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Tractography in Context

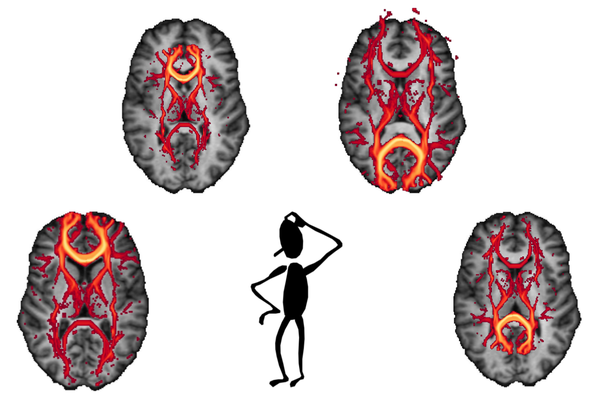
Multimodal Visualization of Probabilistic Tractograms in Anatomical Context

Andreas Berres[1] **Mathias Goldau**[2,3] **Marc Tittgemeyer**[2] **Gerik Scheuermann**[3] **Hans Hagen**[1]

[1] University of Kaiserslautern [2] MPI Neurological Research [3] University of Leipzig

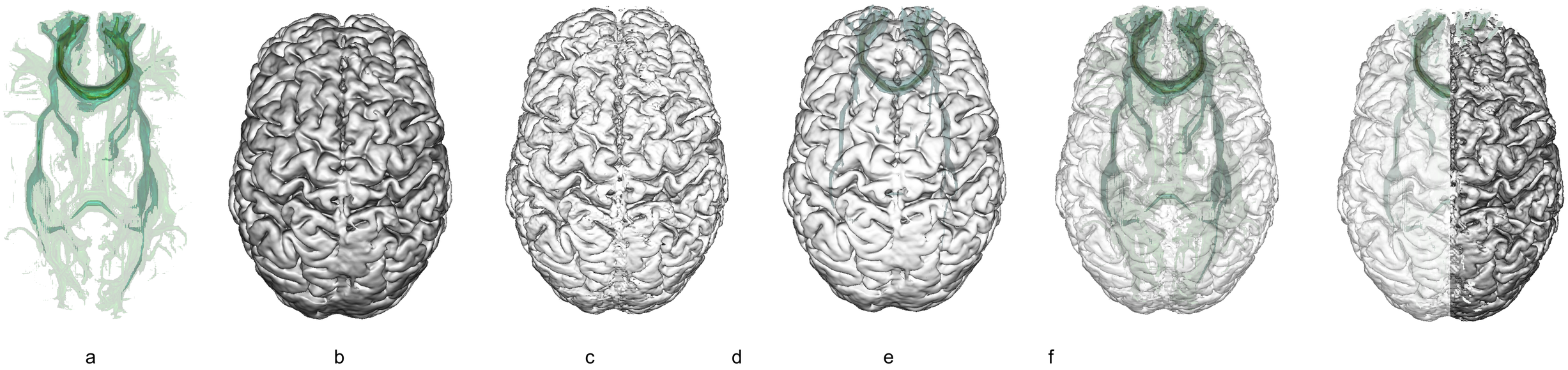
The Problem

Displaying neurological data in anatomical context is a challenging task in biomedical visualization which requires solving of visibility issues of simultaneously presenting focus and context. Our work specifically focuses on probabilistic tractograms. These are scalar fields indicating a connectivity score between a seed voxel and each other voxel.



Expert Requirements

1.Long-range connectivity
2.Intuitive value representation
3.Depth cues
4.Cortex structure
5.Occlusion-handling
6.Focus enhancement
7.More anatomical information

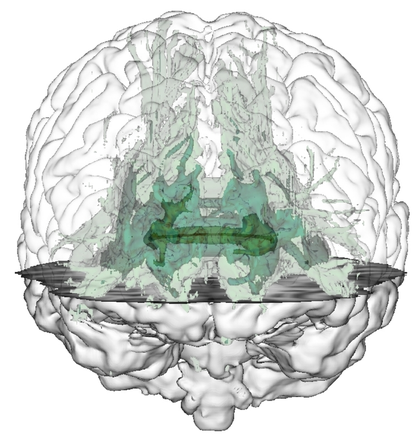


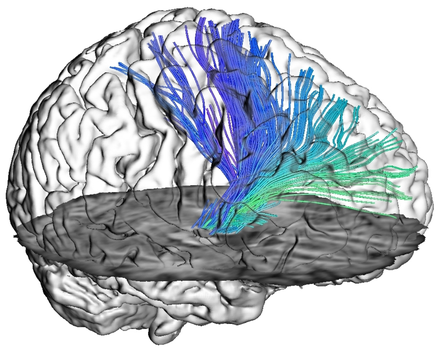
a b c d e f

Our Solution

The tractogram visualization (a) uses nested isosurface layers to depict long-range connectivity, and whose opacity represents the probability of each surface. Additional depth cues are given by depth-dependent saturation modulation and slight contouring.
Cortex structure is enhanced using an illustrative, angle-dependent rendering (b). To handle occlusion, the opacity is decreased depending on color intensity (c,d). Furthermore, users can decrease the overall opacity dependent on the view direction (e) and hide unneeded parts of the visualization by applying selective opacity (f) to cortex parts on one side of each MRI slice.
The cortex rendering can be applied to different kinds of neurological data, e.g. deterministic fibers.

Contact author: a_berres@cs.uni-kl.de





Evaluation

We conducted two small user studies to evaluate our methods.
1.Informal expert feedback for overall visualization: the glass brain was received very well, the tractography visualization was perceived as useful but there no comments on depth perception → added contours.
2.Individual feedback for new contours based on image comparison. Most users preferred visualizations in context with a small amount of contours. Without context, only half the experts preferred the contoured version.

A. Berres, M. Goldau, M. Tittgemeyer, G. Scheuermann, H. Hagen. Tractography in Context: Multimodal Visualization of Probabilistic Tractograms in Anatomical Context, *Visual Computing in Biology and Medicine Proceedings*, Sept. 2012.