Scientific Visualization and Computer Graphics

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Focus

The research group Scientific Visualization and Computer Graphics carries out research in the area of scientific visualization, information and software visualization, illustrative computer graphics, and innovative interfaces using large displays. We apply our research to fundamental and practical problems from the life sciences (functional brain imaging, bioinformatics) and astronomy.

The group participates in the research school Behavioural and Cognitive Neuroscience (BCN) and the Neuroimaging Center (NIC) of the University of Groningen and the University Medical Center Groningen.

Scientific and Information Visualization

We investigate how to visualize medical and biological data. Methodologies such as functional MRI (fMRI), multichannel EEG, and diffusion tensor imaging (DTI) are used to extract functional brain networks and pathways. DNA microarray measurements allow us to visualize regulatory gene networks. We employ insights from perception science to improve current visualization techniques.

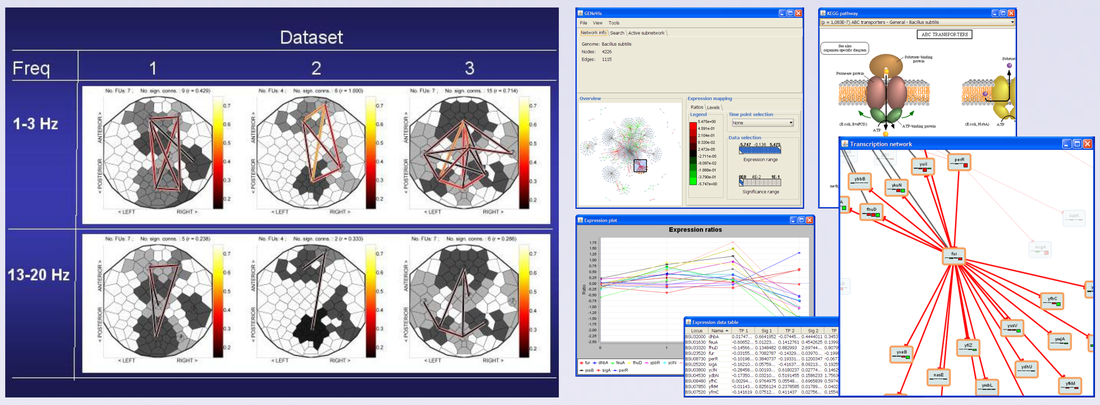

Figure 1: *Functional Unit maps for multichannel EEG coherence visualization (left) and visualization of genome expression and regulatory network dynamics in a genomic and metabolic context (right).*

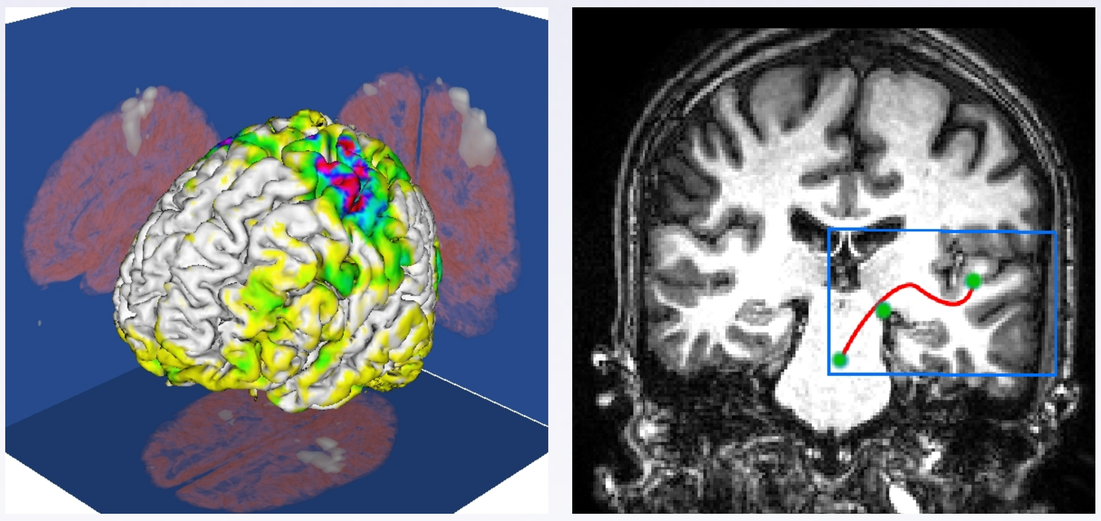

Figure 2: *Surface rendering of the human brain with fMRI data mapped onto the cortex (left) and statistical DTI analysis to show acoustic pathways (right).*

