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The digital twins for Elettra 2.0

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Elettra 2.0, the next-generation synchrotron light source, leverages Digital Twin technologies to enhance commissioning and operational capabilities. This paper presents two Digital Twin implementations tailored to Elettra 2.0, enabling early software validation and performance assessment. The first Digital Twin is an accelerator simulator developed in PyAT, based on the ESRF framework but adapted to Elettra 2.0's needs. It replicates the control system architecture, including Tango-simulated devices for BPMs, power supplies, and other components. This virtual environment allows comprehensive testing of High-Level Software (HLS) before the physical control system is available, reducing commissioning time. The second Digital Twin, based on a C port of Accelerator Toolbox (C-AT), runs on a central server connected via Ethernet to FPGAs managing BPMs, LLRFs, power converters, IDs and beam loss monitors. By bypassing the control system, it provides low-latency access to device parameters and includes optimized magnet kick models for real-time feedback system simulations. This framework evaluates feedback performance, crosstalk, and model-to-machine mismatches.

Footnotes

Paper preparation format

Others

Region represented

Europe

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