Lu Lu

484 393 5858 ◇ lu_lu_1@brown.edu
Division of Applied Mathematics, Brown University ◇ Providence, RI 02912

EDUCATION

Brown University 8/2014–present
- **Ph.D.** in Applied Mathematics Expected 12/2019
- **M.Sc.** in Computer Science Expected 5/2019
- **M.Sc.** in Applied Mathematics
- **M.Sc.** in Fluids and Thermal Sciences
- **GPA 3.94/4.00**

Tsinghua University, Beijing, China 8/2009–7/2013
- **B.Eng.** in Thermal Engineering
- **B.Ec.** in Economics
- **Minor** in Computer Science
- **GPA 92.2/100**, **Rank 1/87**; **Major GPA 93.8/100**; **101 courses**, **281 credits**

RESEARCH EXPERIENCE

George Em Karniadakis' Group, Division of Applied Mathematics, Brown University 9/2014–present
- **Project**: Machine learning
  - Demonstrated numerically and theoretically that deep and narrow neural networks will converge to erroneous mean or median states of the target function depending on the loss with high probability.
  - Quantified total uncertainty in physics-informed neural networks (PINNs) for solving forward and inverse stochastic problems.
  - Extended PINNs to fractional PINNs (fPINNs) to solve space-time fractional advection-diffusion equations, and demonstrated their accuracy and effectiveness in solving multi-dimensional forward and inverse problems with forcing terms whose values are only known at randomly scattered spatio-temporal coordinates.
- **Project**: Computational biomechanics
  - Developed a coarse-grained patchy particle model of sickle hemoglobin (HbS) to probe the formation process, mechanical and structural properties of HbS polymer fiber.
  - Developed a hybrid HbS fiber model by applying mesoscopic adaptive resolution scheme (MARS) which seamlessly couples the microscopic and mesoscopic HbS fiber models toward understanding of interactions between HbS fibers.
  - Developed coarse-grained models to simulate the dynamic self-assembly of two types of amyloids (amylin and amyloid β) to gain a quantitative understanding of the molecular mechanisms causing different aggregated structures and biomechanical properties of amyloid fibrils.
  - Simulated the dynamics of healthy and diseased red blood cells (RBCs) traversing the interendothelial slit in the human spleen using a two-component protein-scale RBC model, which reveals that the spleen not only senses and clears RBCs with abnormal shapes and deformability but also alters the geometries of RBCs that contain protein defects arising from hereditary blood disorders.
- **Project**: High performance computing
  - Developed OpenRBC (a fast simulator of RBCs at protein resolution) using an adaptive spatial searching algorithm based on Voronoi tessellation and k-d tree data structure, which is capable to simulate an entire RBC lipid bilayer and cytoskeleton modeled by 4 million mesoscopic particles on a single SuperVessel 4-core instance. (https://devpost.com/software/openrbc, https://github.com/yhtang/OpenRBC)

PUBLICATIONS (* CONTRIBUTED EQUALLY)

Preprints

1. Pang, G.*, **Lu, L.***, & Karniadakis, G. E. (2018). fPINNs: Fractional Physics-Informed Neural Networks. *arXiv preprint arXiv:1811.08967*.

2. Zhang, D., **Lu, L.**, Guo, L., & Karniadakis, G. E. (2018). Quantifying Total Uncertainty in Physics-informed Neural Networks for Solving Forward and Inverse Stochastic Problems. *arXiv preprint arXiv:1809.08327*.
3. **Lu, L.**, Su, Y., & Karniadakis, G. E. (2018). Collapse of Deep and Narrow Neural Nets. *arXiv preprint arXiv:1808.04947*.

