Farrukh Nauman

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Objective: Seeking a full-time position as a data scientist.

Skills

- **Languages**: Python (2+ years), IDL, C, Fortran **Technologies**: GitHub, Bitbucket
- **Machine Learning Libraries**: scikit-learn, tensorflow/keras, statsmodels, pyspark
- **Computational Fluid Dynamics**: athena, snoopy, pluto, pencil, shenfun
- **Modeling**: (Current) Using machine and deep learning to construct surrogate models of high fidelity simulations of astrophysical fluids. (Previous) Theoretical and classical numerical models for astrophysical fluids.

Experience

(Current) Chalmers University of Technology Gothenburg, Sweden
Origins Fellow (Machine Learning, Astrophysical Fluid Modeling) *Sep 2018 - Present*

- **Machine Learning models of dynamos (1+ years, one paper accepted in Astronomy & Astrophysics)**: (Blog: fnauman.github.io, Data/code: github.com/fnauman/ML_alpha2):
  - I conducted the first study of "dynamos" (magnetic field growth in turbulent plasmas) using modern machine learning methods.
  - Previous work had used only considered ordinary least squares as the primary tool.
  - Algorithms: Lasso, Random Forests, Randomized Lasso, Bayesian MCMC. Best: Lasso.
  - Feature selection/engineering using model ensembling/stacking.
- **GlobalDisks**: Using pluto (written in C), I setup large scale plasma simulations of astrophysical fluids around massive stars.

Niels Bohr Institute Copenhagen, Denmark
Postdoctoral Fellow (Astrophysical Fluid Modeling) *Sep 2015 - Sep 2018*

- **TransitionToTurbulence**: First one to systematically study the importance of aspect ratio in the transition to turbulence.
- **LocalDisks**: Used fluid simulations (snoopy) to model astrophysical turbulence.

Machine Learning Projects

- **Time series**: My experience in modeling highly non-linear physical systems (turbulence) has introduced me to a wide variety of algorithms (github.com/fnauman/timeseries):
  - **Deep learning (tensorflow)**: CNNs, RNNs, LSTMs, wavenet.
  - **Machine learning (sklearn)**: Lasso, Random forests, xgboost.
  - **Econometrics (statsmodels)**: Seasonal Autoregressive Integrated Moving Average.
  - **Dynamical systems (numpy, scipy, sklearn)**: SINDy algorithm for *identifying differential equations* (and for forecasting).
- **Package for scikit-learn models**: (github.com/fnauman/template_travis_sklearn):
  - Modular design: preprocessing, training, testing of scikit-learn models.
  - continuous integration, unit testing.
  - logging, versioning to address reproducibility.
- **API (flask) for scikit-learn models inside a docker container**: (github.com/fnauman/flask_api_for_sklearn_docker):
- **pyspark, scikit-learn, dask_ml applied to the iris dataset**: (https://github.com/fnauman/pyspark_models):

Education

University of Rochester Rochester, New York (USA)
PhD in Physics and Astronomy (Advisor: Eric G. Blackman) *Oct 2015*

Thesis: Turbulence in Rotating and Non-Rotating Magnetohydrodynamic Shear Flows.

Quaid-i-Azam University Islamabad, Pakistan
M. Phil. Physics *June 2009*

Thesis: Modified gravity as an explanation for cosmic acceleration.

Awards and & Achievements

- HPC-Europa3 travel+computing: (i) NORDITA (March-April 2018: Stockholm, Sweden), (ii) ZARM (March 2019: Bremen, Germany).
- Horton fellowship from Laboratory for Laser Energetics. 2010-2015
- Susumu Okubo Prize for the highest performance on the graduate physics written comprehensive exam and excellence in coursework. 2011

Refereeing Service for Journals

Monthly Notices of Royal Astronomical Society, Journal of Cosmology and Astrophysics, Astrophysical Journal, European Physical Journal Plus

Publications (recent)

- **Farrukh Nauman**, Joonas Nättilä. 2019. *Exploring helical dynamos using machine learning*. A&A 629, A89. (arxiv.org/abs/1905.08193)
- **Farrukh Nauman**, Martin E. Pessah. 2018. *Transport properties of Keplerian flows in extended domains with no imposed field*. MNRAS, 480, 204. (arxiv.org/abs/1909.04290)
- **Farrukh Nauman**, Eric G. Blackman. 2017. *Shearing box simulations in the Rayleigh unstable regime*. MNRAS, 467, 1652. (arxiv.org/abs/1507.04711)
- **Farrukh Nauman**, Eric G. Blackman. 2017. *Sustained turbulence and magnetic energy in non-rotating shear flows*. Phys. Rev. E, 95, 033202. (arxiv.org/abs/1701.03531)

Selected Talks & Posters

- Machine learning and dynamos
  Star and Planet Formation, Chalmers Gothenburg, Sweden, June 17th-20th, 2019.
- Using machine learning to model astrophysical flows
  Advancing AI, CHAIR (Chalmers) Gothenburg, Sweden, March 4-5th, 2019
- Energy transfers in turbulent MHD shear flows
  ZARM, University of Bremen, Germany. July 25th, 2018
- Magnetized accretion disks
  Chalmers, Sweden. May 23rd, 2018