CCT Tech Talk Series

F5 - Fiberbundle HDF5

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Johnston Hall 338
December 01, 2011 - 03:00 pm

Abstract:
“The proper abstractions for scientific data are known. We just have to use them.” (D. M. Butler & S. Bryson, 1992): There is no common standard or agreement on file formats for scientific data, but there could be. The inductive approach common in software development usually leads to “special solutions for special problems” which are extended on a case by case basis. Consequently, each application develops their own approach of describing data, ultimately leading to incompatibilities in the file formats associated with these applications and groups of applications. In contrast, the deductive approach to describe data based on the theory of fiber bundles leads to a generalized way of describing scientific data independent of a particular scientific domain or application as it exhibits the mathematical abstractions that are common across disciplines. This presentation will review the “F5” approach of modeling data for scientific visualization using fiber bundles on top of HDF5 as underlying I/O layer. The F5 model has originally been developed about 12 years ago in the context of numerical relativity simulation data as produced by Cactus, for handling both primary simulation (uniform grids, adaptive meshes, curvilinear grids, multipatch data…) and secondary post-processing data (surfaces, lines, particle sets, …). The formalism and implementation itself is independent of Cactus and has since been applied to other domains such as medical imaging, computational fluid dynamics (CFD), smoothed particle hydrodynamics (SPH) and geoscience data, easing scientific visualization through this common denominator. The presentation will provide a short review of the basic concepts and provide an in-depth discussion on how the F5 model describes various common and less common data types.

Speaker's Bio:
Werner Benger is research staff for scientific visualization at CCT, Tier 3, visualization research. He graduated in astronomy at the University of Innsbruck and later joined the Zuse Institute for Information Technology in Berlin (ZIB) in a joint position with the Max-Planck Institute for Gravitational Physics, the Albert-Einstein Institute (AEI), Potsdam. There he worked on extending and applying the in-house medical visualization software system (the now commercially available Amira software) towards astrophysical data sets from numerical relativity. He received his Ph.D. in Mathematics and Computer Science from the Free University of Berlin for research on a unifying model for scientific data and visualization techniques for tensor fields. His images appeared in many magazines, journal covers, TV broadcasts and artistic events. His primary expertise is visualization of astrophysical data, such as from general relativity, ranging from gravitational lensing to scientific visualization of dynamical simulations of gravitational waves utilizing Grid technology, though his techniques can well be applied to other domains such as medical imaging.

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