Mohammad Mohaghar

Research Engineer II
Environmental Fluid Mechanics Laboratory
School of Civil and Environmental Engineering
Georgia Institute of Technology
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RESEARCH INTERESTS

- Experimental fluid mechanics and advanced optical diagnostics, including particle image velocimetry (PIV), planar laser-induced fluorescence (PLIF), and tomographic/volumetric PIV.
- Hydrodynamic instabilities, shock-driven variable-density turbulent mixing, and transition to turbulence.
- Environmental and geophysical fluid dynamics, including stratified flows, internal waves, double-diffusive instability, scalar transport, and ocean mixing.
- Biofluids, biomechanics, zooplankton propulsion, bio-inspired propulsion, and flow dynamics of soft robotic swimmers.
- Magnetically responsive materials, ferrofluid droplet dynamics, and fluid–structure interaction in soft/bio-inspired systems.

EDUCATION

Ph.D. Mechanical Engineering 2014-2019
Georgia Institute of Technology
Ph.D. Thesis: Effects of Initial Conditions and Mach Number on Turbulent Mixing Transition of Shock-driven Variable-density Flow
Thesis advisor: Prof. Devesh Ranjan

M.S. Mechanical Engineering 2015-2017
Georgia Institute of Technology

M.S. Energy for Sustainability 2012-2014
University of Coimbra (MIT-Portugal program)
M.S. Thesis: Developing a Novel Method for Predicting Nearshore and Offshore Wave Energy of the Portuguese Coast
Thesis advisor: Prof. Almerindo Ferreira

M.S. Automotive Engineering 2008-2010
Iran University of Science and Technology
M.S. Thesis: Analysis and Improvement of Longitudinal and Lateral Stability of an Off-Road Vehicle Moving on a Slope Submitted to External Impact Loading
Thesis advisor: Prof. Javad Marzbanrad

B.S. Mechanical Engineering 2004-2008
University of Tehran
B.S. Thesis: Modifications and Improvements of FSW Welding
Thesis advisor: Prof. Mohammad Kazem Besharati Givi

RESEARCH EXPERIENCE

Research Engineer II 2022-Present
Georgia Institute of Technology
Environmental Fluid Mechanics Lab
Research: Biofluids, Biomechanics, Experimental Fluid Mechanics, Turbulence, Flow Instability

- Analyze volumetric flow fields around bio-inspired magnetic-responsive soft robots/materials using tomographic particle image velocimetry (PIV)
- Analyze kinematics and hydrodynamics of zooplankton propulsion (including *Euchaeta* and Antarctic krill) using tomographic PIV
- Investigate double-diffusive convection using simultaneous PLIF/PIV measurements, including finger growth, transport, and mixing dynamics
- Investigate viscosity-dependent deformation and spreading of ferrofluid droplets under applied magnetic fields

Postdoctoral Research Fellow 2019-2022
Georgia Institute of Technology
Environmental Fluid Mechanics Lab
Advisor: Prof. Donald Webster
Research: Biofluids, Experimental Fluid Mechanics, Turbulence

- Analyzed kinematics & hydrodynamics of pteropod using tomographic PIV measurement
- Characterized nonlinear internal waves using combined PLIF/PIV techniques
- Analyzed swimming behavior of copepods around internal waves
- Investigated high-Schmidt number passive scalar fields in turbulent boundary layers

Graduate Research Assistant 2014-2019
Georgia Institute of Technology
Shock Tube and Advanced Mixing Laboratory
Research: Experimental Fluid Mechanics, Turbulence

- Addressed the influence of modal content of the initial condition on the Richtmyer-Meshkov instability transition to a turbulent state
- Investigated the influence of Mach number and Atwood number on turbulent mixing transition of a shock-driven variable density flow
- Analyzed the inclined RMI flow development using high-resolution three-dimensional simulations with the FLASH code

Research Fellow 2012-2014
University of Coimbra
Research: Renewable Energy Systems Particularly Ocean Wave Energy

- Developed a novel numerical method for predicting nearshore wave energy using Delft3D and DelftDashboard
- Modeled and simulated a hospital building with different HVAC systems using EnergyPlus in order to reduce energy consumption

Research Fellow 2008-2010
Iran University of Science and Technology
Research: Optimization of Automotive Suspension Systems

- Optimized the double-wishbone suspension system of an off-road vehicle in critical position by modified Genetic Algorithm

TEACHING EXPERIENCE

Instructor 2024-Present
Georgia Institute of Technology

- Flow Dynamics of Soft Robotic Swimmers (VIP)

Teaching Assistant 2019-Present
Georgia Institute of Technology

- Dynamics

Teaching Assistant 2016
Georgia Institute of Technology

- Introduction to Fluid Mechanics

Teaching Assistant 2006-2010
University of Tehran

- Thermodynamics
- Engineering Economy

Instructor 2006-2009
Payam Hedayat, Emam Hadi & Talash High Schools

- Mathematics
- Physics

INDUSTRIAL WORK EXPERIENCE

Heat Exchanger & Pressure Vessel Designer 2011-2012
GarmaGostar Co.

