Monan Ma | Ph.D.

Boston, MA 02215

[monan@bu.edu] • [www.monan-ma.com] • [monan-ma]

Summary

My research focuses on nonlinear nanomechanics, photonics, optomechanics, and micro- and nano-electromechanical systems (MEMS/NEMS). I build sensitive optical and electrical detection setups, enabled by nanofabrication and informed by finite-element models. In the industry, I developed non-Newtonian fluid sensors for oil drilling. I also served as a Visiting Assistant Professor, teaching core courses in Mechanical Engineering.
Available start date: July 2026, with flexibility.

Education

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

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

Experience

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

- **Experimental research:** nonlinear nanomechanics, photonics and sensor physics
  - Built ultrasensitive optical and electrical detectors to interrogate MEMS/NEMS nonlinear response under deterministic, stochastic, and environmental perturbations
  - Characterized the onset of nonlinearity and identified a roadmap for leveraging it to improve MEMS/NEMS-based sensing
  - Developed piezoelectric actuators for transducing surface-acoustic waves (SAW) in a microcavity
- **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 fluids
  - Incorporated symbolic regression techniques to uncover the governing physics as a system of ordinary differential equations directly from experimental data
- **Fabrication techniques:** additive manufacturing, semiconductor and optoelectronic facilities
  - Two-photon polymerization (2PP) using Nanoscribe PPGT2® and post-development
  - Spin coating, maskless photolithography, thin-film deposition (e-beam), chemical etching, plasma ashing, wire bonding

Aramco Americas Company — **Houston, TX**
Graduate Intern, Robotics & Sensors Development Team — *07/2025 - 09/2025*

- Contributed to **two independent platforms for real-time monitoring of non-Newtonian fluids**
- *Problem*: sensor 1 is an established device, but requires improved precision and automation
  - **Solution**: 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
- *Problem*: sensor 2 is at its feasibility stage and is non-functional
  - **Solution**: improved the sensor performance and signal-to-noise ratio by adjusting the geometry of moving parts and motor specifications, collaborated with the production team for rapid prototyping, and achieved device functionality
- **Deliverables**: achieved full system autonomy with approximately $10\times$ faster sensing speed and $5\times$ higher precision; preparing a joint publication and filing a **patent** (currently in the IDF stage)

Teaching

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

- Fluid Mechanics (Spring 2023): lectured on numerical simulations, supervised 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

Outstanding Ph.D. Dissertation of the Year Award in Mechanical Engineering — Winner	*2026*
MIT Engineering Excellence Postdoctoral Fellowship — Finalist	*2026*
BU Engineering Portfolio Challenge — Runner Up	*2025*
BU.Nano Cross-Disciplinary Fellowship — Two-Time Awardee: $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 († = under review)

8.† **M. Ma**, *et al.*, "Statistical Properties of a Fluctuation-Driven Nanomechanical Duffing Resonator," *under review at Phys. Rev. Appl.*

7. W. G. Jiang, **M. Ma**, *et al.*, "A Dual NEMS Sensor for Nanomechanical Hydrogen Sensing,"*IEEE Sensors*, 2025.

6. N.W.Welles, **M. Ma**, *et al.*, "Theoretical Modeling of the Dynamic Range of an Elastic Nanobeam under Tension with a Geometric Nonlinearity,"*J. Appl. Phys.*, 2025.

5. M. Ma, *et al.*, "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**, *et al.*, "Dynamics of NEMS Resonators across Dissipation Limits," *Appl. Phys. Lett.*, 2022.

2. Solovyov, V., S. Rabbani, **M. Ma**, *et al.*, "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**, *et al.*,"Performance of Layer Wound Epoxy Impregnated Coils Made from Multi-filamentary Cable of Exfoliated YBCO," *Supercond. Sci. Technol.*, 2019.

Select Conference and Talks

Talk: "Nonlinear Nanomechanical Sensing," **On-site Faculty Search 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.

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.

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

Outreach Seminar: "Research v. Industry: Pathways to Finding Your Niche," *Gordon College Physics Department Colloquium Seminar,* Wenham, MA, 01/2022.

Media Coverage

Boston University Photonics Center Article: "**Monan Ma: Making Big Waves with Nanotechnology in the Ekinci Lab**," 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: ACS Nano Letters ($\times 4$), APS Phys. Rev. B ($\times 2$) and Phys. Rev. Appl. ($\times 2$)

Outreach: Co-led the Upward Bound Math Science program targeted for first-generation, low-income, college-bound high school students

Vice President: Boston University Graduate Student Organization

International Student Ambassador: Stony Brook University Admissions

Technical Tools and Languages

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)