluid shear stress. *Acta Mechanica Sinica*, in press, 2016
20. Alexandra Witthoft, Alireza Yazdani, Zhangli Peng, Chiara Bellini, Jay D. Humphrey and George Em Karniadakis. A discrete mesoscopic particle model of the mechanics of a multi-constituent arterial wall. *Journal of The Royal Society Interface*, 13 (114), 20150964, 2016
19. Zhangli Peng<sup>‡</sup>, Yeng-Long Chen, Huijie Lu<sup>†</sup>, Zehao Pan<sup>†</sup>, Hsueh-Chia Chang. Mesoscale simulations of two model systems in biophysics: from red blood cells to DNAs. *Computational Particle Mechanics*, 10.1007/s40571-015-0057-4. 2015
18. Peng Li, Zhangming Mao, Zhangli Peng, Lanlan Zhou, Yuchao Chen , Po-Hsun Huang , Cristina I. Truica, Joseph J. Drabick, Wafik S. El-Deiry, Ming Dao, Subra Suresh, and Tony Jun Huang. Acoustic separation of circulating tumor cells. *Proceedings of the National Academy of Sciences of the U.S.A.*, 112:4970-4975, 2015
17. Zhangli Peng, Sara Salehyar and Qiang Zhu. Stability of the tank treading modes of erythrocytes and its dependence on cytoskeleton reference states. *Journal of Fluid Mechanics*, 771:449-467, 2015
16. Xiaoyun Ding\*, Zhangli Peng\*, Sz-Chin Steven Lin, Michela Geri, Sixing Li, Peng Li, Yuchao Chen, Ming Dao, Subra Suresh and Tony Jun Huang. Cell separation using tilted-angle standing surface acoustic waves. *Proceedings of the National Academy of Sciences of the U.S.A.*, 11:12992-12997, 2014
15. Xuejin Li, Zhangli Peng, Huai Lei, Ming Dao, and George Em Karniadakis. Probing the RBC dynamics, rheology and mechanics with the two component cell model. *Philosophical Transactions of the Royal Society A*.372:2021, 2014
14. Zhangli Peng, Adel Mashayekh, and Qiang Zhu. Erythrocyte responses in low shear rate flows: effects of non-biconcave stress-free state in cytoskeleton. *Journal of Fluid Mechanics*, 742:96-118, 2014
13. Zhangli Peng, Xuejin Li, Igor V. Pivkin, Ming Dao, George Em Karniadakis, and Subra Suresh. Lipid bilayer and cytoskeletal interactions in a red blood cell. *Proceedings of the National Academy of Sciences of the U.S.A.*, 110:13356-13361, 2013
12. Zhangli Peng, and Qiang Zhu. Deformation of the erythrocyte cytoskeleton in tank treading motions. *Soft Matter*, 9:7617-7627, 2013
11. HeeSu Byun, Timothy R. Hillman, John M. Higgins, Monica Diez-Silva, Zhangli Peng, Ming Dao, Ramachandra R. Dasari, Subra Suresh, and YongKeun Park. Optical measurement of biomechanical properties of individual erythrocytes from a sickle cell patient. *Acta Biomaterialia*, 8:4130-4138, 2012.

10. Mythili Aingaran\*, Rou Zhang\*, Sue Law\*, Zhangli Peng\*, Evan Meyer, Monica Diez-Silva, Christof Gruering, Luis Ibanez, Tobias Spielmann, Chwee Teck Lim, Subra Suresh, Ming Dao and Matthias Marti. Host cell deformability is linked to transmission in the human malaria parasite Plasmodium falciparum. **Cellular Microbiology**, 14:983-993, 2012.
9. Zhangli Peng, Robert J. Asaro, and Qiang Zhu. Multiscale modelling of erythrocytes in Stokes flow. **Journal of Fluid Mechanics**, 686: 299-337, 2011.
8. Jiddu Bezares, Zhangli Peng, Robert J. Asaro, and Qiang Zhu. Macromolecular structure and viscoelastic response of the organic framework of nacre in *Halotis rufescens*: a perspective and overview. **Theoretical and Applied Mechanics**, 38: 75-106, 2011.
7. Zhangli Peng, Robert J. Asaro, and Qiang Zhu. Multiscale modeling of erythrocyte membranes. **Physical Review E**, 81: 031904, 2010.
6. Zhangli Peng and Qiang Zhu. Energy harvesting through flow-induced oscillations of a foil. **Physics of Fluids**, 21: 123602, 2009.
5. Qiang Zhu and Zhangli Peng. Mode coupling and flow energy harvesting by a flapping foil. **Physics of Fluids**, 21: 033601, 2009.
4. Xingfei Yuan, Zhangli Peng and Shilin Dong, Baojun Zhao. A new tensegrity module -“Torus”. **Advances in Structural Engineering**, 11: 243-251, 2008.
3. Xingfei Yuan, Zhangli Peng, Shilin Dong. Study and application of tensegrity torus. **China Civil Engineering Journal**, 41: 8-13, 2008.
2. Xingfei Yuan, Zhangli Peng and Shilin Dong. Load-carrying capacity of welded hollow spherical joints subject to combined planar tri-directional axial force and bending moment. **Journal of Zhejiang University (Engineering Science)**, 41: 1436-1442, 2007.
1. Zhangli Peng, Xingfei Yuan and Shilin Dong. Tensegrity torus. **Spatial Structures**, 13: 60-64, 2007.

