

Ra'ad Mahmoud

Career Summary

Output-oriented, highly driven individual with strong initiative seeking to continue impactful work in the field of machine learning. I have a track record of valuable software contributions in a range of sectors, from producing world-class data modeling code in black hole accretion research during my PhD, to new computer vision techniques now employed at a major automotive manufacturer, to finite-element models in the sector of submarine pipeline detection. I learn quickly, and always approach new problems with fervour, particularly as part of an equally dynamic team. I am currently working on applying novel computer vision techniques in the areas of aviation security and metagenomic pathogen classification.

Technical Skills

Programming Languages.

- Python** High proficiency: >7 years experience on a range of projects including physical modelling of magnetic dipoles, cosmic expansion, and black hole accretion dynamics. I make daily use of the Python scientific stack SciPy, in particular numpy and matplotlib, alongside sklearn and pandas. I am also extremely comfortable working within virtual environments, such as conda.
- C++** Moderate proficiency: 1 year experience, producing fast subroutines to model the energy and time-dependent behaviour of accretion physics. This fast code has allowed direct model fitting of observational high-energy data for the first time, overcoming decades-long standing challenges for the field.
- Java** Moderate proficiency: 1 year experience.
- JavaScript** Moderate proficiency: 1 year experience.

High-Performance Computing (HPC) & Parallelisation.

- MPI** 3 years experience writing and optimising Python codes for usage on COSMA5, a 6700-core Sandy Bridge system at Durham. These approaches generally used the OpenMP and multiprocessing APIs.

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Deep Learning Techniques.

Tensorflow & Keras 4 years experience (2 years research + 2 years industry) building deep learning algorithms for data sets in astronomy, the automotive industry, aviation security and metagenomics. I have a good understanding of the mathematical basis underlying many types of neural networks - in particular CNNs and the object detection family - and how best to utilise diagnostics such as confusion matrices and layer visualisations to assess and optimise networks.

Python Deployment.

Docker, TCP/IP I have a working experience of converting image prediction pipelines in a research context into robust prediction routines, ready for customer use. This has entailed the extensive use of containerisation, Docker(Hub) and network protocols to interface with other parts of the overall algorithms, as well as continuous improvement and version control services (Git/GitHub).

Interpersonal Skills.

Extensive experience of presenting my work, having spoken both within the University, and at several international conferences.

Well suited to output-oriented teamwork and collaboration, evidenced by past internships and prolific collaborations during PhD.

Good experience of mentoring in an industrial context at Kromek, where I have overseen and directed the technical work of a PhD intern.

Education

2016–2020 **PhD in Computational Astrophysics**, *Centre for Extragalactic Astronomy*, Durham University, (*Funded by STFC.*)

Thesis title: *Spectral-Timing Models of the Central Engine in Accreting Black Holes*

Supervisors: Professor C. Done & Professor T. P. Roberts

Awards:

- Elsevier book prize for outstanding 1st year postgraduate student [pool of 30; £100].

2012–2016 **MPhys in Physics and Astronomy**, *Department of Physics*, Durham University, *1st Class, Ranked #1 in year* .

Dissertation Title: *A Monte Carlo Approach to Habitability in the Milky Way*

Supervisor: Dr R.J. Wilman

Awards:

- Vice-Chancellor's academic excellence award 2013/14 [£2000].
- Level 3 computational physics prize 2015 [pool of 200; £100].
- J A Chalmers prize 2016 for highest overall degree mark (83%) [pool of 200; £100].

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2005–2012 **‘A2’: Mathematics (A*), Physics (A), Chemistry (A).**
‘AS’: Further Mathematics (A)
Monks Walk Comprehensive School

Internships + Employment

- 2020–Present **Machine Learning Engineer at Kromek Group Ltd.**, Thomas Wright Way, Sedgefield.
- 18 months My current role at Kromek involves the design and production deployment of novel algorithms which integrate computer vision and materials analysis for applications in aviation security; in particular, I augment existing object-detection architectures with 3D and materials information, to improve threat detection rates using pre-existing X-ray imaging hardware. I also develop algorithms for the identification of novel pathogens, using large nucleotide sequence databases and other bioinformatics tools.
- 2019–2019 **AI Intern at Nissan Motor Manufacturing UK Ltd**, Washington Road, Sunderland.
- 2 months Industrial placement in the Deep Learning team at Nissan, Sunderland, developing methods for improved computer vision techniques. Involved heavy use of convolutional neural net (CNN) construction and optimisation, and advanced image processing techniques. The image optimization method I designed is now being integrated into their automated defect detection system, with this system to be rolled out at many distribution points around the globe.
- 2017–2017 **Astronomy Intern at Japan Aerospace Exploration Agency**, Sagami-hara Campus, Tokyo, Japan.
- 3 months Lived and worked at the JAXA facility at Sagami-hara, networking with global contacts, contributing to cutting-edge X-ray research and providing Python detector calibration code now employed throughout the field.
- 2015–2015 **Intern at Superconductivity Group**, Durham University, Durham.
- 3 months Conducted research into the mechanical properties of superconducting solder alloys for use in the next generation of fusion tokamaks to follow the \$14 billion ITER (International Thermonuclear Experimental Reactor) in Cadarache, France. These solders will permit a more compact version of these game-changing reactors to provide clean and sustainable energy to the world over the coming decades.
- 2014–2015 **Intern at Tracerco, Billingham**, via Physics Department, Durham University, Durham.
- 3 months Led a team investigating non-destructive Magnetic Flux Leakage (MFL) methods in sub-marine pipelines. As a direct result of our research, the client company, Tracerco Ltd., opted out of a £24 million deal with a company offering this method, which our work proved to be spurious.
- 2014–2014 **Freelance Tutor**.
- 3 months Tutored GCSE and A-Level students in physics and mathematics.

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- 2011–2012 **Intern at Department of Astronomy and Mathematics**, University of Hertfordshire, Hatfield.
- 2 months Surveying M-dwarf stars as a supporting study for the Exoplanet Characterisation Observatory proposal (EChO).

Publications

“Discarding the disc in a changing state AGN: the UV/X-ray relation in NGC 4151”, R. Mahmoud, C. Done, 2019, Accepted in MNRAS, <https://arxiv.org/abs/1908.05461>.

“Reverberation Reveals the Truncated Disc in the Hard State of GX 339-4”, R. Mahmoud, C. Done, B. De Marco, 2019, MNRAS, 486(2), 2137.

“A Physical Model for the Spectral-Timing Properties of Black Holes”, R. Mahmoud, C. Done, 2018, MNRAS, 480(3), 4040.

“Modelling the Energy Dependence of Black Hole Binaries”, R. Mahmoud, C. Done, 2018, MNRAS, 473(2), 11.

“Superconducting and Mechanical Properties of Low-Temperature Solders for Joints”, Y. Tsui, R. Mahmoud, E. Surrey and D. Hampshire, 2016, IEEE Trans. Appl. Supercond., 23 (3).

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