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Transverse phase space tomography using machine learning at the CLARA accelerator test facility

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Phase space tomography is a powerful technique for characterising beams in particle accelerators and has found widespread use at many facilities. However, conventional tomography techniques require significant computational resources, particularly when reconstructing the charge distribution for two or more degrees of freedom. Here, we describe a novel technique that employs machine learning and image compression for transverse phase space tomography in two degrees of freedom. The use of machine learning allows the beam distribution in 4D phase space to be reconstructed more quickly than by conventional tomography techniques, while the application of image compression can dramatically reduce the size of the data sets involved in the analysis. The new method has been deployed on the CLARA accelerator at Daresbury laboratory to characterise electron bunches with moderate energy (35 MeV) and charges up to 100 pC. We compare the machine learning technique against a conventional tomography algorithm (algebraic reconstruction) applied to the same data set, and show that the results are at least as good in terms of predicting the observed beam profiles for a range of quadrupole strengths.

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Footnotes

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Yes

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