Product Engineer 2010-2011
Mapna Locomotive Co.

AWARDS

- *CEE Young Faculty Research Award*, Georgia Tech, 2025
- *CEE Postdoctoral Excellence Award*, Georgia Tech, 2022
- *CEE Future Faculty Fellow Award*, Georgia Tech, 2022
- The article "Characteristics of swimming shelled Antarctic pteropods (*Limacina helicina antarctica*) at intermediate Reynolds number regime" was named an Editors' Suggestion by *Physical Review Fluids* and selected as a Focus Feature in *Physics*, 2019. [Featured Article]
- Full scholarship from Iran University of Science and Technology for M.S. in Automotive Engineering, 2008–2010

- Full scholarship from University of Tehran for B.S. in Mechanical Engineering, 2004–2008
- Passed the first level of the National Physics and Mathematics Olympiads with a distinction, 2003

PATENTS

- Portable Hybrid Generator, Iran, 2011

PROFESSIONAL AFFILIATIONS

- Member, Association for the Sciences of Limnology and Oceanography (ASLO), 2019–Present
- Member, American Physical Society (APS), 2014–Present

TECHNICAL SKILLS

Experimental Techniques

Particle Image Velocimetry (PIV), Planar Laser-Induced Fluorescence (PLIF), tomographic/volumetric PIV, flow visualization, image processing, and coupled scalar–velocity measurements

Computer Programs

MATLAB, C++, Fortran, Python, Visual Basic, LabVIEW, Tecplot, AutoCAD, SolidWorks, FLASH, TSI Insight, LaVision DaVis, Delft3D, SWAN, ADAMS, PDMS, EnergyPlus

SERVICE

- Reviewer for archival journals including PRL, PRF, JFM, PoF, Physica D Scripta, Shock Waves, and others, 2017–Present
- Session chair, International Symposium on Particle Image Velocimetry, 2022 and 2024
- Session chair, American Physical Society Division of Fluid Dynamics conferences, 2019, 2022, and 2024

MENTORED STUDENTS

Ph.D. Students

- **Ali Mojtabaei Soleimani:** *Flow Dynamics of Soft Robotic Swimmers* (2024–Present)

Master's Students

- **Anika Govil:** *Double-Diffusive Instability Experiments* (Master Special Topics student, 2025–2026)

Undergraduate Students

Current:

- **Seokhwa Hong:** *Double-Diffusive Instability Experiments* (2026–Present)
- **Eric Sher:** *Double-Diffusive Instability Experiments* (2026–Present)
- **Trevor Hodgson:** *Double-Diffusive Instability Experiments* (2026–Present)
- **Kennedy Hughes:** *Flow Dynamics of Soft Robotic Swimmers* (2026–Present)

- **Fiona Chen:** *Flow Dynamics of Soft Robotic Swimmers* (2026–Present)

Previous:

- **Ewan Pritchard:** *Double-Diffusive Instability Experiments* (2023–2026)
  Received the 2025 Outstanding Undergraduate Researcher Award from the College of Engineering at Georgia Tech
- **Amelia Faust:** *Double-Diffusive Instability Experiments* (2026)
- **Saaketh Reddy Chintha Reddy:** *Flow Dynamics of Soft Robotic Swimmers* (2025)
- **Akil Quadir:** *Flow Dynamics of Soft Robotic Swimmers* (2024–2025)
- **Blaire Doss:** *Double-Diffusive Instability Experiments* (2023–2026)
- **Prathyusha Paresh:** *Double-Diffusive Instability Experiments* (2024)
- **Gracen Dutton:** *Double-Diffusive Instability Experiments* (2024)
- **Anikait Dhond:** *Non-Linear Internal Waves* (2021)

GRANTS

Awarded Proposals:

