Ali **Farghadan**

Ph.D. Student

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Education

2020–2024 **Doctor of Philosophy**, *University of Michigan*, Ann Arbor, MI, USA, *GPA – 4.0*.
Mechanical Engineering, Supervisor: Dr. Towne

2018–2020 **Masters of Science**, *Northern Arizona University*, Flagstaff, AZ, USA, *GPA – 4.0*.
Mechanical Engineering, Supervisor: Dr. Arzani

2013–2017 **Bachelor of Science**, *Sharif University of Technology*, Tehran, Iran, *GPA – 3.85*.
Mechanical Engineering, Supervisor: Dr. Shafii

Journal Publications

1. **Farghadan, A.**, Jung, J., Bhagwat, R., Towne A. (2024) Efficient harmonic resolvent analysis via time-stepping, *Theoretical and Computational Fluid Dynamics*
2. **Farghadan, A.**, Martini E., Towne A. (2023) Scalable resolvent analysis for three-dimensional flows, *Journal of Computational Physics (accepted)*
3. **Farghadan, A.**, Towne A., Martini E., Cavalieri A. (2021) A randomized time-domain algorithm for efficiently computing resolvent modes, *AIAA Aviation*
4. Mahmoudi, M., **Farghadan, A.**, McConnell, D. R., Barker, A. J., Wentzel, J., Budoff, M. J., Arzani, A. (2021) The story of wall shear stress in coronary artery atherosclerosis: biochemical transport and mechanotransduction, *Journal of biomechanical engineering*
5. Meschi, S. S., **Farghadan, A.**, Arzani, A. (2021) Flow topology and targeted drug delivery in cardiovascular disease, *Journal of Biomechanics*
6. **Farghadan, A.**, Poorbahrami, K., Jalal, S., Oakes, J. M., Coletti, F., Arzani. A. (2020) Particle transport and deposition correlation with near-wall flow characteristic under inspiratory airflow in lung airways, *Computers in Biology and Medicine*
7. **Farghadan, A.**, Coletti, F., Arzani, A. (2019) Topological analysis of particle transport in lung airways: predicting particle source and destination, *Computers in Biology and Medicine*
8. **Farghadan, A.**, Arzani, A. (2019) The combined effect of wall shear stress topology and magnitude on cardiovascular mass transport, *International Journal of Heat and Mass Transfer*

Research Interests

- Reduced-order Modeling
- Data-driven Modeling
- Machine Learning
- Optimization and statistics

Conference Abstracts

1. **Farghadan, A.**, Towne A. An efficient algorithm for resolvent and harmonic resolvent analyses, *13th International Symposium on Turbulence and Shear Flow Phenomena (TSFP13)*, Montreal, Canada, 2024
2. **Farghadan, A.**, Towne A. Harnessing time-stepping for cost-effective harmonic resolvent analysis, *APS Division of Fluid Dynamics*, Washington, DC, 2023
3. **Farghadan, A.**, Martini E., Cavalieri A., Towne A. Global resolvent analysis of three-dimensional jets using randomized linear algebra and time stepping, *APS Division of Fluid Dynamics*, Indianapolis, IN, 2022
4. **Farghadan, A.**, Martini E., Cavalieri A., Towne A. A new algorithm for computing global resolvent modes in a CPU and memory efficient manner, *APS Division of Fluid Dynamics*, Phoenix, AZ, 2021
5. **Farghadan, A.**, Poorbahrami, K., Jalal, S., Oakes, J. M., Coletti, F., Arzani. A., Particle deposition correlates with wall shear stress divergence in human airways, *Summer Biomechanics, Bioengineering and Biotransport Conference*, Seven Springs, PA, 2019
6. **Farghadan, A.**, Coletti, F., Arzani, A. A dynamical systems approach to particle transport in lung airways, *APS Division of Fluid Dynamics*, Seattle, WA, 2019
7. **Farghadan, A.**, Poorbahrami, K., Jalal, S., Oakes, J. M., Coletti, F., Arzani. A., The role of wall shear stress divergence in lung particle transport, *Thermal and Fluids Engineering Conference*, Las Vegas, NV, 2019
8. **Farghadan, A.**, Arzani, A. The effect of wall shear stress topology and magnitude on mass transport in atherosclerosis, *APS Division of Fluid Dynamics*, Atlanta, GA, 2018

