Monan Ma | CV

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Summary

My research focuses on nonlinear nanomechanics and predictive scaling laws in nanoelectromechanical systems, combining sensitive optical and electrical measurements with numerical simulations and nanofabrication. In industry, I developed closed-loop control systems for fluid sensing in harsh conditions. I have also served as a full-time Visiting Assistant Professor, teaching core mechanical engineering courses.

Education

Boston University **Boston, MA**
Ph.D. candidate in Mechanical Engineering *09/2021 - 05/2026*
GPA: 4.0/4.0

Stony Brook University **Stony Brook, NY**
M.Sc. and B.Eng. in Mechanical Engineering, minor: Music *09/2014–05/2019*
GPA: 3.83/4.00, Magna Cum Laude

Experience

Boston University **Boston, MA**
Doctoral Research Fellow, Advisor: Prof. Kamil Ekinci *09/2021 - present*

- **Experimental research:** nonlinear nanomechanics and sensor physics
  - Built ultrasensitive optical and electrical detectors to interrogate nanoelectromechanical systems' (NEMS) response under deterministic, stochastic, and environmental perturbations
  - Characterized nonlinear dynamics for the improvement of NEMS-based sensing applications
  - Electrical actuation and detection of 2D membrane vibrations using surface acoustic waves
- **Computational research:** finite-element modeling, physics-informed machine learning
  - Developed and experimentally validated a 3D model in COMSOL® to fully capture the physics of electrothermal transducers, allowing for the estimation of transduction efficiency in various surrounding media
  - Adapted a data-driven technique to uncover the governing laws of nonlinear oscillators from experimental data
- **Fabrication techniques:** additive microfabrication and semiconductor clean room facilities
  - Two-photon polymerization (2PP) using Nanoscribe PPGT2®
  - Maskless photolithography, thin-film e-beam metal deposition, chemical etching, wire bonding

Aramco Americas Research Center **Houston, TX**
Graduate Intern in the Sensor Development Team *07/2025 - 09/2025*

- Developed two independent sensors for real-time **monitoring of non-Newtonian fluids in harsh conditions**
- Sensor 1 is an established device currently deployed by Aramco, but requires improved precision and automation
  - Built a robust closed-loop control system that tracks fluid properties in real time using a digital lock-in amplifier, phase-locked loop, and automatic gain control
  - Achieved full system autonomy with approximately $10\times$ faster sensing speed and $5\times$ higher precision, *patent in IDF stage*
- Sensor 2 is a novel device in its feasibility study stage
  - Improved the sensor performance by adjusting the geometry of moving parts and motor specifications, collaborated with the fabrication team to 3-D print the new prototype, and achieved state-of-the-art performance

Teaching

Boston University **Boston, MA**
Graduate Student Teacher, Mechanical Engineering *09/2022 - 05/2023*

- Fluid Mechanics (Spring 2023): delivered a lecture on numerical simulations and graded the final project on modeling fluid-structure interactions and the Stokes' second problem
- Statics (Fall 2022): co-led and graded the experimental bridge design project

State University of New York (SUNY) **Farmingdale, NY**
Visiting Assistant Professor, Mechanical Engineering Technology *08/2019 - 09/2020*

- Primary instructor for teaching Thermodynamics, Engineering Dynamics, Statics, and CAD Design for a total of ~ 100 undergraduate students over one academic year
- Teaching reviews available at: https://www.monan-ma.com/teaching

Awards and Stipends

BU Engineering Portfolio (Website) Competition - Best Graduate Student Runner Up	*2025*
BU.Nano Cross-Disciplinary Fellowship: $38,250	*2022-2024*
BU Nanotechnology Innovation Center Research Travel Grant: $1,500	*2024*
MIT NT'24 Nanotechnology Conference Travel Grant: $525	*2024*
3MT® Three-Minute Thesis Competition Finalist	*2023*
BU Graduate Student Organization Executive Board Service Award: $250	*2023*
BU Mechanical Engineering Departmental Distinguished Fellowship: $36,782	*2021-2022*
NCEES Fundamentals of Mechanical Engineering Certification, ID: 18-286-61	*2018*
Stony Brook Strategic Partnership for Industrial Resurgence (SPIR) Research Scholarship: ∼$7,500	*2017*

Publications († = in preparation)

8.† **M. Ma**, J. Barbish, N. W. Welles, C. Yanik, I. I. Kaya, M. R. Paul and K. L. Ekinci, "Statistical Properties of a Fluctuation-Driven Nanomechanical Duffing Resonator." *under preparation for Phys. Rev. Lett.*

7. W.G.Jiang, **M. Ma**, H. Gress, K. L. Ekinci, and M. Gonzalez, "A Dual NEMS Sensor for Nanomechanical Hydrogen Sensing,"*IEEE Sensors*, 2025.