- **Title of Project:** Initiative Proposal: Flow Instabilities and Fluid Dynamics for Space Applications
  Agency/Company: Space Research Institute Center, Program, Initiative (CPI)
  Total Dollar Amount: **$8,000** (year 1), **$25,000** (years 2 and 3)
  Role: Co-PI
  Collaborators: Suhas Jain (PI), Donald Webster (Co-PI)
  Status: Awarded January 2026

- **Title of Project:** Instability-Resolved Ocean Mixing for Climate Prediction and Climate Solutions
  Agency/Company: Georgia Tech Sustainability Next Institute Strategic Plan
  Total Dollar Amount: **$30,000**
  Role: Co-PI
  Collaborators: Suhas Jain (PI), Donald Webster (Co-PI)
  Status: Awarded May 2026

Submitted Proposals:

- **Title of Project:** Evolution and Mixing Mechanisms of Double-Diffusive Instabilities
  Agency/Company: National Science Foundation (NSF)
  Total Dollar Amount: **$499,999**
  Role: Co-PI
  Collaborators: Donald Webster (PI), Suhas Jain (Co-PI)
  Status: Submitted 2026

Proposals in Preparation:

- **Title of Project:** Double-Diffusive Pathways to Ocean Mixing Across High-Gradient Thermohaline Interfaces
  Agency/Company: ONR Physical Oceanography Core Program

Total Dollar Amount: **Not finalized**
Role: PI
Collaborators: Donald Webster (Co-PI)
Status: Proposal in preparation; white paper submitted 2026

- **Title of Project:** Design Science for Fluid–Structure Systems: Data-Driven Co-Design with a Soft-Robot Jellyfish Exemplar via Experimental and Computational Hydrodynamics
Agency/Company: National Science Foundation (NSF)
Total Dollar Amount: **Not finalized**
Role: Co-PI
Collaborators: Donald Webster (PI), Karthik Menon (Co-PI), Elizabeth Qian (Co-PI)
Status: Proposal in preparation, 2026

PEER-REVIEWED JOURNAL PAPERS [Google Scholar]

11. A. Connor, M. Mohaghar, D.R. Webster, "Hydrodynamics of active metachronal swimming modes in Antarctic krill, *Euphausia superba*", *Marine Biology* **172**, 135 (2025).

10. M. Mohaghar, D.R. Webster, "Hydrodynamics of cruise swimming and turning maneuvers in *Euchaeta antarctica*", *Scientific Reports* **14**, 1 (2024).

9. M. Mohaghar, A. Connor, S. Wu, R. Zhao, D.R. Webster, "Effects of symmetry-breaking mechanisms on the flow field around magnetic-responsive material appendages that mimic swimming strokes", *Physical Review Fluids* **9**, 023101 (2024).

8. M. Mohaghar, D.R. Webster, "Experimental investigation of non-linear standing internal waves using combined density and velocity measurements", *Experiments in Fluids* **64**, 77 (2023).

7. M. Mohaghar, J. McFarland, D. Ranjan, "Three-dimensional simulations of reshocked inclined Richtmyer–Meshkov instability: Effects of initial perturbations", *Physical Review Fluids* **7**, 093902 (2022).

6. M. Mohaghar, L.P. Dasi, D.R. Webster, "Scalar power spectra and turbulent scalar length scales of high-Schmidt-number passive scalar fields in turbulent boundary layers", *Physical Review Fluids* **5**, 084606 (2020).

5. M. Mohaghar, S. Jung, K. A. Haas, D. R. Webster, "Copepod behavior responses around internal waves", *Frontiers in Marine Science* **7**, 331 (2020).

4. M. Mohaghar, D. Adhikari, D.R. Webster, "Characteristics of swimming shelled Antarctic pteropods (*Limacina helicina antarctica*) at intermediate Reynolds number regime", *Physical Review Fluids* **4**, 111101 (2019).

3. M. Mohaghar, J. Carter, G. Pathikonda, D. Ranjan, "The transition to turbulence in shock-driven mixing: effects of Mach number and initial conditions", *Journal of Fluid Mechanics* **871**, 595–635 (2019).

2. M. Mohaghar, J. Carter, B. Musci, D. Reilly, J. McFarland, D. Ranjan, "Evaluation of turbulent mixing transition in a shock-driven variable-density flow", *Journal of Fluid Mechanics* **831**, 779–825 (2017).

1. D. Reilly, J. McFarland, M. Mohaghar, D. Ranjan, "The effects of initial conditions and circulation deposition on the inclined-interface reshocked Richtmyer–Meshkov instability", *Experiments in Fluids* **56**, 168 (2015).

