Exploring Cosmology with SDAV Technologies

Overview
SDAV technologies aim to help cosmologists unravel the mysterious nature of dark matter and energy by transforming raw data into meaningful representations. For example, mesh tessellations help analyze point data because they transform sparse discrete samples into dense continuous functions. Similarly, large-scale structures such as halos and voids are extracted, tracked, and summarized in high-level models. The goal of SDAV’s partnership with computational cosmology is to bring such methods to extreme scale.

Feature Detection & Modeling
leverages thread-parallelism of Voronoi interactive visual clusters, and GPU-based and many-core CPUs.

CosmoTools: In Situ Analysis Framework
Right: A unified framework facilitates integration of new algorithms, services, and tools without modifying HACC codes. A simple API, consisting of 7 main functions allows different tools to be easily controlled through a configuration file.

Visualisation
Right: VI3 is a parallel visual analysis framework for Blue Gene supercomputers, GPU-based clusters, and scientists’ laptops. Its modular design scales to 10K GPU cores and supports interactive visual analysis and data exploration of 1 trillion particles.

Checkpoint and Analysis I/O
Under a common generic I/O interface, we implemented efficient parallel I/O checkpoint restart based on GLEAM directly into the HACC simulation that delivers performance at full scale, and we are working toward petriCDF implementations of in situ analysis products.

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