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Development of a flexible digital twin framework for accelerators using design patterns

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These days designing an accelerator consist of prototyping and testing adequate commissioning software. Digital twins serve as natural test benches for validating and monitoring the required physics software stack. These twins must align with the current design state of the accelerator from the project's inception to the machine's commissioning. The authors have developed a modern digital twin framework based on software design patterns. Its architecture emphasizes clean design principles with minimal coupling between components. Its setup requires only lattice and device configuration data. Thanks to its design, it seamlessly integrates into prototyping environments or control system infrastructures. In this paper, we briefly describe the design patterns underlying this architecture, highlight the flexibility and advantages of the infrastructure, and outline the steps needed to implement it for a machine currently lacking a digital twin.

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Author: SULAIMAN KHAIL, Waheedullah (Helmholtz-Zentrum Berlin für Materialien und Energie GmbH)

Co-author: SCHNIZER, Pierre (Helmholtz-Zentrum Berlin für Materialien und Energie GmbH)

Presenter: SULAIMAN KHAIL, Waheedullah (Helmholtz-Zentrum Berlin für Materialien und Energie GmbH)

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