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Harnessing Artificial Intelligence for Single-Shot Measurement of Free Electron Laser Pulse Power

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In the realm of Free Electron Laser (FEL) research, the accurate characterization of radiation pulse profiles is crucial for optimizing beam quality and experimental outcomes. Our presentation introduces a pioneering approach utilizing machine learning techniques for virtual diagnostic profiling of FEL radiation pulses. Our innovative Artificial Intelligence (AI) diagnostic tool leverages longitudinal phase space data from the X-band transverse deflecting cavity collected by a DAQ system at FLASH facility in DESY to reveal the shot-to-shot temporal profile of FEL pulses in real-time. Unlike conventional methods, our AI-driven approach overcomes the limitation of single-shot measurements, offering a non-invasive and efficient method for characterizing radiation pulses.

By harnessing cutting-edge machine learning models, our tool enables accurate single-shot measurements of FEL pulse power, facilitating groundbreaking research in ultrafast science. This presentation will delve into the theoretical foundations, methodology, and validation results of our virtual diagnostic tool, showcasing its potential to revolutionize FEL research and unlock new frontiers in science and technology.

Footnotes

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