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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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