6. N.W.Welles, **M. Ma**, K. L. Ekinci, and M. R. Paul, "Theoretical Modeling of the Dynamic Range of an Elastic Nanobeam under Tension with a Geometric Nonlinearity,"*J. Appl. Phys.*, 2025.

5. M. Ma, N. W. Welles, C. Yanik, I. I. Kaya, O. Svitelskiy, M. R. Paul and K. L. Ekinci, "Mode Dependent Scaling of Nonlinearities in a NEMS Resonator," *Appl. Phys. Lett.*, 2024.

4. M. Ma and K. L. Ekinci, "Electrothermal Actuation of NEMS Resonators: Modeling and Experimental Validation,"*J. Appl. Phys.*, 2023.

3. Ti C., G. McDaniel, A. Liem, H. Gress, **M. Ma**, S. Kyong, O. Svitelskiy, C. Yanik, I. I. Kaya, M. S. Hanay, M. Gonzalez, and K. L. Ekinci, "Dynamics of NEMS Resonators across Dissipation Limits," *Appl. Phys. Lett.*, 2022.

2. Solovyov, V., S. Rabbani, **M. Ma**, Z. Mendleson, Z. Wang, A. Polyanskii, and P. Farrell, "Electromechanical Properties of 1-mm-Wide Superconducting Cables Comprised of Exfoliated YBCO Filaments," *IEEE Trans. Appl. Supercond.*, 2019.

1. Solovyov, V., S. Rabbani, **M. Ma**, Z. Mendleson, T. Haugan, and P. Farrell,"Performance of Layer Wound Epoxy Impregnated Coils Made from Multi-filamentary Cable of Exfoliated YBCO," *Supercond. Sci. Technol.*, 2019.

Conference and Internal Talks

Talk: "Nonlinear Nanomechanical Sensing," *Faculty Search Seminar Talk, Gordon College,* Wenham, MA, 12/2025.

Talk: "Development of sensor platforms for real-time rheology monitoring of drilling fluids," *Aramco Research Center,* Houston, TX, 09/2025.

Talk: "Nonlinearity problem and big data solution in nanoscale sensors and devices," *Gordon College Physics Department Colloquium Seminar,* Wenham, MA, 12/2024.

Poster: "Electrothermal actuation of nanoscale transducers," *COMSOL Conference,* Burlington, MA, 10/2024.

Talk: "Nonlinearities in a NEMS Resonator: Mode-Dependent Scaling," *19th International Workshop on Nanomechanical Sensing,* Vienna, Austria, 06/2024.

Poster: "Big data in nano sensors," *BU.Nano Center Annual Symposium,* Boston, MA, 11/2023.

Talk: "Integration of machine learning techniques for nanoscale systems and classical noise suppression," *MIT AeroAstro,* Cambridge, MA, 01/2022. Hosting faculty: Prof. Chuchu Fan

Talk: "Research v. Industry: pathways to finding your niche," *Gordon College Physics Department Colloquium Seminar,* Wenham, MA, 01/2022.

Media Coverage

"Monan Ma: Making Big Waves with Nanotechnology in the Ekinci Lab," BU Photonics News, 2024. [Link]

Student Research Mentorship

- **Undergraduate students**
  - Ricardo Gonzales, REU program in summer 2025, currently a senior at UC Davis
    Project: *Physics-informed machine learning for studying nonlinear dynamics in NEMS*
  - Vlad Pyltsov, UROP program in summer 2022, currently a Ph.D. student at Columbia University
    Project: *Spectral measurements of an electromechanical resonator in laminar air flow*
- **Graduate students**
  - Ali Tarlani Beris, Spring 2023
    Project: *Resonance tracking of quartz tuning forks using lock-in amplifiers*
  - Eli Forstadt, Fall 2022
    Project: *Building a high-frequency phase-locked loop using field-programmable gate arrays*

Leadership and Service

Journal Referee: Nano Letters ($\times 4$), Phys. Rev. B ($\times 2$), Phys. Rev. Appl. ($\times 2$)

Outreach: Upward Bound Math Science program for first-generation college-bound high school students

Vice President: BU Graduate Student Organization

International Student Ambassador: Stony Brook U Admissions

Technical Tools

Software: COMSOL, Matlab, Python, C++, JavaScript, Verilog, LabVIEW, LaTeX, Microsoft Office, Origin Pro

Hardware: Lock-in amplifiers, arbitrary waveform generators, oscilloscopes, spectrum and network analyzers, DC and EC motors, piezoelectric actuators, optical detection systems, and high-power lasers

Testing: Ultra-high vacuum (UHV) systems, cryogenic systems

Languages: Native speaker of Russian and Mandarin, fully proficient in English (IELTS score: 9.0/9.0)