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Achieving diverse beam modes with modelling and optimisation with a versatile SRF photoelectron gun and booster at SEALab

Wednesday 4 June 2025 16:00 (2 hours)

The SEALab facility in Berlin is home to a Superconducting Radio-Frequency photoelectron gun and booster (SRF photoinjector) and electron diagnostics beamline aiming to produce tailored electron beams for a wide range of applications from Energy Recovery Linacs (ERL) to Ultrafast Electron Diffraction (UED) to Electron Beam Water Treatment (EBWT). The variety in these applications span three orders of magnitude in bunch charge, bunch length and emittance, requiring flexibility in the injector and precise control of the individual and distinctive beam modes. An integral component to achieving this range of beam dynamics is the incorporation of computational models. Thus, an analytical model, particle-in-cell simulations and machine learning surrogate models have been developed for understanding, achieving and controlling the required beam parameters. These models are paired with a Multi-Objective Bayesian Optimisation (MOBO) algorithm to aid during the setup and operation of the accelerator, and enable efficient switching between the beam modes. This work demonstrates the development of these models and their first application to accelerator control through MOBO.

Footnotes

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Author: BROOKES, Emily Jayne (Helmholtz-Zentrum Berlin fuer Materialien und Energie GmbH)

Co-author: KAMPS, Thorsten (Helmholtz-Zentrum Berlin fuer Materialien und Energie GmbH)

Presenter: BROOKES, Emily Jayne (Helmholtz-Zentrum Berlin fuer Materialien und Energie GmbH)

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