Navid Mousavi

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Research Interests

- Active matter, Biophysics, Machine learning, Fluid mechanics

Education

- **University of Gothenburg** — Gothenburg, Sweden
  Ph.D. in Physics — *Jan 2020 - present*
  Optimal navigation strategies of Plankton
  Supervisor: Kristian Gustavsson
  Different species of Plankton, such as copepods, have very detailed environmental perception by measuring flow disturbances. They are also capable of weak navigation in competition with being advected. This suggests that, they should have learned by evolution, to leverage different flow signals to increase their survival chance. For example, vertical migration is a daily habit of Plankton, that their survival is highly dependent on. During my PhD, I worked on mathematical modeling of Plankton navigation and finding optimal strategies for purposes such as, vertical migration, and high strain avoidance. I used reinforcement learning to find possible strategies and relevant flow signals that Plankton can exploit as an active microswimmer. For this purpose, I used C/C++ for the main simulations and machine learning, and different libraries of Python (numpy, scipy, pandas, matplotlib, plotly) to analyze the resulting data. For the deep RL training I used TensorFlow and PyTorch libraries in Python.

- **Shiraz University** — Shiraz, Iran
  M. Sc. in Physics — *September 2016 - September 2018*
  Statistical properties of particle spread in quenched random media
  Supervisor: Saeed Davatolhagh
  Anomalous diffusion has attracted a large number of scientists in recent years as it is observed in an enormous number of phenomena, from bacterial dynamics to foraging movements of the larger animals. In my thesis, I investigated the anomalous diffusion and transport characteristics, such as MSD, first passage time probability, aging, ergodicity breaking and correlations, in tracer diffusion in a random quenched velocity field, known as Matheron-de Marsily. I used C and Python for the simulations and analyzed the data using Python and MATLAB.

- **Shiraz University** — Shiraz, Iran
  B. Sc. in Physics — *September 2011 - September 2016*
  Kuramoto model simulation of a system of oscillators
  Supervisor: Mohsen Ghasemi
  Studied synchronization transition in a one-dimensional periodic system of phase-oscillators interacting with asymmetric periodic function. The oscillators interact with a saw-tooth function with the control parameter and the oscillators frequencies are distributed according to a normal Gaussian probability distribution function. Numerical simulations showed that the system exhibits a second order phase transition and the critical point of the model found to be extremely depending on the asymmetric control parameter. I used C for the numerical simulation and Octave for the analysis of the results.
  Light curve and frequency analysis of delta scuti variable star
  Supervisor: Ahmad Poostforoush
  Observed the variable star, AE UMa, at Biruni observatory, Shiraz University. Analyzed the data using different astronomical software and packages and reported the result to IBVS(Information

Bulletin on Variable Stars). In the process I learned observational techniques, image processing, and data reduction, working with 11 and 20 inch telescopes of the observatory and various detectors.

Publication

- **Microswimmer navigation in turbulence**
  N. Mousavi Doctoral thesis, ISBN 978-91-8069-752-1 (2024).
- **Short term vs. long term: optimization of microswimmer navigation on different time horizons**
  N. Mousavi, J. Qiu, B. Mehlig, L. Zhao, K. Gustavsson Submitted to Physical Review X Life
- **Efficient survival strategy for zooplankton in turbulence**
  N. Mousavi, J. Qiu, B. Mehlig, L. Zhao, K. Gustavsson Accepted for publication in Physical Review Research, arXiv:2309.09641 (2023).
- **Smart microswimmers in complex flows**
  N. Mousavi Licentiate thesis, ISBN 978-91-8009-831-1 (2022).
- **Active gyrotactic stability of microswimmers using hydromechanical signals**
  J. Qiu, N. Mousavi, L. Zhao, K. Gustavsson, Physical Review Fluids, 7 (1), 20, 014311, 2022
- **Navigation of micro-swimmers in steady flow: the importance of symmetries**
  J. Qiu, N. Mousavi, K. Gustavsson, C. Xu, B. Mehlig, L. Zhao, Journal of Fluid Mechanics, 932, 21, A10, 2021
- **Synchronization in coupled phase oscillators with asymmetric interaction**
  N. Mousavi, M. G. N. Haghighi, S. Bazmi, Annual Physics Conference of Iran, 2016
- **Light curve and maximum time report of SX Phe star AE UMa**
  S. Hojjatpanah, N. Mousavi, S. M. Kazemi, Information Bulletin on Variable Stars (IBVS) No. 6199, 2014

