Visualization and Analysis Tools for Assisting in Evaluating Fusion Simulations

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As part of the DOE SciDAC program computer scientists working with fusion scientists have developed and deployed several visualization and analysis tools for assisting in the evaluation of fusion simulations. In this poster we highlight two of these tools which have been deployed within the visualization package VisIt.

The first is a tool is for interactively and rapidly exploring the topology of the magnetic field using a Poincaré map. Unlike traditional Poincaré maps that rely on a dense set of puncture points to form a contiguous representation of each magnetic surface we use a sparse set of puncture points while analyzing the topology. The resulting analysis not only allows for the identification of the topology but also allows for the visualization of the magnetic surface using a minimal number of points. Depending on the surface order a reduction of one to two orders in magnitude of puncture points can be realized. Figure 1. Highlights a typical result.

The second tool is for performing query based visualization and analysis. Many fusion simulations include particles as part of their calculations. As the complexity of the simulations grow so do the number of particles. Trying to understand thousands let alone hundreds of thousands of particles is a difficult task especially when only a few particles exhibit a particular behavior. To assist in the analysis we have deployed analysis tools that combine parallel coordinates plots combine with accelerated index searches. Parallel coordinate plots allow one to identify trends within multivariate data while accelerated index searches allows one to quickly perform range based queries on a large number of multivariate entries. Figure 2. Shows the results of the analysis of a PIC code used to investigate "trapped" particles.
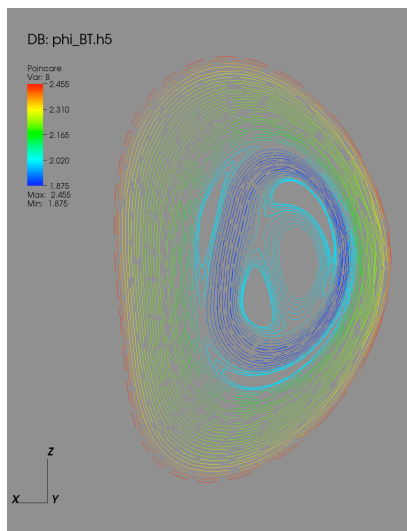

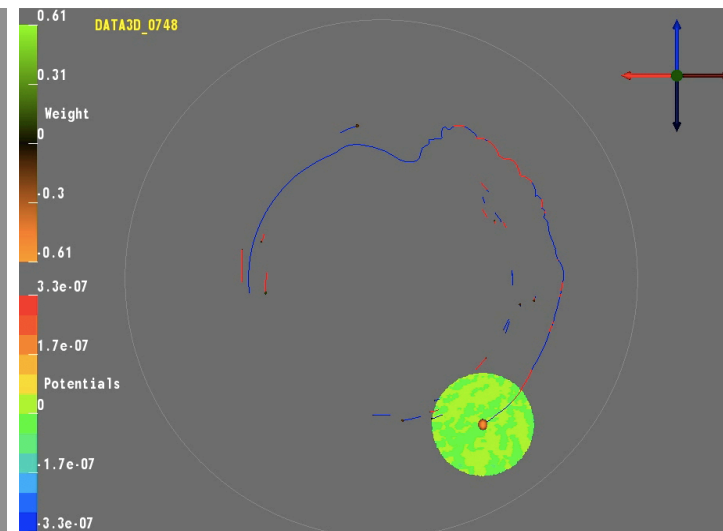Figure 1. Poincaré Plot of a MHD simulation showing the magnetic field topology.

Figure 2. Path of a particle from a PIC code that was repeatedly "trapped" during the simulation.