



DIGITAL TOTAL

Contribution ID: 104 Contribution code: 81

Type: Poster

Machine Learning based optimization of transverse beam emittance in Free Electron Lasers

In the context of Free Electron Lasers like the European XFEL at DESY Hamburg, it is essential to optimize the transverse emittance of a charged particle beam. Within the project OPAL-FEL we therefore aim to implement a Machine Learning based online optimal control process to minimize emittance.

The process will consist of a forward prediction model and an inverse feedback model.

Their implementations will incorporate experimental as well as artificial data, sampled by high fidelity digital twin simulations taking into account non linear space charge effects and other physical phenomena.

Additionally we are interested in studying the impact of different methodologies to be used such as Helmholtz machines, variational autoencoders and physics-informed neural networks.

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Keywords

free-electron laser
machine learning
transverse emittance
beam control
digital twin

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