Flow Visualization and the SemSeg project

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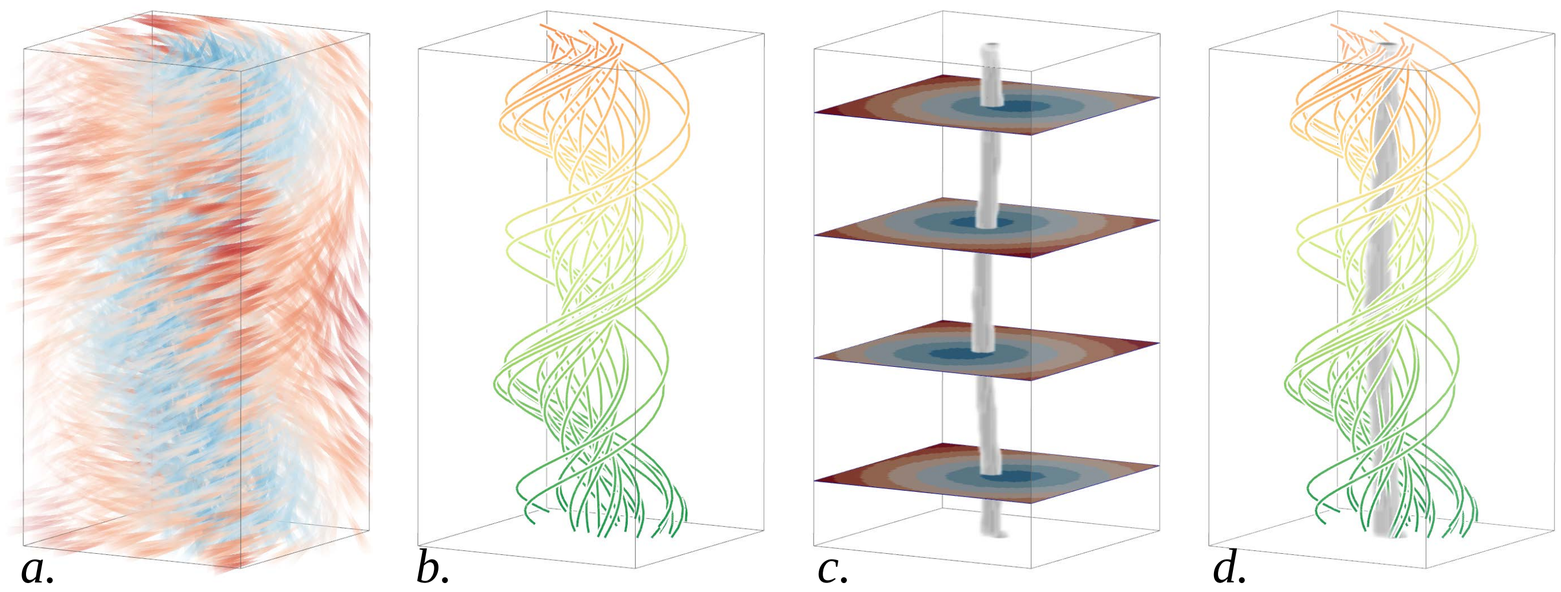
Flow Visualization

- *Visualization* refers to the use of (computer based) graphical abstractions to help users to gain insights into the real-world phenomena represented by the data.
- Visualization is useful for a preliminary exploration of the data, for the following in-depth analysis and for the final presentation of the findings.
- Flow Visualization is concerned with the representation of flow phenomena.
- Flow data can be expressed in different forms, leading to different kinds of visual representation (e.g., *a.* Hedgehog, *b.* Pathlines, *c* and *d.* Vortex core).



a. *b.* *c.* *d.*

SemSeg in a nutshell

SemSeg is a FET Open project within the 7th framework programme for research of the European Commission (FP7).

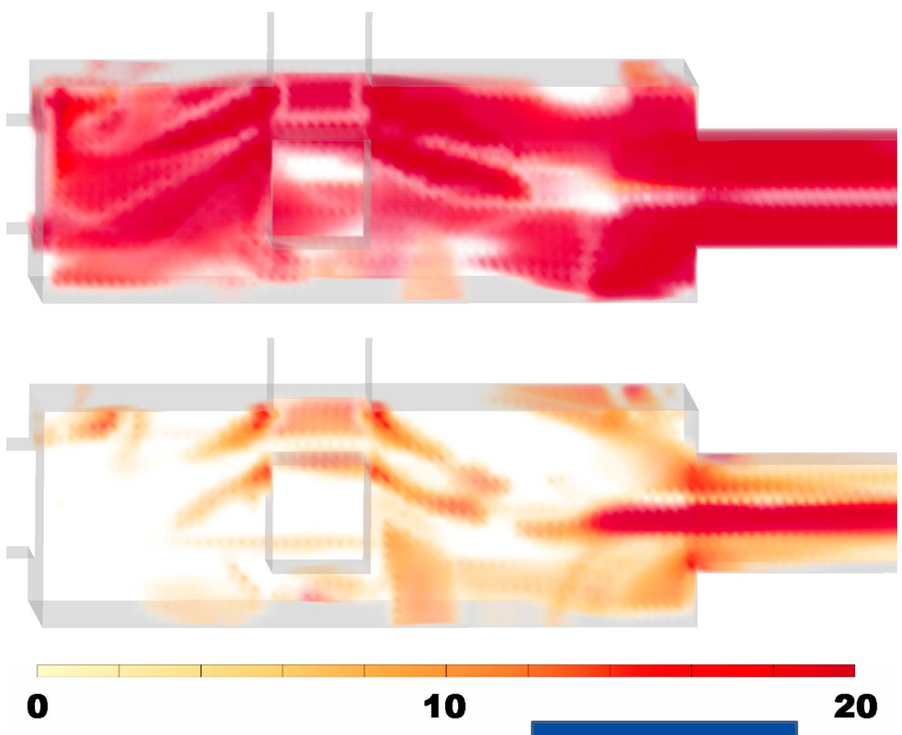
SemSeg aims at the formulation of a sound theoretical mechanism to describe structural features in time-dependent flow.