CONFERENCE  
PROCEEDINGS AND  
ABSTRACTS

1. Huijie Lu, and Zhangli Peng. Red Blood Cells Squeezing through Submicron Slits: From Healthy Cells to Hereditary Spherocytosis and Sickle Cell Disease. The 68th Annual Meeting of the APS Division of Fluid Dynamics, Portland, 2016.
2. Zhangli Peng, On-Shun Pak, Yuan-Nan Young, Allen Liu and Howard Stone. Gating of mechanosensitive channels. The 67th Annual Meeting of the APS Division of Fluid Dynamics, Boston, 2015.
3. Zhangli Peng, Igor Pivkin, George Karnidakis and Ming Dao. Coupling dissipative particle dynamics, finite element and boundary element to study red blood cell mechaics. The 7th World Congress of Biomechanics, Boston, 2014.
4. Zhangli Peng, and Ming Dao. Bilayer-skeleton relative motions and splenic clearance of erythrocytes. The 58th Annual Meeting of the Biophysical Society, San Francisco, 2014.
5. Zhangli Peng, Igor Pivkin and Ming Dao. Filtration of red blood cells in the spleen. The 66th Annual Meeting of the APS Division of Fluid Dynamics, Pittsburgh, 2013.
6. Zhangli Peng, Red blood cell mechanics in the spleen. Joint Weizmann Institute of Science/Mechanobiology Institute Conference, Singapore, 2013. (poster)
7. Zhangli Peng and Ming Dao, Quantifying the deformation of red blood cell skeleton in shear flow.

APS March Meeting, Boston, 2012.

8. Zhangli Peng and Ming Dao. Biomechanics of red blood cell diseases The 65th Annual Meeting of the APS Division of Fluid Dynamics, Baltimore, 2012.
9. Zhangli Peng and Qiang Zhu, Bilayer-skeleton relative motions and splenic clearance of erythrocytes. The 56th Annual Meeting of the Biophysical Society, San Diego, 2012. (poster)
10. Zhangli Peng and Qiang Zhu, 3D Dynamics of Protein Network Coupled to Lipid Bilayer in Diseased Erythrocytes, The 64th Annual Meeting of the APS Division of Fluid Dynamics, San Diego, 2011.
11. Zhangli Peng, Igor Pivkin, and Ming Dao, Red Blood Cells In Limiting Geometries. The 6th MIT Conference on Computational Fluid and Solid Mechanics, Boston, 2011.
12. Zhangli Peng, and Qiang Zhu, Molecular-detailed simulation of red blood cells in Stokes flows, The 63rd Annual Meeting of the APS Division of Fluid Dynamics, Long Beach, 2010.
13. Zhangli Peng, Multiscale simulation of red blood cell membrane. All Graduate Symposium, University accepted of California San Diego, 2010.
14. Zhangli Peng, Multiscale simulation of red blood cell membrane, NSF Boundary Element Method Workshop, University of Akron, Ohio, 2010. (**Best poster award**)
15. Zhangli Peng, Research Expo of Jacob Engineering School, University of California San Diego, 2009. (poster)
16. Zhangli Peng, and Qiang Zhu, Interactions between lipid bilayer and protein skeleton in erythrocyte deformations. The 53rd Annual Meeting of the Biophysical Society, San Francisco, 2009. (**Platform talk**)

