

ERFAN PIRMORAD

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Erfan is currently a Graduate Research Assistant at University of Toronto. His main research interest is on machine learning for scientific computing, the so-called **Scientific Machine Learning**, that embraces **Physics-based** and **Data-driven** modeling for **Computational Physics**, with focus on discovering physics of fluids and modeling flow behaviours through **Deep Reinforcement Learning**. Highly skilled in **Software Development** and knowledgeable in many facets of **High Performance Computing**, including shared and distributed memory paradigms.

EDUCATION

University of Toronto, Toronto

September 2019 - Present

Master of Applied Science

CGPA: 4/4, A+

Department of Mechanical & Industrial Engineering

Thesis: *Developing Physics-Informed Machine Learning Models for Direct Numerical Simulation (DNS) of Fluid-Structure Interaction.*

University of Tehran, Tehran

September 2015 - June 2019

Bachelor of Science, Mechanical Engineering

CGPA: 19.42/20, Overall Percentage: 97.1

Minor in Computer Science

Graduated *summa cum laude* : **1st rank** all semesters

Thesis: *Machine Learning Based Reduced-Order Modeling of Turbulent Fluid Flows by using a POD-LSTM Approach.*

HONORS AND AWARDS

- **Ontario Graduate Scholarship, 2020-2021:** One of the most prestigious merit-based awards for graduate students, valued at \$15,000
- **William Dunbar Memorial Fellowship, 2020:** Merit-based award, valued at \$5,000
- **Winner of F.O.E Prize, 2015-2019:** As a recognition awarded to the highest scoring student of B.Sc. in Faculty Of Engineering. (Every year)
- Ranked **1st** among undergraduate students of Mechanical Engineering. (GPA: 19.42/20 or 97.1%)
- Ranked **1st** (Gold Medal) out of more than 10,000 applicants in national Mechanical Engineering Olympiad.
- ranked **125th** out of 250,000 applicants at the national level for admission to B.Sc.
- Silver Medalist in National **Physics Olympiad** and National **Computer Olympiad**.
- **3rd** Place in IYPT (International Young Physicist Tournament).
- **1st** Place in PYPT (Persian Young Physicist Tournament).
- Awarded University of Toronto Graduate Fellowship, for M.A.Sc program.
- Awarded Stanford University Graduate Fellowship for PhD studies. (Declined)
- Awarded University of Michigan Graduate Fellowship for PhD studies. (Declined)

EXPERIENCE

Graduate Research Assistant (M.A.Sc Student)

September 2019 - Present

University of Toronto – Department of Mechanical & Industrial Eng. (MIE)

Toolboxes: [C++, OpenMP, MPI, CUDA, Pyhon, Tensoflow, PyTorch, LAMMPS, Trillinos, Eigen, Git]

- On going: Multi-agent Deep Reinforcement Learning based modeling of fluid-structure interaction through Immersed Boundary Method (IBM).
- Developed a hybrid CPU/GPU massively parallel multiphase LBM-MD solver based on Direct Forcing Immersed Boundary Method for the simulation of complex multiphysics fluid-structure interaction problems.
- Direct Numerical Simulation (DNS) and control of capillary interaction of self-Assembled granular particles at fluid-fluid Interfaces.
- Developed a collision model for particle-particle interaction in fully-resolved simulation of interfacial particulate flows.

Teaching Assistant (M.A.Sc Student)

September 2019 - Present

University of Toronto – Department of Mechanical & Industrial Eng. (MIE)

- Numerical Methods *Winter 2021*
- Business Process Engineering *Fall 2020*
- Data modelling *Winter 2020*
- modelling with Differential and Difference Equations *Fall 2019*

Research Assistant (B.Sc. Student)

September 2017 - June 2019

University of Tehran – School of Mechanical Eng.

Toolboxes: [C++, MATLAB, OpenMP, MPI, CUDA, OpenFOAM, Git]

- Machine Learning based Reduced-Order Modeling of turbulent flows by using Spectral Proper Orthogonal Decomposition (POD).
- Development of a novel parallel Block Cyclic Reduction (BCR) method for simulating incompressible 2D viscous flows on a hybrid CPU/GPU platform.
- Developed a hybrid CPU/GPU accelerated Lattice-Boltzmann solver of lead-acid batteries for simulation of charging and discharging process.
- Lattice-Boltzmann simulation of a self propelling micro-droplet entrapped between two non-parallel plates.
- Numerical simulation of charged sub-micron particles deposition in the human conducting airways using OpenFOAM framework.

Teaching Assistant

September 2017 - May 2019

University of Tehran – School of Mechanical Eng.

- Computational Fluid Dynamics (CFD) *Winter 2019*
- Numerical Methods *Winter 2019*
- Heat Transfer I *Fall 2018*
- Fluid Mechanics II *Fall 2018*
- Fluid Mechanics I *Winter 2018*
- Algorithms and Data Structures *Winter 2018*
- Introduction to CPP Programming *Winter 2018*
- Engineering Mathematics and PDEs *Fall 2017*
- Ordinary Differential Equations *Fall 2017*

OTHER PROJECTS

Artificial Intelligence & Data Science

- Conducted a data-driven study on the effect of the risk factors on incubation period For COVID-19.
- Developed an AI-based Data Science program designer and course recommend-er platform.
- Forecasting the 2019 Canadian Federal Election by Twitter data sentiment analysis.

PUBLICATIONS

- M. Ataei, E. Pirmorad, F. Costa, S. Han, C. B. Park, M. Bussmann. A massively parallel multiphase lbm-md solver based on direct forcing immersed boundary method: Applications in foam-fiber composites. *Journal of Computational Physics*, 2020: (Under review)
- E. Pirmorad, M. Bussmann. Towards numerical modeling of capillary interaction between self-assembled pairs of granular rafts. *Proceedings of the Canadian Society for Mechanical Engineering International Congress 2020, CSME Congress 2020, Charlottetown, PE, Canada*, 2019
- E. Pirmorad, M. Bussmann. Towards a numerical model of capillary interaction of self-assembled granular rafts. *14th World Congress on Computational Mechanics (WCCM XIV)8th European Congress on Computational Methods in Applied Science and Engineering (ECCOMAS 2020)*, 2020, Paris, France, 2019
- E. Pirmorad, M. Raisee. Reduced order modeling of vortex rope in timisoara swirl generator by using spod-lstm framework. *Journal of Turbulence*, 2019: (Under Review)
- S. Sattarzadeh, E. Pirmorad. An study on the origins of the sound and the aeroacoustic of an incompressible flow over a cylindrical rigid body. *International Conference of Acoustic and Vibration (ISAV)*, 2012

CERTIFICATES

- Certification in Reinforcement Learning Specialization (PyTorch).
- Certification in Neural Networks and Deep Learning from Coursera (Advanced Neural Network programming, Tensorflow).
- Certification in Scientific Computing from SciNet Compute Canada (C++, Python, OpenMP, MPI, Linux shell).
- Certification in Parallelism on Intel Architecture from Coursera (MPI, OpenMP)

VOLUNTEERING AND MEMBERSHIPS

Scientific Association of Mechanical Engineers (SAME)

2018 - 2019

University of Tehran, Iran

Responsibilities:Ran software training class, professional training, scientific events and conferences

National Organization for Developing Exceptional Talents (NODET)

2016 - 2017

Tehran, Iran

Responsibilities:Physics Research Instructor , and Physics Olympiad Teacher