USER-CENTRIC SCIENTIFIC VISUALIZATION

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Visualization is an effective way to communicate information to the viewer. Nowadays, visualization is utilized in a wide variety of applications in science, engineering, medicine, social sciences, humanities, and also in every-day life. Although visualization is omni-present at the current-day, visualization of complex information helped human to communicate and gain understanding throughout the entire history of the mankind. Most remarkably it has been developed in scientific illustration since renaissance. Illustrators, sometimes knowledgeable of perceptual studies, sometimes relying on their own intuition and experience, have laid down important visual abstraction principles for clearly understandable communication to the viewer. Their abstraction techniques are throughout the time fine-tuned for low-level human visual perception. At the same time, these abstractions exploit high-level human cognitive capabilities. Although illustration artists and craftsmen were limited by the static character of available display media, their static methods are a great resource of inspiration for interactive data visualization technology for dynamic virtual scenes.

The purpose, for which the user typically employs visualization, is usually of exploratory, analytical, or communicative character. In scenarios when the data set content is practically unknown, the user needs visualization and interaction tools for exploring the data. Typical application scenario can be exploration of seismic structures from acoustic measurements. In another scenario, the user has a certain knowledge of the data set content and needs visualization and interaction tools for analyzing and planning particular action, based on specifics from the underlying data. Typical such visualization application scenario can be neurosurgical treatment planning. When the data insights are to be communicated to the audience of mixed competences or even to the lay men, simple and clearly understandable visualization inspired from illustration is often the preferred choice. To achieve the best possible result for a given user task, the visualization needs to consider aspects of visual perception, human cognitive skills, application domain specifics, and the purpose of the particular task. The lecture series on user-centric scientific visualization will touch upon all these important aspects that form requirements for visualization:

- In the first lecture we will discuss the low-level signalling mechanism of the human visual perception from the eye to the cortex. We discuss the the low-level vision processing stages that act upon the visual stimulus. Furthermore we discuss important visual cues that convey the human essential details about the observed structure.
- The second lecture will outline the development of the illustration craft for visual communication and storytelling. On exemplary illustration techniques, the relationship between the technique and the perceptual cues, such as shape and depth cues will be drawn. Furthermore, we discuss other aspects such as the visual dissonance that hampers effective communication the and the integration of high-level semantics into the artwork.
- The third lecture will describe how are different low-level visual abstraction techniques formalized into a rendering algorithm. We will discuss numerous algorithms for line drawing, shading, and stylized rendering that expressively communicate the material properties.
- During the fourth lecture we will focus on illustration-inspired visualization techniques that exploit the high-level cognitive skills of the human observer to maximize the information content of the visualization. Interactive cutaways, peel-aways, and exploded views, focus of attention techniques, and visual storytelling techniques will be in focus of this lecture.
- The last lecture within the user-centric scientific visualization series will describe how to combine display algorithms with formalized domain knowledge and semantics to alleviate the user from time consuming tasks so that he or she can focus on the most essential tasks.

The lecture series will be accompanied with hands-on sessions. Participants will implement different illustrative shading and clipping techniques in the VolumeShop prototyping framework. Therefore minimal C++ and OpenGL programming skills are a pre-requisite for the hands-on sessions. The GPU shader programming skills are welcome but not a strict requirement.