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## Synergia: A Modern Tool for Accelerator Physics Simulation

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Computer simulations play a crucial role in both the design and operation of particle accelerators. General tools for modeling single-particle accelerator dynamics have been in wide use for many years. Multi-particle dynamics are much more computationally demanding than single-particle dynamics, requiring supercomputers or parallel clusters of PCs. Because of this, simulations of multi-particle dynamics have been much more specialized. Although several multi-particle simulation tools are now available, they tend to cover a narrow range of topics. Most also present difficulties for the end user ranging from platform portability to arcane interfaces.

In this presentation, we discuss Synergia, a multi-particle accelerator simulation tool developed at Fermilab, funded by the DOE SciDAC program. Synergia was designed to cover a variety of physics processes while presenting a flexible and humane interface to the end user. It is a hybrid application, primarily based on the existing packages mxyzptlk/beamline and Impact. Our presentation covers Synergia's physics capabilities and human interface. We focus on the computational problems we encountered and solved in the process of building an application out of codes written in Fortran 90, C++, and wrapped with a Python front-end. We also discuss some approaches we have used in the visualization of the high-dimensional data that comes out of a particle accelerator simulations, especially our work with OpenDX.

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