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SciBmad: a modern, differentiable ecosystem for accelerator physics simulations including machine learning

Wednesday 4 June 2025 16:00 (2 hours)

SciBmad is a new, open source software project that will provide a modern, differentiable, and full-featured toolkit for all types of accelerator physics simulations and design tasks. A set of modular, extensible packages providing the fundamental tools needed for accelerator physics simulations is currently being developed in the Julia programming language. Users will instantly have access to the entirety of Julia's rich ecosystem of optimizers, integrators, machine learning toolkits, plotting packages, etc. SciBmad will include, in a fully-differentiable environment, nonlinear tracking, normal form analysis including spin and radiation, also being developed is GPU-parallelized tracking and interfacing to machine learning packages. In this paper we detail the current status of SciBmad development and plans for the future. Julia is a relatively new high-level, high performance computing language that adopts multiple dispatch with just-in-time (JIT) compilation as a central paradigm, and includes a powerful type system providing universal, ad-hoc, and subtype polymorphisms. Such features simplify the code and enable automatic differentiation of code with zero extra effort.

Footnotes

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