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Mapping the Parameter Space of Laser-Driven Ion Acceleration via Neural Networks[1] BLAGOJE DJORDJEVIC, ANDREAS KEMP, Lawrence Livermore National Laboratory, JOOHWAN KIM, University of California, San Diego, SCOTT WILKS, Lawrence Livermore National Laboratory, RASPBERRY SIMPSON, Massachusetts Institute of Technology, TAMMY MA, DEREK MARISCAL, Lawrence Livermore National Laboratory — Laser-driven ion acceleration is constrained by the difficulty and expense involved not only in experiments but also in modeling. High-resolution simulations in 1D can take hundreds of hours to resolve and this cost only increases for more complex problems. Using multilayer neural networks, one can effectively map out large swaths of parameter space in ways not computationally accessible to a traditional parameter scan. An ensemble of 1D simulations focusing on Target-Normal Sheath Acceleration was built for a large spread of initial conditions, varying initial parameters such as intensity, pulse-length, target thickness, etc. The crux of the technique is the continuous, data-informed function generated by the neural network that can rapidly produce output parameters for various times and inputs. The function can accurately reproduce sampled datapoints as well as interpolate to untrained points within the parameter space. As a diagnostic, it can pinpoint discrepancies between its results and the simulation ensemble. It can be used to identify unique physics suggested by the network or simulation failure due to numerical error or insufficient resolution.

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