CyclusJS: A Distributed Web-based Fuel Cycle Visual Analytics System

PI: Yarden Livnat-
University of Utah

Program: Fuel Cycle

Collaborators: Valerio Pascucci - University of Utah

Paul Wilson - University of Wisconsin-Madison

Anthony Scopatz - University of South Carolina

ABSTRACT:

The US Department of Energy's Office of Nuclear Energy (DOE-NE) aims to ensure that nuclear energy continues to be a competitive energy option in the coming decades. Decisions about individual nuclear energy technologies will be informed by the technical, political and socio-economical impacts of these technologies on the whole nuclear energy ecosystem. The success of the DOE-NE programs relies in part on scientists' ability to explore, analyze and understand different fuel cycles technologies under a myriad of scenarios. Visual analytics aims to combine interactive visual representations with underlying analytical processes in order to facilitate sense making, reasoning and decision making. It encompasses techniques from information visualization data transformation and data analysis. Creating an effective visual analytics environment depends on the ability to develop and deploy a complex visualization environment that facilitates hypothesis driven analytical reasoning.

This project will encompass four major aims. The first aim is the creation of a web-based simulation and data management services framework. The focus of this aim is to develop and deliver the foundation for the visual analytics solution that is based on a distributed web-based client-server architecture. The goal of the second aim is to develop visual analytics capabilities that are accessible from any modern web browser and are intuitive to both novice and expert users. The second aim will deliver an interactive web-based visualization client and a remote computational analysis service.

The third aim will focus on developing the capability to understand the effects and impacts of various existing and potential technologies, socio-economics and political pressures, as well as initial conditions and other input variables on a fuel cycle To this end, we will develop a visual analysis component to perform and visualize high-dimensional analysis of ensemble of simulation runs. We propose to use topological methods to develop analysis and exploration of high dimensional spaces whose dimensions are the inputs parameters of a given simulation and that are sampled by executing the simulation under different initial conditions.

The fourth and final aim of the project is to establish a first-class metric computation capability into the Cyclus ecosystem and to provide a reliable local or remote server on which to execute fuel cycle simulations and metric calculations. Once this is completed the metric computation capability will provide users will built in metric calculation for a number of important nuclear fuel cycle metrics.