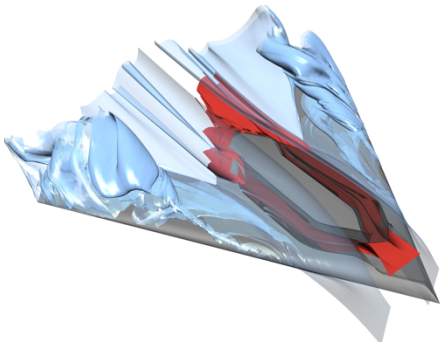
Bachelor's / Master's Thesis

Selection of View Parameters for Scientific Visualization using Multi-Criteria Optimization Techniques

Motivation:



Scientific visualization creates graphical representations in the form of images of scientific data sets (e.g. computer simulations) that convey their important characteristics. This allows an intuitive and visual interpretation of such data and supports the process of scientific discovery. Most algorithms employed in scientific visualization rely on parameters that determine the result. For example, camera position and orientation, transparency of surfaces, or control of iso-values in level set visualization are usually manually tuned by a visualization user.

In a growing number of use cases, this is however inconvenient or even impossible. For example, in the case of in situ visualization, manual adaptation of visualization parameters is not feasible since all visualization is performed while a simulation is running – only the resulting images are stored for later viewing.Thus, the question arises whether visualization parameters can be automatically and optimally determined based on multiple criteria that attempt to measure the quality of the visualization result.

In this context, the possible work program merges elements from both numerical optimization and computer graphics to explore the automatic tuning of visualization parameters. Based on existing implementations of visualization algorithms, the goal is to perform an implementation of quality criteria and one or multiple optimization techniques to investigating among others the following questions:

- Which image-based criteria are suited to determine the quality of a visualization result?
- Which algorithmsfor multi-criteria optimization are suitable for this problem?
- How do automated visualization results compare to human-generated ones?
- How can optimization be performed using graphics hardware architectures?
- What is a suitable approach for obtaining the derivatives needed for optimization?

The thesis will be jointly supervised by the Scientific Computing and Computational Topology groups. The specific focus of the thesis – emphasizing either scientific visualization or optimization techniques – will be determined according to mutual interest between the candidate and supervisors.

Requirements:

- interest in numerical algorithms and/or scientific visualization
- a working understanding of visualization and computer graphics
- good implementation skills in C++

Contact:

- Christoph Garth (Scientific Visualization), 36/237, garth@cs.uni-kl.de
- Lisa Kusch (Scientific Computing), 36/409, lisa.kusch@scicomp.uni-kl.de