#### INVITED TALKS

- Weldon School of Biomedical Engineering, Purdue University, 2016.
- Department of Mathematics, Pennsylvania State University, 2016.
- Department of Mechanical and Aerospace Engineering, University of California San Diego, 2016.
- 2015 meeting of the Great Lakes International Imaging and Flow Cytometry Association, Buffalo, NY, 2015 (**Alexander Nakeff Young Investigators Award**).
- Department of Engineering Sciences and Applied Mathematics, Northwestern University, 2015.
- SIAM Conference on Computational Science and Engineering (CSE15), Salt Lake City, 2015.
- Mechanobiology Subgroup, the 59th Annual Meeting of the Biophysical Society, Baltimore, 2015.
- Department of Mathematics, Purdue University, 2015.
- Rare and Neglected Disease Research Symposium, Center of Rare and Neglected Diseases, University of Notre Dame, 2015.
- Harper Cancer Institute, Indiana University School of Medicine, South Bend, 2014.
- Department of Applied and Computational Mathematics and Statistics, University of Notre Dame, 2014.
- Dynamics of Biological Membranes Symposium, SIAM Annual Meeting, Chicago, 2014.
- Department of Aerospace and Mechanical Engineering, University of Notre Dame, 2014.
- Department of Mechanical and Industrial Engineering, Northeastern University, 2014.
- Department of Mechanical Engineering, Michigan State University, 2014.
- Department of Mechanical Engineering, Binghamton University, Binghamton, 2014.
- Modeling Blood Cell Interactions Workshop, University of Tennessee, Knoxville, 2013.
- ASME 2nd Global Congress on NanoEngineering for Medicine and Biology, Boston, 2013.
- Center for Fluid Mechanics, Division of Applied Mathematics, Brown University, 2011.
- Jacobs Innovators Forum: Engineering in Medicine, University of California San Diego, 2011.
- Departmental of Structural Engineering, University of California San Diego, 2010.

- Center for Theoretical Biological Physics, University of California San Diego, 2010.

PATENTS

- Separation of low-abundance cancer cells from fluid using surface acoustic waves (International Application No. PCT/US2015/044712)

TEACHING EXPERIENCES

**Instructor**, University of Notre Dame

- **Aerospace Structures** (AME30341), Fall 2016 (undergraduate course, 42 students).
- **Numerical Methods** (AME60614), Spring 2016 (graduate course, 16 students).
- **Aerospace Structures** (AME30341), Fall 2015 (undergraduate course, 32 students).
- **Numerical Methods** (AME60614), Fall 2014 (graduate course, 14 students).

**Teaching Assistant**, University of California San Diego

- **Mechanical Vibration/Structural Dynamics** (MAE130C/SE101C), Fall 2008 (undergraduate course, 198 students, instructor Qiang Zhu).
- **Nonlinear Finite Element Method and Isogeometric Analysis** (MAE232C), Spring 2010 (graduate course, 22 students, instructor David Benson).

THESIS ADVISOR

Huijie Lu (2014-present), Zhe Feng (2015-present), Sebastian Sensale (2015-present, co-advised with Prof.Hsueh-Chia Chang, Department of Chemical and Biomolecular Engineering)

THESIS COMMITTEE

Daniel Taller, Xin Mu, Jiayi Guo, Yunsong Pang, Yu Yan, Jie Yang, Xufei Wu, Ming Ma, Teng Zhang

PROFESSIONAL ACTIVITIES

**Refereeing**

*Journal of Fluid Mechanics, Physics of Fluids, Biophysical Journal, Journal of Biomechanics, Reports on Progress in Physics, PLOS ONE, Journal of Computational Physics, Journal of Sound and Vibration, AIAA Journal, SIAM Journal on Scientific Computing, Journal of Fluid and Structures, Biomechanics and Modeling in Mechanobiology, Interface Focus, Biomicrofluidics, Biorheology, Bioinspiration & Biomimetics, Biomedical Optics Express, Progress in Biophysics and Molecular Biology, Cell Biochemistry and Biophysics, Cellular & Molecular Biology Letters, Drug Discovery Today: Disease Models, Ocean Engineering, Applied Energy, International Journal of Computational Fluid Dynamics, Frontiers of Structural and Civil Engineering*

**Memberships**

- American Physical Society (APS)
- Biophysical Society (BPS)
- American Society of Mechanical Engineers (ASME)
- Society for Industrial and Applied Mathematics (SIAM)

**Conference Organizing Activities**

- Session Chair, Biocomposite, American Society for Composites (ASC) 30th Technical Conference, 2015.
- Session Chair, Mechanical behaviors of cytoskeleton and cells, the 53rd Annual Technical Meeting of the Society of Engineering Science, 2016.