Contribution ID: 9

Type: Flash Talk

The Virtual Spectrometer at EuXFEL

Friday 22 November 2024 12:14 (6 minutes)

Virtual diagnostics can provide complementary diagnostics, by combining information from several sources, thereby profiting from the advantages of each one. To this end, we present the Virtual Spectrometer, which maps data from a low-resolution time-of-flight spectrometer to a high-resolution one. While the low-resolution spectrometer is non-invasive, can operate at 4.5 MHz and has complex calibration, the high-resolution spectrometer is invasive, operates at 10 Hz and has a simpler calibration procedure. By combining the two through data science methods, a virtual spectrometer with higher resolution than the time-of-flight spectrometer is obtained, while maintaining its other benefits. After a short setup and training period with the invasive grating spectrometer, it is removed from the beamline. The resulting virtual spectra are obtained at 4.5 MHz non-invasively with an up to 40% increased resolution, with respect to the time-of-flight spectrometer. The Virtual Spectrometer can use a Bayesian linear fit, or a Bayesian Neural Network to perform the fit, depending on the fit time requirements.

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Session Classification: Flash Talks 2