SUBMITTED JOURNAL PAPERS

2. M. Mohaghar, S. A. Mojtabaei Soleimani, D.R. Webster, "Viscosity-dependent deformation and spreading dynamics of a ferrofluid droplet under an applied magnetic field", *Physics of Fluids*, submitted (2026).

1. M. Mohaghar, A. Bhattacharjee, S. S. Jain, D.R. Webster, "Dynamics of finger-type convection in double-diffusive instability", *Journal of Fluid Mechanics*, submitted (2026).

MANUSCRIPTS IN PREPARATION

3. M. Mohaghar, D.R. Webster, "Interaction of double-diffusive finger convection with Rayleigh–Bénard-type convection under a free surface", *Journal of Fluid Mechanics*.

2. S. A. Mojtabaei Soleimani, M. Mohaghar, D.R. Webster, "Effect of inter-appendage spacing on the three-dimensional hydrodynamics of axisymmetric jellyfish-like soft robotic swimmers", *Science Advances*.

1. S. A. Mojtabaei Soleimani, M. Mohaghar, D.R. Webster, "Hydrodynamics of pulsation-driven flow generated by a Xenia-inspired soft coral robot", *Science Advances*.

PEER-REVIEWED PROCEEDINGS

8. M. Mohaghar, A. Connor, S. Wu, R. Zhao, D.R. Webster, "Volumetric PIV measurements of bio-inspired magnetic-responsive materials that mimic swimming strokes", *15th International Symposium on Particle Image Velocimetry* , San Diego (2023).

7. M. Mohaghar, J. McFarland, and D. Ranjan, "A study of modal interaction between different scales of the turbulent Richtmyer-Meshkov instability using high-resolution three-dimensional FLASH simulations", *17th International Workshop on the Physics of Compressible Turbulent Mixing* , Atlanta (2022).

6. M. Mohaghar, D.R. Webster, "Characterization of non-linear internal waves using PIV/PLIF techniques", *14th International Symposium on Particle Image Velocimetry* , Chicago (2021).

5. G. Pathikonda, J. Carter, M. Mohaghar, and D. Ranjan, "Temporal evolution of Richtmyer-Meshkov induced mixing using simultaneous high-speed PIV-PLIF", *32nd International Symposium on Shock Waves* , Singapore (2019).

4. M. Mohaghar, J. Carter, G. Pathikonda and D. Ranjan, "Turbulent mixing driven by Richtmyer-Meshkov instability: Effect of Atwood number", *16th International Workshop on the Physics of Compressible Turbulent Mixing* , Marseilles (2018).

3. J. Carter, M. Mohaghar, G. Pathikonda and D. Ranjan, "Turbulent mixing driven by Richtmyer-Meshkov instability: Effect of Mach number", *16th International Workshop on the Physics of Compressible Turbulent Mixing* , Marseilles (2018).

2. V. Tsiklashvili, D. Reilly, M. Mohaghar, J. Carter and D. Ranjan, "Effect of the initial conditions on the evolution of Richtmyer - Meshkov instability turbulent quantities", *15th International Workshop on the Physics of Compressible Turbulent Mixing* , Sydney (2016).

1. M. Mohaghar, Z. Mousavi Karimi and A. Ferreira, "Developing a novel method for predicting nearshore wave energy of Matosinhos, Portugal", *Energy for Sustainability Multidisciplinary Conference* , Coimbra (2013).

CONFERENCE PRESENTATIONS

21. M. Mohaghar, S. A. Mojtabaei Soleimani, D.R. Webster, "Influence of bath fluid viscosity on magnetic deformation of a floating ferrofluid droplet", *Bulletin of the American Physical Society* , Orlando (2026).

20. S. A. Mojtabaei Soleimani, M. Mohaghar, F. Chen, K. Hughes, D.R. Webster, "Hydrodynamic effect of varying spacing between axisymmetrically arranged soft robot appendages", *Bulletin of the American Physical Society* , Orlando (2026).

19. D.R. Webster, M. Mohaghar, "Salt fingers under a free surface: Coupling of double-diffusive and Rayleigh–Bénard-type convection", *Bulletin of the American Physical Society* , Orlando (2026).

18. M. Mohaghar, E. Pritchard, B. Doss, D.R. Webster, "Finger Growth to Mixed Layers in Double Diffusive Instability: Simultaneous Scalar-Velocity Measurements", *Ocean Sciences Meeting* , Glasgow (2026).

