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Data-driven Simulation of Target Normal Sheath Acceleration by Fourier Neural Operator

Particle-in-Cell simulations are a ubiquitous tool for linking theory and experimental data in plasma physics rendering the comprehension of non-linear processes such as Laser Plasma Acceleration (LPA) feasible. These numerical codes can be considered as state-of-the-art approach for studying the underlying physical processes in high temporal and spatial resolution. The analysis of experiments is performed by optimising simulation parameters so that the simulated system is able to explain experimental results. However, a high spatio-temporal resolution comes at the cost of elevated simulation times which makes the inversion nearly impossible. We tackle that challenge by introducing and studying a reduced order model based on Fourier neural operator that is evolving the ion density function of Laser-driven Ion acceleration via 1D Target Normal Sheath acceleration (TNSA). The ion density function can be dynamically generated over time with respect to the thickness of the target. We show that this approach yields a significant speed-up compared to numerical code Smilei while retaining physical properties to a certain degree promising applicability for inversion of experimental data by simulation-based inference.

Speed Talks

I am unable/unwilling to give a speedtalk.

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