Josh Borrow

Computational Astrophysicist and Open Source Software Engineer

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JBorrow

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*

HPC CFD Simulations

Core developer on the SWIFT code, a hybrid **MPI + threads C99 CFD and gravity** particle simulation code designed to simulate real problems on up to **100'000 cores**.

Responsibilities: development and implementation of **novel Lagrangian CFD schemes**; 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, MPI, CFD, scaling tests, community management, code calibration and verification*

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*

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, multiple compiler stacks, 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

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

2013-2017 **MPhys, Physics and Astronomy**
1st Class, Hons. Durham University
Thesis 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**: 3rd Place Libersky Prize (SPHERIC 2019), DiRAC Day Poster Prize (2020), CIUK Poster Prize (2018); *Durhack* Winner.