Shape Processing

Segmenting organic 3D shapes into their natural parts, such as the limbs of a human body, is a challenging problem, with applications in graphics, computer vision, and shape matching. We work on methods that produce segmentations of complex, real-world shapes, computing their *curve skeleton*, detecting its junctions, and use geodesics traced between each junction's feature points to produce a segmentation.

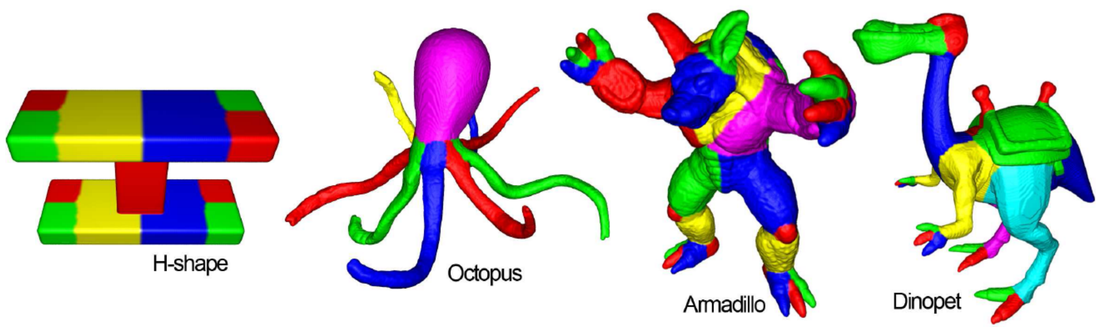

Figure 3: *Using skeleton extraction to identify natural parts of shapes.*

Software Visualization

Modern software systems have an increasing size and structural complexity; also, they evolve in time. *Software visualization* methods address the challenge of understanding and maintaining large code bases by presenting the structure, attributes, and evolution of source code in scalable and intuitive ways. We develop methods that show the structural evolution of code at class, function, or statement level and that combine the visualization of software architecture diagrams with software metrics defined on groups of diagram elements. We implement our methods in tools that can be tested on real-world software systems.

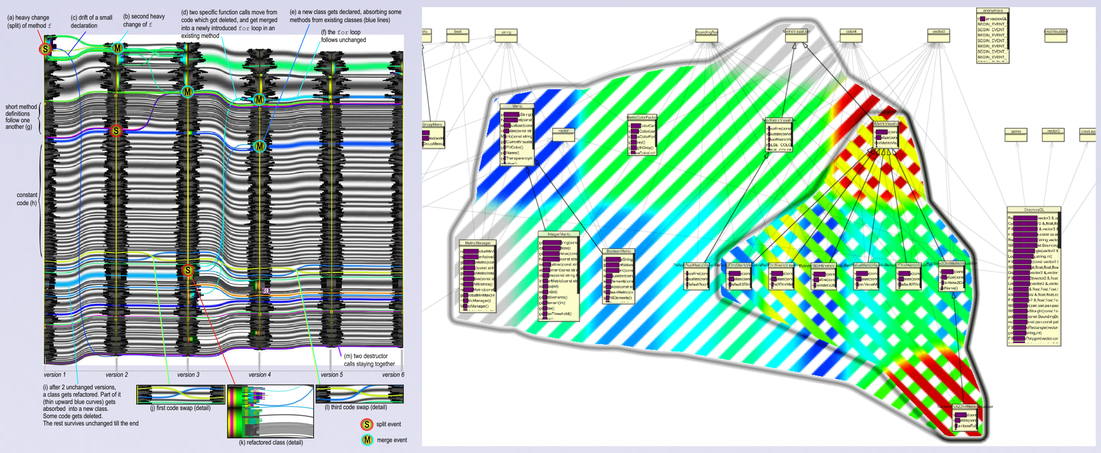

Figure 4: *Combining the visualization of software architecture diagrams with software metrics defined on groups of diagram elements.*