17. M. Mohaghar, E. Pritchard, B. Doss, D.R. Webster, "Salinity effects on double-diffusive instability evolution: Finger growth, mixing, and transport", *Bulletin of the American Physical Society* , Houston (2025).

16. D.R. Webster, E. Pritchard, B. Doss, M. Mohaghar, "Finger-scale dynamics in double-diffusive instability: Vorticity, flux, and zig-zag ascent", *Bulletin of the American Physical Society* , Houston (2025).

15. S. A. Mojtabaei Soleimani, M. Mohaghar, D.R. Webster, "Tomographic PIV measurement of a magnetically actuated, bio-inspired, four-legged soft robot swimmer", *Bulletin of the American Physical Society* , Houston (2025).

14. M. Mohaghar, P. Paresh, B. Doss, E. Pritchard, G. Dutton, D.R. Webster, "Quantitative analysis of double-diffusive instability: Growth and mixing transition of ascending fingers", *Bulletin of the American Physical Society* , Salt Lake City (2024).

13. M. Mohaghar, D.R. Webster, "Hydrodynamic characterization of the adult *Euchaeta antarctica* during straight swimming and turning", *Ocean Sciences Meeting 2024* , New Orleans (2024).

12. M. Mohaghar, D.R. Webster, "Hydrodynamics of cruise locomotion in the adult *Euchaeta antarctica*", *Bulletin of the American Physical Society* , Washington (2023).

11. M. Mohaghar, A. Connor, R. Zhao, D.R. Webster, "Analysis of flow field around magnetic-responsive soft materials using tomographic particle image velocimetry", *Bulletin of the American Physical Society* , Indianapolis (2022).

10. M. Mohaghar, D.R. Webster, "Characterization of non-linear internal waves using PIV/PLIF techniques", *Bulletin of the American Physical Society* , Phoenix (2021).

9. D.R. Webster, M. Mohaghar, S. Jung, K. Haas, "Marine copepod behavior responses in and near internal waves", *Bulletin of the American Physical Society* , Phoenix (2021).

8. M. Mohaghar, S. Jung, K.A. Haas, D.R. Webster, "Copepod behavior responses around internal waves", *Ocean Sciences Meeting 2020* , San Diego (2020).

7. M. Mohaghar, L.P. Dasi, D.R. Webster, "Scalar power spectra and turbulent length scales in high-Schmidt-number scalar fields", *Bulletin of the American Physical Society* , Seattle (2019).

6. M. Mohaghar, J. Carter, J.S. Rubio, G. Pathikonda and D. Ranjan, "Experimental investigation of the effects of Mach number and initial condition on mixing transition in shock-driven flow", *Bulletin of the American Physical Society* , Atlanta (2018).

5. M. Mohaghar, J. Carter, G. Pathikonda and D. Ranjan, "Investigation of Atwood ratio influence on turbulent mixing transition of a shock-driven variable density flow after reshock", *Bulletin of the American Physical Society* , Denver (2017).

4. M. Mohaghar, J. Carter, B. Musci and D. Ranjan, "Experimental investigation of the effect of multimodal inclined interface on Richtmyer–Meshkov instability evolution", *APS Meeting Abstracts* , Portland (2016).

3. D. Reilly, M. Mohaghar, J. Carter, J. McFarland and D. Ranjan, "Progress on simultaneous PLIF/PIV measurements for a turbulent complex fluid interface", *APS Meeting Abstracts* , Boston (2015).

2. M. Mohaghar, D. Reilly, J. Carter, J. McFarland and D. Ranjan, "Simultaneous PLIF/PIV measurements for a single-mode inclined interface", *APS Meeting Abstracts* , Boston (2015).

1. D. Reilly, J. Carter, M. Mohaghar, D. Jarrahbashi, J. McFarland and D. Ranjan, "Observations of variable-density turbulence from a complex fluid interface", *APS Shock Compression of Condensed Matter Meeting Abstracts* , Tampa (2015).

OTHER CREATIVE PRODUCTS

2. M. Mohaghar, S. A. Mojtabaei Soleimani, D.R. Webster, "Viscosity Sets the Pace: Magnetic Deformation of a Floating Ferrofluid Droplet", *APS Gallery of Fluid Motion* , Orlando (2026).

1. M. Mohaghar, P. Paresh, B. Doss, E. Pritchard, D.R. Webster, "Dancing Fingers: The Evolution of Double-Diffusive Instability", *APS Gallery of Fluid Motion* , Salt Lake City (2024).