Journal Papers

1. Li, H.*, **Lu, L.***, Li, X., Buffet, P. A., Dao, M., Karniadakis, G. E., & Suresh, S. (2018). Mechanics of Diseased Red Blood Cells in Human Spleen and Consequences for Hereditary Blood Disorders. *Proceedings of the National Academy of Sciences*, 115(38), 9574–9579.
2. Li, H., Papageorgiou, D., Chang, H. Y., **Lu, L.**, Yang, J., & Deng, Y. (2018). Synergistic Integration of Laboratory and Numerical Approaches in Studies of the Biomechanics of Diseased Red Blood Cells. *Biosensors*, 8(3), 76.
3. **Lu, L.***, Deng, Y.*, Li, X., Li, H., & Karniadakis, G. E. (2018). Understanding the Twisted Structure of Amyloid Fibrils via Molecular Simulations. *The Journal of Physical Chemistry B*, 122(49), 11302-11310.
4. Li, H., Yang, J., Chu, T. T., Naidu, R., **Lu, L.**, Chandramohanadas, R., ... & Karniadakis, G. E. (2018). Cytoskeleton Remodeling Induces Membrane Stiffness and Stability Changes of Maturing Reticulocytes. *Biophysical Journal*, 114(8), 2014–2023. (**Highlighted on *Biophysical Journal* homepage**)
5. Li, H., Chang, H. Y., Yang, J., **Lu, L.**, Tang, Y. H., & Lykotrafitis, G. (2018). Modeling Biomembranes and Red Blood Cells by Coarse-grained Particle Methods. *Applied Mathematics and Mechanics*, 39(1), 3–20.
6. **Lu, L.**, Li, H., Bian, X., Li, X., & Karniadakis, G. E. (2017). Mesoscopic Adaptive Resolution Scheme toward Understanding of Interactions between Sickle Cell Fibers. *Biophysical Journal*, 113(1), 48–59. (**Cover Article**)
7. Tang, Y. H.*, **Lu, L.***, Li, H., Evangelinos, C., Grinberg, L., Sachdeva, V., & Karniadakis, G. E. (2017). OpenRBC: A Fast Simulator of Red Blood Cells at Protein Resolution. *Biophysical Journal*, 112(10), 2030–2037. (**Highlighted on *Biophysical Journal* homepage**)
8. **Lu, L.**, Li, X., Vekilov, P. G., & Karniadakis, G. E. (2016). Probing the Twisted Structure of Sickle Hemoglobin Fibers via Particle Simulations. *Biophysical Journal*, 110(9), 2085–2093. (**Highlighted on *Biophysical Journal* homepage**)
9. **Lu, L.**, Zhang, X., Yan, Y., Li, J. M., & Zhao, X. (2014). Theoretical Analysis of Natural-Gas Leakage in Urban Medium-pressure Pipelines. *Journal of Environment and Human*, 1(2), 71–86.
10. **Lu, L.**, & Li, J. M. (2011). The Feasibility Analysis of Small-sized Commercial Ice-storage Air-conditioning System. *China Appliance Technology* 9 (Supplement): 27–29.

CONFERENCE PRESENTATIONS

1. Quantitative Prediction of Erythrocyte Sickling for Anti-polymerization Activities in Sickle Cell Disease. *60th Annual Red Cell Meeting*, New Haven, CT, Oct. 2018. (Poster Presentation)
2. OpenRBC: A Fast Simulator of Red Blood Cells at Protein Resolution. *SIAM Annual Meeting*, Pittsburgh, PA, Jul. 2017. (Oral Presentation)
3. Probing the Twisted Structure of Sickle Hemoglobin Fibers via Particle Simulations. *20th Biennial Hemoglobin Switching Conference*, Pacific Grove, CA, Sept. 2016. (Poster Presentation)
4. Shock Tube Ignition Delay Time Study of RP-1/Oxygen/Argon Mixtures. *Stanford Undergraduate Visiting Research Symposium*, Stanford, CA, Aug. 2012. (Oral and Poster Presentation)
5. The Feasibility Analysis of Small-sized Commercial Ice-storage Air-conditioning System. *10th National Symposium on Refrigerators, Air Conditioners and Compressors*, Qingdao, Shandong, Aug. 2011. (Oral Presentation)