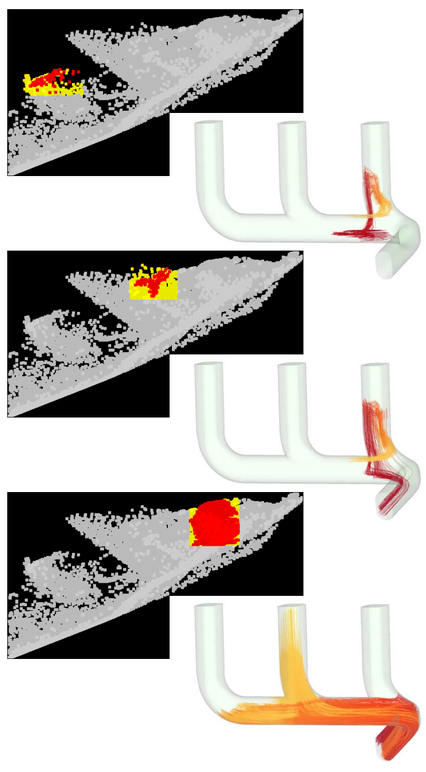
SemSeg is a collaboration between University of Bergen (Norway), University of Magdeburg (Germany), ETH Zurich (Switzerland) and VRVis Research Center (Austria).

For details, publications and results visit **http://www.SemSeg.eu**

Flow Visualization and Energy-Scales

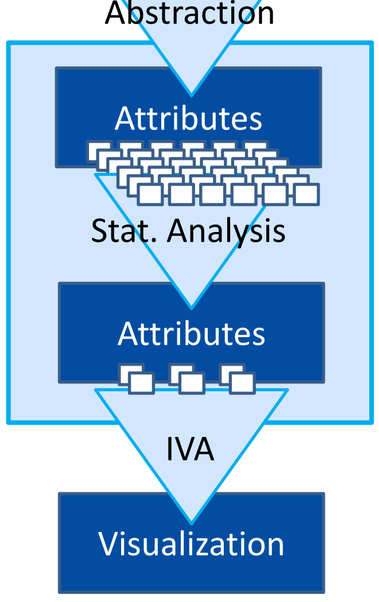
- Flow fields naturally consist of different *energy-scales*, with different roles in its dynamics, ranging from transport to the dissipative scales.
- In order to understand the role of a visualized structure in the flow field, it is important to understand which scale the structure acts on.
- Some scales may hide structures present in others (cf. right figure. Top: vortical structures in the original field. Bottom: vortical structures associated to the highly energetic scales).
- In our paper [1], we extract structures at different energy-scales, combining classical flow visualizations with *proper orthogonal decomposition.*





Interactive Visual Flow Analysis

- *Interactive Visual Analysis (IVA)* is a scheme for the design of a feedback loop between visualization and data analysis. It is based on the idea of linking and interactively updating multiple data views (cf. left figure).
- IVA has limitations if the number of variables to investigate is large.
- In our paper [2], we investigate the possibility to find a fixed subset of variables that describes the various aspects of fluid flow, using factor analysis.
- We achieve a considerable reduction of the number of variables to investigate, and give practical examples of IVA based on our proposed variable set. See right picture for a sketch of the process.



Acknowledgments

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References

[1] Pobitzer, A., Tutkun, M., Andreassen, Ø., Fuchs, R., Peikert, R. and Hauser, H. (2011), *Energy-scale Aware Feature Extraction for Flow Visualization*. Computer Graphics Forum, 30: 771–780. doi: 10.1111/j.1467-8659.2011.01926.x

[2] Pobitzer, A., Lež, A., Matković, K., Hauser, H. (2012), *A Statistics-based Dimension Reduction of the Space of Path Line Attributes for Interactive Visual Flow Analysis*. To appear in proceedings of the 5th IEEE Pacific Visualization Symposium (PacificVis), 28 Feb - 2 Mar 2012.

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