Shaun Preston

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EDUCATION

University of Oxford, Oriel College   **Oct 2023 – present**

    DPhil in Accelerator Physics, *Supervisors: Prof. Ian Martin, Prof. Philip Burrows*

Title: *Application of Machine Learning Techniques for the Online Optimisation of Synchrotron Light Sources*

Gaussian Process (GP) models are infinite-dimensional stochastic processes that can act as surrogate approximations of black-box systems. Characterised by a mean and covariance kernel, they are highly flexible and descriptive which makes them well-suited to interpolation, extrapolation and Bayesian optimisation on small datasets, as is often the case in applied physics. The framework is particularly nice as all finite-dimensional samples are drawn from conjugate multivariate normal distributions, which can be found in closed-form.

Developing a custom GP in JAX from scratch, mostly for technical understanding, and deploying it in the control room to improve injection efficiency into the Diamond Light Source storage ring. A pipeline has also been developed to enable interaction between the GP and machine; a bespoke PV (EPICS variable) class has been created which can be used seamlessly by the model for optimisation over arbitrary magnets and magnet hysteresis is compensated for during optimisation runs to name a few.

Currently preparing a poster and oral presentation "Optimising Injection Efficiency at Diamond Light Source using Gaussian Processes with non-Gaussian Likelihoods" for an upcoming ICFA workshop in 2025 hosted by CERN. In the future, I plan to investigate long-term seasonal drifts which affect injection, by exploiting archived data. I will also be investigating latent variable and latent force GPs as ML-mechanistic methods for emulation and physics discovery.

    Interests: *machine learning, beam dynamics, non-linear motion, numerical optimisation, Lie-methods*

University of Portsmouth   **Sep 2019 – Jun 2023**

    BSc in Physics, Astrophysics & Cosmology - First Class, 77%

Final year project: *Formation of Dust and Water from the First Cosmic Explosions (available on req.)*
An investigation into the concentrations of dust and water produced in the supernova remnants of early Type I stars in the primordial universe. I ran numerical simulations of gas collapse in the Enzo Automatic Mesh Refinement (AMR) code using the university supercomputer.

    Top modules: *Mechanics & Dynamics, Quantum Mechanics, Thermodynamics, Statistical Mechanics*

UTC Oxfordshire, Didcot   **Sep 2017 – Jun 2019**

    A Levels in Maths, Physics and Computer Science

RESEARCH/WORK EXPERIENCE

Virtual Computing Labs, University of Oxford, Demonstrator   **Oct 2024 - present**

    Working within a team of a dozen demonstrators taking calls from undergraduate students to assist them with a MATLAB coursework teaching numerical methods. Grading submitted work according to a written mark scheme by going through question-by-question on a call with students and being constructively critical to push them.

CERN, Summer Student   **Jun – Aug 2023**

    Part of the BE-ABP-HSL section, I designed single-pass particle tracking simulations in Travel for RFQs (Radio Frequency Quadrupoles). Learnt about beam dynamics and acceptance boxes as a diagnostic for particle transmission. Pre-bunched a beam using E-fields to test longitudinal acceptance and validated a box for a new Carbon Ion RFQ using a quadrupole triplet to focus both waists simultaneously.

Diamond Light Source, Year in Industry   **Sep 2021 – Sep 2022**

Performed studies into single-bunch instabilities of the Diamond synchrotron beam using the Elegant tracking code. Vertical beam emittance fluctuates due to quantum effects and insertion device gap length changes, and I mitigated this by using a stripline kicker to incoherently excite the beam at a synchrotron sideband. I also increased the dynamic aperture by 10% using a genetic algorithm to control sextupoles.

Oxford Computer Consultants, Internship   **Jun – Jul 2018**

Wrote a REST API using the Flask micro-framework to sell satellite weather data to customers. Handled user access levels using HTML arguments passed to JSON to determine whether certain data could be sold to a particular user.

Sophos, Internship   **Jun – Jul 2015**

Work experience learning about CCLs (data leakage protection).

PUBLICATIONS

Laser-hybrid Accelerator for Radiobiological Applications (LhARA)   **2024**

Authors: Giusy Passarelli, Matt Pereira, Carl Jolly et al.

https://cds.cern.ch/record/2902966

Measurements for Emittance Feedback based on Resonant Excitation at Diamond Light Source, IBIC   **2022**

Authors: Shaun Preston, Lorraine Bobb, Alun Morgan, Teresia Olsson

doi:10.18429/JACoW-IBIC2022-WEP37

Emittance Feedback for the Diamond-II Storage Ring using Resonant Excitation, IPAC   **2022**

Authors: Shaun Preston, Teresia Olsson, Beni Singh

doi:10.18429/JACoW-IPAC2022-TUPOMS035

ACHIEVEMENTS

Santander Universities Scholarship   **2020**

£250 seed funding to design a novel solar powered device after a competitive round of presentations to a panel of judges.

Duke of York Gold Award   **2018**

Recognition for the submission of a technical report on the role of APIs during work experience.

National Citizen Service   **2018**

Team-building and volunteering activities with other students in and around the local area.