

Josh Borrow

Data Visualisation, Data Science, & Computational Astrophysics

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Core Experience and Expertise

Big Data Analysis

Lead developer of the swiftsimio python package that sits at the core of the analysis toolchain for SWIFT galaxy formation simulations.

Uses numba acceleration for visualisation and data processing.

Close interaction with on-the-fly metadata production within SWIFT enables rapid analysis of petascale datasets with consumer-grade single node hardware.

Applied for and supervised a dedicated RSE (3 months support from DiRAC), leading to publication in the Journal of Open Source Software.

<http://github.com/swiftsim/swiftsimio>

Key skills: code documentation, code review, big data analysis, management & supervision, python, numpy, scipy, open source

Data Visualisation

Lead developer of the open-source SWIFT pipeline, enabling users to go from physics input parameters to a full analysis dashboard seamlessly.

Multiple data streams are brought together to generate publication-quality figures and insights instantly.

Development of a HPC-friendly dashboard interface simplified and centralised the data reduction process.

Feeds post-processed simulation output into a gaussian process emulation procedure to calibrate physics models in an un-biased and programmatic way.

<http://github.com/swiftsim/pipeline>

Key skills: web development, matplotlib, object-oriented programming, scripting, HTML/CSS, statistical inference

HPC CFD Simulations

Core developer on the SWIFT code, a hybrid MPI + threads C99 CFD and gravity particle simulation code leveraging AVX-2 and AVX-512 designed for over 100'000 cores.

Responsibilities: development and implementation of novel Lagrangian CFD algorithms; calibration of physics models; performing profiling and scaling tests in a HPC environment; code testing on novel architectures (e.g. Arm); daily user support and community management.

Utilised Tier-0 and Tier-1 HPC daily to perform hundreds of simulations, delivering insights with swiftsimio.

<http://www.swiftsim.com>

Key skills: HPC, C, vectorisation, MPI, CFD, scaling tests, community management, code calibration and verification

Additional Experience

- Teaching and Mentoring:** Taught three undergraduate-level classes; mentoring of multiple students; supervised RSEs.
- Graphic and Web Design:** freelance graphic designer and web developer (2014-2017).
- Technical Communication:** 7 first author publications on HPC, CFD, and Astrophysics, with over 30 talks worldwide.
- Outreach:** Lead designer on major scientific outreach programmes reaching thousands of people annually.
- Event Organisation:** Organised multiple scientific conferences, outreach events, and developer meetings.

Core Skills

Programming Languages

python (7 years; with numpy, matplotlib, scipy, pandas, numba, scikit-learn, h5py, attrs, jinja2, dask, among others)

C (4 years; with MPI, vectorisation, multiple compilers, parallel debuggers)

HTML/JS/CSS (5 years, including bootstrap, jQuery, static site generation)

Technical Tools

Version Control (7 years; git, GitHub, GitLab, pull requests, issue trackers)

Linux (9 years; HPC, batch system, shell scripting, vim, CLI, automation)

Testing and Deployment (5 years; Travis & Jenkins CI, pytest, GitHub Actions, PyPI deployment)

Additional

Data Visualisation (Affinity Designer, particle data rendering, 3D modelling)

Presentations (webcasts with OBS, conference talks, poster presentations)

Statistical Analysis (regression modelling, bayesian inference, principal component analysis)

Education & Employment

2021-Now Postdoctoral Research Associate
Massachusetts Institute of Technology (MIT)
Supervisor: Mark Vogelsberger

2017-2021 PhD, Computational Astrophysics
Institute for Computational Cosmology,
Durham University. Supervisor: Richard Bower

Grants, Awards, and Prizes

- Outreach Funding:** £15'000 STFC Spark proposal for hardware related to outreach accepted as Co-I.
- Computing Time:** Over 100 M CPU/h (approx £5M value) awarded to projects as a team member.
- Prizes:** 2nd Place Libersky Prize (SPHERIC 2021), DiRAC Day Poster Prize (2020), CIUK Poster Prize (2018); Durhack Winner.