AWARDS AND HONORS

- Associate Member, Sigma Xi, 2018.
- George Irving Hopkins Fellowship, Brown University, 2017.
- Open Graduate Education Program, Brown University, 2017–2019.
- Third Prize, IBM OpenPower Developer Challenge contest, 2016.
- Fellowship for graduate students, Brown University, 2015.
- Provincial Outstanding Graduates, Beijing, China, 2013. (top 5% of graduating students)
- Provincial Merit Student, Beijing, China, 2013. (top 1 student in every department)
- Outstanding Graduates, Tsinghua University, 2013. (top 2% of graduating students)
- Outstanding Undergraduate Graduation Thesis, Tsinghua University, 2013. (top 5% of graduating students)
- Excellent Student Cadre, Tsinghua University, 2013.
- Jiang Nanxiang Scholarship, Tsinghua University, 2012. (top 1 student in every department)
- Summer Research Scholarship, Chinese Undergraduate Visiting Research Program, Stanford University, 2012.
- Outstanding Volunteer, Tsinghua University learning center, 2012.

- Member of "Spark" Innovative Talent Cultivation Program, Tsinghua University, 2011–2013. (top 36 of 3300 students)
- Tsinghua Friend–Kai Feng Fellowship, Tsinghua University, 2011. (top 10 students in every grade)
- Best Paper Award, 10th National Symposium on Refrigerators, Air Conditioners and Compressors, Shandong, China, 2011.
- Three-star Volunteer, Tsinghua University, 2011. (entitled to those who devoted more than 100 hours to voluntary work)
- Tsinghua Friend–Kai Feng Fellowship, Tsinghua University, 2010. (top 10 students in every grade)
- First Prize, 27th Annual National Physics Contest for College Students, Beijing, China, 2010.
- First Prize, Chinese Physics Olympiad, Jiangsu, China, 2008.
- First Prize, Chinese Mathematical Olympiad, Jiangsu, China, 2008.

PROFESSIONAL SERVICES

- Reviewer, Journal of Computational Physics

TEACHING EXPERIENCE

- Teaching Assistant, Numerical Solution of Partial Differential Equations I 9/2018–12/2018
- Teaching Assistant, Operations Research: Probability Models 1/2018–5/2018
- Teaching Assistant, Computational Probability and Statistics 9/2017–12/2017
- Teaching Assistant, Advanced Fluid Mechanics 1/2015–5/2015
- Instructor, Tsinghua University National Students' Innovation Camp (instructed 24 senior high school students to complete 8 innovation projects in one week) 8/2011
- Instructor, Tsinghua University learning center (taught freshmen mathematics and physics) 3/2010–12/2011

ACADEMIC ACTIVITIES

- **Leader** of the Tsinghua–Toshiba Innovation Development Interest Group (managed 60 students and 10 research projects on city construction and energy conservation) 6/2012–3/2013
- **President** of the Association of Students for Science and Technology, Tsinghua University (organized the science contest on energy saving and emission reduction, which 40 groups participated in) 12/2011–2/2013
- **Representative** of Tsinghua University, 6th Freescale Cup National University Students Intelligent Car Race, Shanxi, China 8/2011
- **Team leader** of an in-field study on power generating and environment protection, Daihai Power Plant, Inner Mongolia, China 8/2010
- **Volunteer** of the 33rd International Symposium on Combustion, Beijing, China 8/2010

SKILLS

Softwares	LAMMPS, VMD; OpenFOAM, Gambit, Fluent, Chemkin; AutoCAD, SolidWorks; LaTeX.
Programming	C/C++, Python, MATLAB, Fortran, Java, SQL, x86/x86-64 Assembly; TensorFlow, OpenMP, MPI.
Systems and Tools	Linux/UNIX; Vim, Emacs; CMake, GDB, Valgrind; Git, SVN; MongoDB, Redis.

Last updated: January 11, 2019