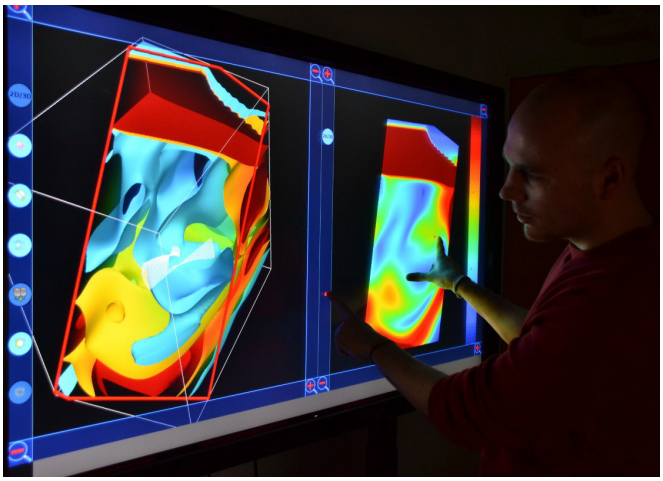
PhD Project Proposal:

Investigating the Visualization and Exploration of Fluid Mechanics Data using Tactile Surfaces and Tangible Objects

Understanding and supporting the exploration and analysis of 3D datasets that represent actual scans or computer simulations of our natural 3D world lies at the heart of visualization research. In particular in the field of fluid mechanics we do not only need to create meaningful visual repreentation of simulation data but we also need to provide the domain experts with powerful interactive tools to explore the data. This means we need to provide both the best possible visual representations and the best possible interaction tools and techniques.



Therefore, this PhD project will explore in which way we can benefit from the richness of expression and fluid interaction styles of touch-based and tangible input devices, while providing the needed level of precise control. In particular, the PhD student will explore the combination of large displays with stationary and mobile touch input as well as dedicated tangible devices. A question that needs to be answered is for what tasks it is better to employ tangible user interfaces, and for which ones touch-based input is preferable. Similarly, we want to investigate how the interaction design has to be adjusted if the data is shown on a stereoscopic display, because stereoscopy has known issues when combined with touch input.

In addition, the goal of our work is not to replace the use of traditional PC-based environments for data analysis. Instead, we want to add to the spectrum of visual data analysis tools in a way that adds benefits for certain exploration scenarios. For example, traditional single-user tools have their limitations when discussions of a dataset among several collaborators are needed. In this case it makes more sense to employ environments such as large-displays coupled with touch and tangible input that cater specifically to these situations. Ultimately, however, we have to provide solutions that facilitate a transition along the interaction spectrum, from traditional PC environments to collaborative scenarios and back. Similarly, we want to also explore how an interactive visualization environment can support a range of domain expert users, ranging from novices in the field and in the interaction to experts in one or in both.

The general approach for this work is to study tactile input (e.g., touch surfaces) and the use of tangible devices in the context of computational fluid dynamics (CFD). The goal is not only to understand the benefits and limitations of these two types of input individually but also, in particular, to investigate how they can be combined to facilitate a fluid and practically applicable

data exploration. For this purpose the PhD project will rely on a collaborattion between visualization experts, human-computer interaction researchers, and domain scientists and will employ a participatory design approach.

The PhD research will be conducted under the supervision of Tobias Isenberg and within the AVIZ research team at INRIA Saclay—Île-de-France which concentrates on the visualization of complex data. AVIZ is one of the most respected research labs in information visualization and visual analytics worldwide. The PhD student will closely collaborate, in particular, with Mehdi Ammi from from the LIMSI lab at CNRS whose expertise in haptics for virtual reality and human-machine interaction will be essential for the work. In addition, we will work with domain experts in fluid mechanics such as Luc Pastur from the LIMSI lab.

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