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A Non-Invasive, Single-Shot Emittance Diagnostic, Using Edge-Radiation and a CNN Based Inference Model

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Accelerators are moving towards higher repetition rates with extremely high current and brightness beams. Advanced control techniques using machine learning are required for the optimisation and operation of such accelerators.

These techniques greatly benefit from having single-shot beam measurements.

However, high intensity beams present an issue for conventional diagnostics as they will destroy any material placed in the beamline.

Therefore, single-shot, non-invasive diagnostics are highly desirable.

Edge-radiation is produced in the fringe fields of bending magnets and is common to both linear and circular accelerators.

The radiation is both sensitive to the beam parameters and non-intercepting, making it an ideal candidate for future diagnostics.

Here, we will present experimental results of an edge-radiation based diagnostic at FACET-II.

This diagnostic collects edge-radiation and uses machine learning to characterize the beam.

We will discuss the image processing techniques used and demonstrate how a convolutional neural network can predict the emittance in a single-shot.

Acknowledgments

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