Honors and Awards

2021 ME Departmental Fellowship, University of Michigan, Ann Arbor, MI, USA

2020 Graduate Division Block Grant Award, University of California, Berkeley, CA, USA – MechSE Departmental Fellowship (5-year guaranteed funding), University of Illinois, Urbana-Champaign, IL, USA [Declined]

2020 Winner of 2020 Outstanding Graduate Research Award, Northern Arizona University, AZ, USA

2019 Graduate Student of the Month (October), Northern Arizona University, AZ, USA

2019 Nominated for 2019 NAU Research and Creativity Award (RCA) on behalf of Mechanical Engineering Department, Northern Arizona University, AZ, USA

2013 Ranked 231st among over 250,000 participants, B.Sc. Nationwide University Qualification Test in Math & Physics, Tehran, Iran

Work Experiences

2020 – present **Research Assistant**, University of Michigan, Ann Arbor, MI.

- Created a groundbreaking algorithm from scratch for resolvent analysis, a widely-adopted method in fluid flow modeling. This open-source package, called RSVD-Δt, scheduled for release by September 2024, showcases expertise in algorithm development.
- Utilized PETSc and SLEPc open-source libraries to implement various linear algebra operations, demonstrating proficiency in numerical computation. Conducted comprehensive statistical, qualitative, and quantitative analysis to validate results.
- Pioneered RSVD-Δt for harmonic resolvent analysis, extending the application to periodic flows.
- Optimized the algorithm to achieve unprecedented scalability at $O(N)$, resulting in significant reductions in CPU and memory usage (orders of magnitude) compared to existing state-of-the-art methods operating at $O(N^2)$.
- Analyzed various three-dimensional flows, breaking through previous limitations and demonstrating expertise in tackling complex problems.

Fall 2023 **Teaching Assistant**, University of Michigan, Ann Arbor, MI.

TA for Fluid Mechanics undergraduate course: Conducted recitation sessions and held office hours

2018 – 2020 **Research Assistant**, Northern Arizona University, Flagstaff, AZ.

- Conducted patient-specific cardiovascular and respiratory flow simulations using open-source software like FEniCS, and added new features to in-house software primarily using Python.
- Designed and implemented a novel method for distributing flow rates, precisely aligning them with experimental data, along with various contributions to particle tracking software.

2018 – 2019 **Teaching Assistant**, Northern Arizona University, Flagstaff, AZ.

- TA for Finite Element Analysis graduate course: Conducted office hours and assisted in grading biweekly projects and final projects.
- Thermo-fluids lab: Designed two new experiments and developed lab manuals for both.

Spring 2018 – Fall 2018 **Teaching Assistant**, Northern Arizona University, Flagstaff, AZ.

Thermal-fluids lab: Conducted hands-on laboratory sessions. Evaluated and graded student reports. Provided guidance and support to students in their final projects.

Computer Skills

Programming Languages

Python, C/C++

Other Softwares

MATLAB, FEniCS (Partial Differential Equation Solver), Oasis (Navier-Stokes Solver), SimVascular (Modeling and CFD Solver), Paraview (Visualization Software)

References

1. **Aaron Towne**, Assistant Professor, University of Michigan, Department of Mechanical Engineering, Ann Arbor, MI, USA. Phone: (734) 647-5338; Email: towne@umich.edu
2. **Amirhossein Arzani**, Associate Professor, University of Utah, Department of Mechanical Engineering, Salt Lake City, UT, USA. Phone: (801) 585-1867; Email: amir.arzani@sci.utah.edu