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Surrogate Models for X-Ray Pulse Diagnostics at the European XFEL

The European XFEL is a scientific research facility that produces ultra-short and ultra-brilliant x-ray pulses. The facility is 3.4 kilometers long and comprises, very simplistically, three main sections: a linear electron accelerator, undulators, and photon beamlines. The entire facility is densely instrumented with various diagnostic devices that produce a vast amount of diverse data.

This talk focuses on an on-going effort that aims to understand the interplay between the various components of the whole facility on the properties of the produced x-ray pulses via a surrogate model. The sheer amount of available diagnostic data makes such a holistic approach possible and potentially invaluable. While still at an early stage, data analysis and preliminary results already provide useful insights into the correlation between electron bunches and x-ray spectral properties at MHz repetition rates. Furthermore, the goal of the program is not only to provide a surrogate model of the machine, but also to allow for its inversion; i.e. providing a systematic method to obtain self-consistent machine setting ranges that reliably produce the desired photon beam properties.

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