Teaching

- **Chalmers/Gothenburg University** — Gothenburg, Sweden
  Artificial neural networks (info), Dynamical systems (info) — *September 2020 - present*
- **Shiraz University** — Shiraz, Iran
  Computational physics, Thermodynamics, Mechanics, Electromagnetism — *September 2013 - 2018*
- **Biruni Observatory** — Shiraz, Iran
  Astrophysics, Observational astronomy — *September 2013 - 2018*

Experience

- **Beheshti University** — Tehran, Iran
  Researcher — *July 2019 - December 2019*

  Studied the first-passage time statistics of generation of new pages in Wikipedia as a complex network. Used Python API for Wikipedia for data collection and analysis.
- **Tarjoman Club** — Shiraz, Iran
  Data Scientist — *September 2018 - December 2018*

  Built a database of best selling books, separated in translated/non-translated (to Persian) groups. Used Python web-scraping libraries such as Beautifulsoup to collect the data and MongoDB for database.
- **Satvis Institute** — Shiraz, Iran
  Co-Founder, Developer, Teacher — *January 2016 - October 2019*

  Co-founded an institute for teaching astronomy using virtual reality glasses. Developed the framework for the courses, developed material and videos, and taught the courses.

- **Biruni Observatory** Shiraz, Iran
  Web Developer *September 2017 - January 2018*
  Collaborated as a developer of the observatory's website. Worked with WordPress, CSS, and JS.

- **Biruni Observatory** Shiraz, Iran
  Researcher *September 2013 - April 2016*
  Studied variable stars by photometry. Observation and data collection with large scale telescopes. Data reduction and analysis with various astronomical packages and software.

- **Biruni Observatory** Shiraz, Iran
  Manager of Outreach *September 2015 - April 2018*
  Organized and managed the outreach activities, including public and private visits, courses, seminars, stargazing tours, and astronomical events.
  Also served as board member of Astronomy and Astrophysics society of Shiraz University during September 2012 to September 2015.

Computational Skills

- **Languages** C, C++, Python, MATLAB, Octave, Mathematica, Unix scripting
- **Tools** GIT, TensorFlow, PyTorch, scipy, numpy, pandas, BeautifulSoup, JSON, HDF5
- **Text and Visualization** LaTeX, Microsoft Office, matplotlib, plotly, GIMP, Inkscape

Presentations

- **Emergent counter-current swimming of zooplankton**
  13th Nordic workshop on statistical physics, Nordita, Sweden, March 2024

- **Active strategy to avoid high strain regions in plankton navigation**
  Cloud physics on the Zugspitze, Schneefernerhaus, Germany, April 2023

- **Plankton navigation in turbulent flow**
  Particle growth in turbulence, Nordita, Sweden, March 2023

- **Navigation of micro-swimmers in steady flow: the importance of symmetries**
  Summer school on active matter and complex media, Corsica, France, September 2022

- **Active gyrotactic stability of microswimmers**
  Quantitative AI in Complex Fluids and Complex Flows: Challenges and Benchmarks,Centro Enrico Fermi, Rome, Italy, July 2022

- **Optimal Vertical Navigation of Microswimmers in Steady Flow**
  7th Warsaw school of statistical physics, Sandomierz, Poland, June 2022

- **Cartwheel galaxy's ULX and HLX sources**
  International school for young astronomers (ISYA), IPM, Tehran, Iran, August 2016

- **Introduction to CCDs and CMOSs**
  Physics department, Shiraz University, Shiraz, Iran, November 2015

International Schools, Workshops, and Conferences

- **Complex motion in fluids**
  Cambridge University, Cambridge, UK, July 2023

- **Cloud physics on the Zugspitze**
  Schneefernerhaus, Germany, April 2023

- **Particle growth in turbulence**
  Nordita, Stockholm, Sweden, March 2023

- **Summer school on active matter and complex media**
  Corsica, France, September 2022
- **Quantitative AI in Complex Fluids and Complex Flows: Challenges and Benchmarks**
  Centro Enrico Fermi, Rome, Italy, July 2022
- **7th Warsaw School of Statistical Physics**
  Institute of Theoretical Physics, Sandomierz, Poland, June 2022
- **Workshop on Non-equilibrium Soft Matter**
  Institute for Research in Fundamental Sciences (IPM), Tehran, Iran, April 2019
- **Science with small telescopes**
  Biruni Observatory, Shiraz, Iran, October 2017
- **Spring College on the Physics of Complex Systems**
  International Center for Theoretical Physics (ICTP), Trieste, Italy, April 2017
- **International school for young astronomers (ISYA)**
  International Astronomical Union, IPM, Tehran, Iran, August 2016

Hobbies

- Astrophotography, Calligraphy, Camping.

Updated on April 26, 2024