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SOFTWARE ENGINEERING

de RSE | CONFERENCE
KARLSRUHE 2025

Contribution ID: **36**   Type: **Poster**

Python Interface for Particle Accelerator Control and Modelling

Wednesday 26 February 2025 19:40 (20 minutes)

Particle accelerators are widely used around the world for both research and industrial purposes. The largest facilities consist of synchrotron light sources, high energy physics colliders and nuclear physics research facilities. These are essential tools for scientists in a broad range of fields from life sciences to cultural heritage and engineering, and use significant national or international investments for their construction and operation. To ensure reliable operation and that the accelerators meet the performance goals set by the users, it is crucial to have up-to-date, well-maintained software which allows the accelerator physicists to easily interact with the machine and relate its behaviour to a machine model.

Presently, Matlab Middle Layer (MML), initiated in the 1990s, is a key tool at many synchrotron light sources for commissioning, operation and accelerator tuning. While widely adopted, MML has over time become outdated and fragmented, making it both difficult to extend and to maintain. In addition, Matlab is a propriety software with decreasing user base among students and young professionals in the accelerator physics field, highlighting the need for a new modern, open-source solution which can meet the requirements of the future.

Therefore, an initiative for a world-wide collaboration is underway to develop a Python Accelerator Middle Layer (pyAML). Some key requirements for the pyAML are control system agnosticism, machine independence, easy integration with already existing Python packages allowing for use of high performance computing, modern optimisation algorithms and machine learning, connection to a digital twin, FAIR data management, and a software architecture which makes it possible to maintain the code in a collaborative way while individual facilities can contribute developments that are directly usable at other facilities. In addition, the pyAML collaboration aims to strengthen collaboration, offer training and in general improve the software development skills in the community.

The work presented here details the contribution of Helmholtz-Zentrum Berlin (HZB) and Karlsruhe Institute of Technology (KIT) to the broader effort. Our goal is to make use of the experienced we have gained from software development for our two facilities and be active participants in building the foundation for pyAML together with other facilities around the world.

I want to participate in the youngRSE prize

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Session Classification: Poster and Demo Session together with Reception

Track Classification: Policies and Community Building: research software support