Interactive and Illustrative Rendering

We combine techniques from computer graphics, visualization, and interactive systems and get inspiration from centuries of traditional illustration. This *non-photorealistic rendering* breaks free from the traditional (photo-)realism and generates images or animations that use abstraction, exaggeration, and stylization. This increases the freedom of expression and, thus, has great potential for visualization and illustration. We also investigate how to allow intuitive interaction with such renderings, on large, touch-sensitive displays for single or multiple people, to allow them to be creative without a limiting interface.

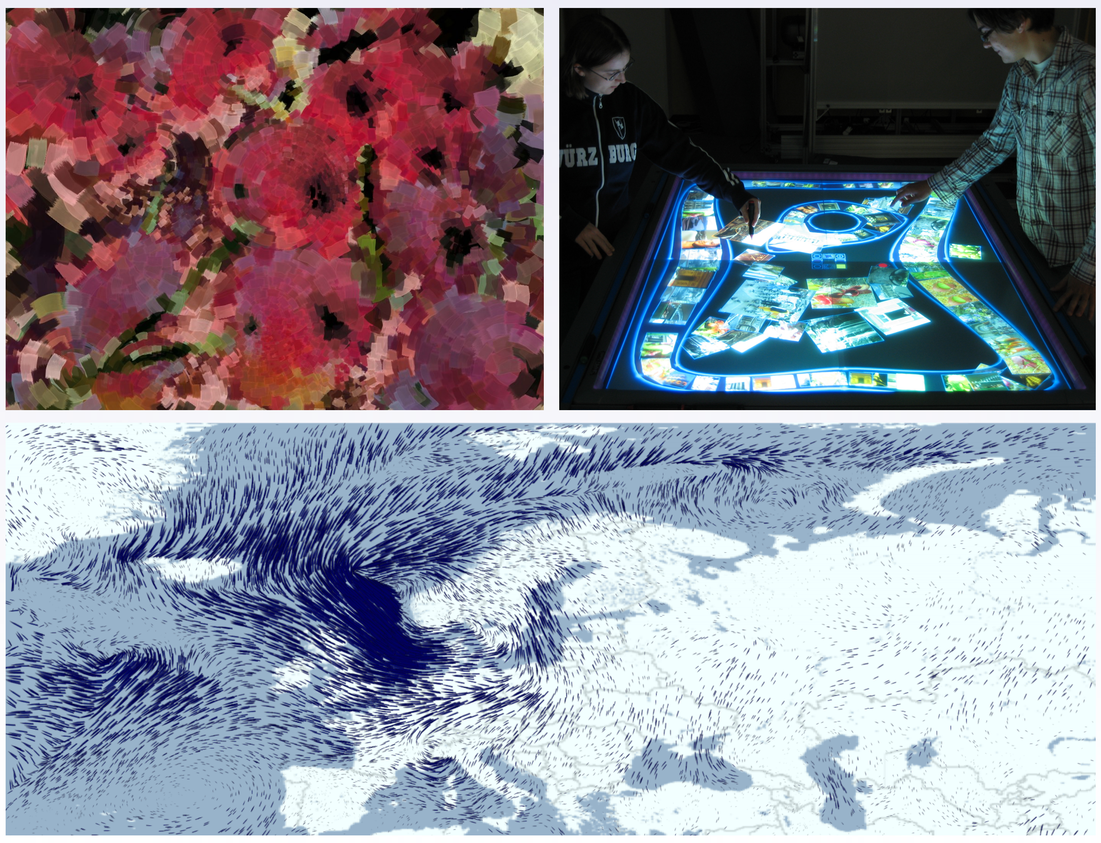

Figure 5: *Interactively generated painting (left), interaction platform to collaboratively explore information and interact with renderings (right), and interactively created visualization of 2D vector data (wind over Europe, bottom).*

Contact

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