MATTER AND TECHNOLOGIES

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

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Recently, free electron lasing at UV wavelength, seeded by a laser plasma accelerator has been demonstrated at the COXINEL beamline in collaboration with HZDR[1]. Further control and optimization of FEL radiation requires 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. find 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, provide novel means for design space exploration and promise reliable in-situ analysis of experimental diagnostics and parameters. We apply the simulation-based inference technique for this purpose. This method is a combination of deep learning and statistical approaches to resolve an inverse problem into a multivariate 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.

Speed Talks

Normal

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