

### Feature of Interest based Direct Volume Rendering Using Contextual Saliency-driven Ray Profile Analysis

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**Abstract:** Direct volume rendering (DVR) visualization helps interpretation because it allows users to focus attention on the subset of volumetric data that is of most interest to them. The ideal visualization of the features of interest (FOIs) in a volume, however, is still a major challenge. The clear depiction of FOIs depends on accurate identification of the FOIs and appropriate specification of the optical parameters via transfer function (TF) design and it is typically a repetitive trial-and-error process. We address this challenge by introducing a new method that uses contextual saliency information to group the voxels along a viewing ray into distinct FOIs where ‘contextual saliency’ is a biologically inspired attribute that aids the identification of features that the human visual system considers important. The saliency information is also used to automatically define the optical parameters that emphasize the visual depiction of the FOIs in DVR. We demonstrate the capabilities of our method by its application to a variety of volumetric data sets and highlight its advantages by comparison to current state-of-the-art ray profile analysis methods.

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### Viewing Visual Analytics as Model Building

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**Abstract:** To complement the currently existing definitions and conceptual frameworks of visual analytics, which focus mainly on activities performed by analysts and types of techniques they use, we attempt to define the expected results of these activities. We argue that the main goal of doing visual analytics is to build a mental and/or formal model of a certain piece of reality reflected in data. The purpose of the model may be to understand, to forecast or to control this piece of reality. Based on this model-building perspective, we propose a detailed conceptual framework in which the visual analytics process is considered as a goal-oriented workflow producing a model as a result. We demonstrate how this framework can be used for performing an analytical survey of the visual analytics research field and identifying the directions and areas where further research is needed. .

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**On-The-Fly Tracking of Flame Surfaces for the Visual Analysis of Combustion Processes**

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**Abstract:** The visual analysis of combustion processes is one of the challenges of modern flow visualization. In turbulent combustion research, the behaviour of the flame surface contains important information about the interactions between turbulence and chemistry. The extraction and tracking of this surface is crucial for understanding combustion processes. This is impossible to realize as a post-process because of the size of the involved datasets, which are too large to be stored on disk. We present an on-the-fly method for tracking the flame surface directly during simulation and computing the local tangential surface deformation for arbitrary time intervals. In a massively parallel simulation, the data are distributed over many processes and only a single time step is in memory at any time. To satisfy the demands on parallelism and accuracy posed by this situation, we track the surface with independent micro-patches and adapt their distribution as needed to maintain numerical stability. With our method, we enable combustion researchers to observe the detailed movement and deformation of the flame surface over extended periods of time and thus gain novel insights into the mechanisms of turbulence–chemistry interactions. We validate our method on analytic ground truth data and show its applicability on two real-world simulations.