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Illustrative Rendering of Dense Line Data

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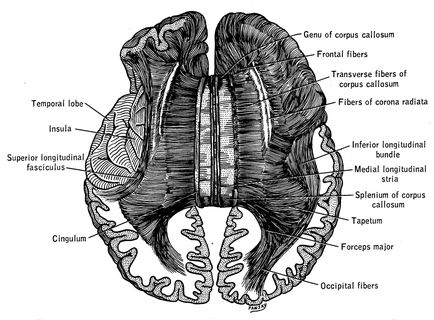
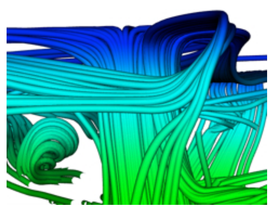
Inspiration & Motivation

Illustrative depictions have been playing an essential role in the communication of knowledge for centuries. Despite being limited to two "colors", black-and-white illustrations can convey shape, material, and illumination. Through emphasis and abstraction, such black-and-white illustrations often have a certain clarity and crispness. Our goal: illustrative black-and-white visualization of dense line data with the same clarity and crispness.

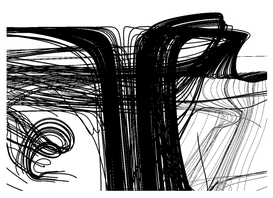


[House and Pansky, 1960]

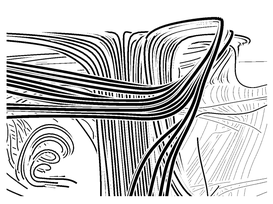
Depth-Dependent Halos



Traditional visualizations of dense lines often use shaded tubes for the depiction of depth relation. The minimum tube width limits the number of lines that can be visualized.



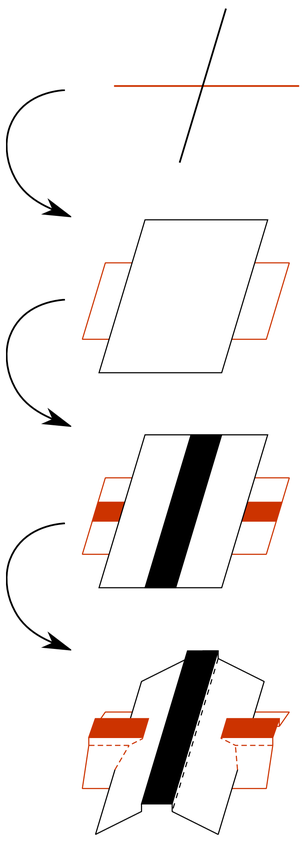
Simple black lines on a white background can show more detail, but it also results in clutter and makes it hard to distinguish lines.



Adding halos, an illustration technique, improves depth perception, but has the downside that the halos also occlude lines, removing much of the added detail.

We propose *depth-dependent* halos. Lines with the same distance to the viewer do not occlude one another and as the distance increases, so does the width of the halo.

Overview of Our Approach

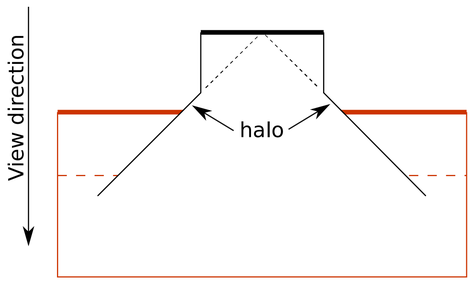


We illustrate our approach with two lines, one red (back) and one black (front).

View-oriented triangle strips are created from the lines. This can be done efficiently on the graphics card.

The triangle strips are colored to create the lines and the halos.

Finally, the depth of the triangle strips is manipulated as illustrated. This is what makes the halos depth-dependent. See also the illustrations below.



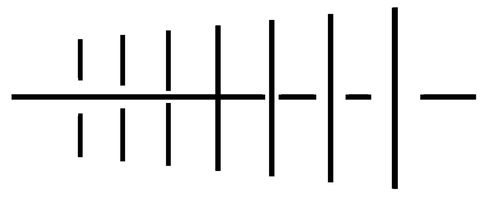
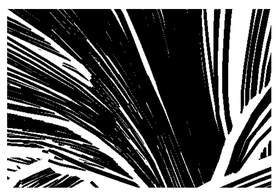


Illustration of how halo-width changes with the difference in distance.

