Project: Interactive Visualization of Multi-scale, Multi-physics Simulations

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Summary

The long-term goal of this project is to develop algorithms and techniques which will allow interactive visualization of the simulations carried out within the project network "Multi-scale Multi-physics Modeling of Multi-Phase Fluids and Materials". In order to support such a wide range of different applications, we will need to develop a novel software frame work for visualization which tightly integrates with the specific solvers and discretization schemes as well as making optimal use of modern programmable graphics hardware and parallel visualization environments such as GPU clusters. By interfacing to the simulation software infrastructure DUNE and its generic and persistent representation of grid hierarchies, we will be able to implement scalable visualization techniques for steering and post-processing scenarios which can benefit from the internal adaptive refinement and submodel structure. Interactive visualization of general finite element schemes has not been possible so far for large data sets due to the difficult mapping to the regular structure of graphics pipelines. Therefore, we will extend our preliminary work in GPU support of hierarchies of unstructured grids and high-order discontinuous Galerkin schemes. The multi-physics aspect of simulations directly corresponds to the multi-field challenge in visualization. In order to move beyond the first results in the combined visualization of co-registered scalar fields in medical visualization, we need to extend these concepts to volumes of different data and grid types, e.g. higher-order flow fields in regular cells partially overlapping with tetrahedral scalar fields resulting from a simulation on finer scales.