Contribution ID: **187**   Type: **Poster (student)**

Machine Learning-based Data Analysis and Surrogate Modeling For COXINEL Experiment

Tuesday, 19 September 2023 19:00 (1h 30m)

Recently, free electron lasing at UV wavelength has been demonstrated by deploying the COXINEL beamline driven by HZDR plasma accelerator in a seeded configuration[1]. Further control and optimization of such an FEL radiation require full knowledge of strongly-coupled multivariate parameters involved in laser plasma acceleration, electron beam transport and radiation generation. For this purpose, one has to solve an inverse problem, i.e. finding matching parameters of the simulation to reproduce the experiment. Such inverse problems are ill-posed and cannot be easily resolved due to high computational complexity. Here, machine learning-based methods have a high potential to accelerate theoretical comprehension of the system, novel means for design space exploration and promise reliable in-situ analysis of experimental diagnostics and parameters. We apply simulation-based inference technique for this purpose. This method is a combination of deep learning and statistical approaches to resolve an inverse problem up to a posterior distribution of the simulation parameters given an experimental sample. In addition, we have developed machine learning-based surrogate models that can significantly accelerate forward computations for even faster results of the inverse solver.

[1] M. Labat, et al. "Seeded free-electron laser in driven by a compact laser plasma accelerator", Nat. Photonics, 17, 150(2023)

Primary author: WILLMANN, Anna (HZDR)

Co-authors: GHAITH, Amin (Helmholtz Zentrum Dresden Rossendorf);   CHANG, Yen-Yu (Helmholtz Zentrum Dresden Rossendorf); DEBUS, Alexander (Helmholtz-Zentrum Dresden-Rossendorf);   Dr LABERGE, Maxwell (Helmholtz-Zentrum Dresden-Rossendorf);   Dr LABAT, Marie (Synchrotron SOLEIL, Saint-Aubin, France);   UFER, Patrick (Helmholtz-Zentrum Dresden-Rossendorf);   SCHOEBEL, Susanne (Helmholtz-Zentrum Dresden-Rossendorf);   Dr HOFFMANN, Nico (Helmholtz Zentrum Dresden Rossendorf);   BUSSMANN, Michael (Forschungszentrum Dresden-Rossendorf e.V.);   COUPRIE, Marie Emmanuelle (Synchrotron SOLEIL);   SCHRAMM, Ulrich (Helmholtz-Zentrum Dresden-Rossendorf);   IRMAN, Arie (Helmholtz Zentrum Dresden Rossendorf)

Presenter: WILLMANN, Anna (HZDR)

Session Classification: Poster session

Track Classification: WG7: Beam diagnostics, instrumentation, Machine Learning