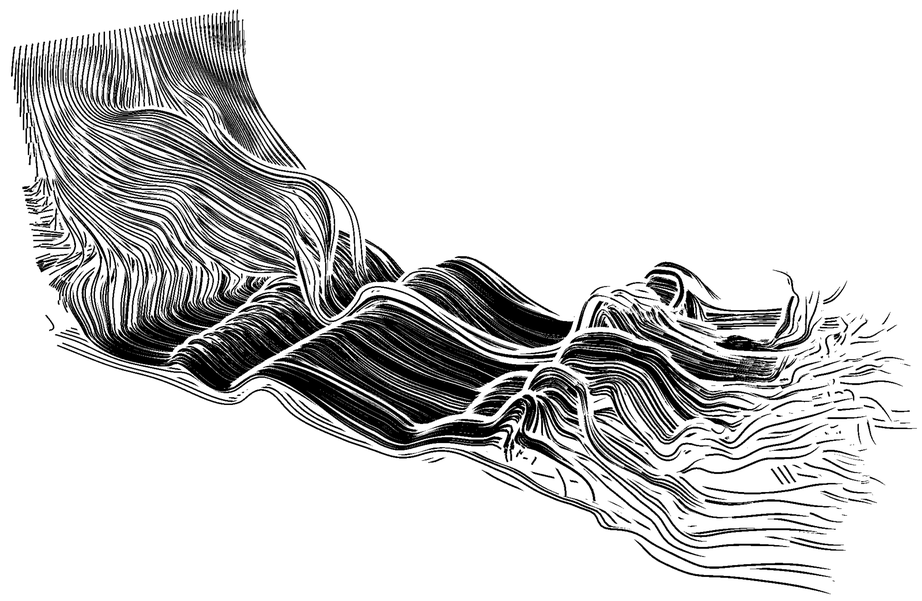
Example Results

Illustrative visualization of a subset of brain fiber tracts with depth-dependent halos.



Emphasis

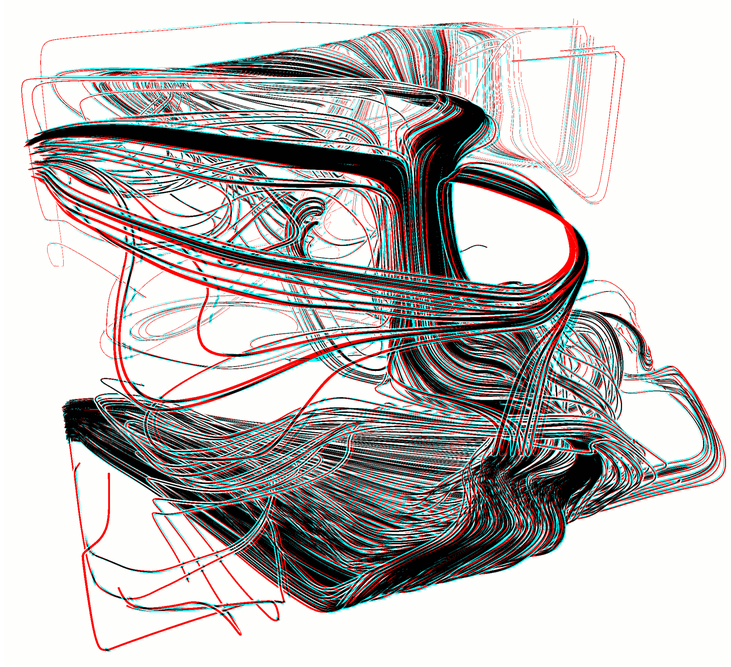
Abstraction



Visualization of a selection of simulated water flow streamlines.

Real 3D: Anaglyphic Stereo Rendering

The black-and-white nature of our visualizations makes it suitable for anaglyphic stereo 3D rendering. With red-cyan glasses to view these images (red on left eye) one can experience improved depth perception. The image below is an anaglyphic stereo visualization of a simulated air flow in an office.



Conclusion

- New technique for illustrative visualization of dense line data.
- Emphasis and abstraction through depth-dependent halos around lines.
- Simple method that easily maps to the graphics pipeline.
- Interactive frame rates.
- Positive feedback from informal evaluation with experts.

NWO
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