Visualization Group

Visibility-oriented Visualization Design for Flow Illustration

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Abstract

Flow phenomena are ubiquitous in our world and they affect many aspects of our daily life. For this reason, they are the subject of extensive studies in several research fields, such as medicine, engineering and climatology. Thanks to the recent advancements in computational fluid dynamics and to the increasing power of modern hardware, accurate simulations of flow phenomena are feasible nowadays. The evolution of multiple flow attributes, such as velocity, temperature and pressure, can be simulated over large spatial and temporal domains (4D). The amount of data generated by this process is massive, therefore visualization techniques are often adopted in order to ease the analysis phase. The overall goal is to convey information about the phenomena of interest through a suitable representation of the data at hand. Due to the multivariate and multidimensional nature of the data, visibility issues (such as cluttering and occlusion), represent a significant challenge. Flow visualization can greatly benefit from studying and addressing visibility issues already in the design phase. In this thesis we investigate and demonstrate the effectiveness of taking visibility management into account early in the design process. We apply this principle to three characteristic flow visualization scenarios. Our techniques result in clutter- and occlusion-free visualizations, which effectively illustrate the key aspects of the flow behavior.