

## 5th ICFA Beam Dynamics Mini-Workshop on Machine Learning for Particle Accelerators



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### **Predicting Space-Charge Potentials and E-Fields Using CNN and KAN- 15'+5'**

This study explores various neural network approaches to simulate beam dynamics, specifically addressing non-linear space charge effects. We introduce a convolutional encoder-decoder architecture with skip connections, achieving a relative error of 0.5% in predicting both transversal and coupled 3D electric self-fields. Additionally, to enhance interpretability and robustness, we investigate an auxiliary Kolmogorov-Arnold Network (KAN) designed to replicate the solution flow of a Finite Element Method (FEM). Our findings suggest that these advancements offer a potentially more efficient alternative to traditional numerical methods for non-linear space-charge calculations in beam dynamics simulations, delivering substantial speed-up.

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