



Tensor Field Visualization

Scientific Visualization – Summer Semester 2021

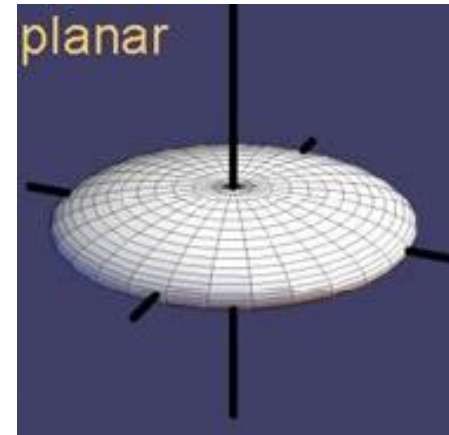
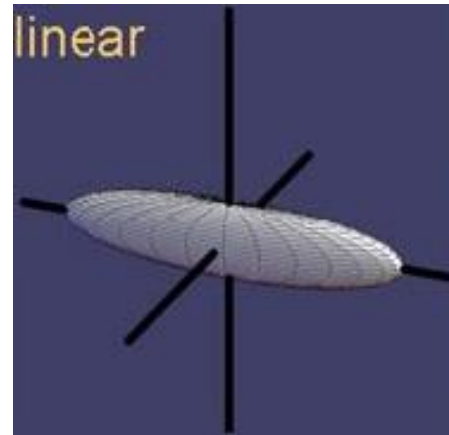
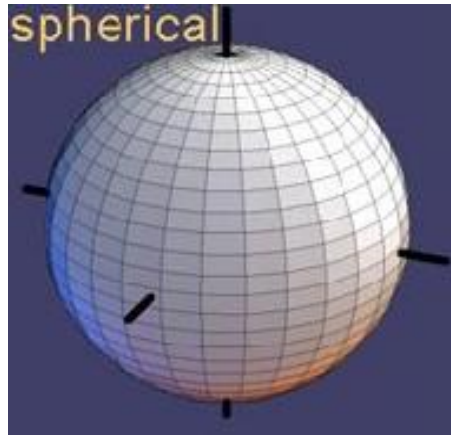
Jun.-Prof. Dr. **Michael Krone**

Tensor Field Visualization

- **Example:** Diffusion Tensor (second-order tensor)
 - Diffusion: based on motion of fluid particles on microscopic level
 - Probabilistic phenomenon, based on particle's Brownian motion
 - Measurements by modern MR (magnetic resonance) scanners
 - Diffusion tensor describes diffusion rate into different directions via symmetric tensor (probability density distribution)
 - In 3D: representation via 3×3 symmetric matrix

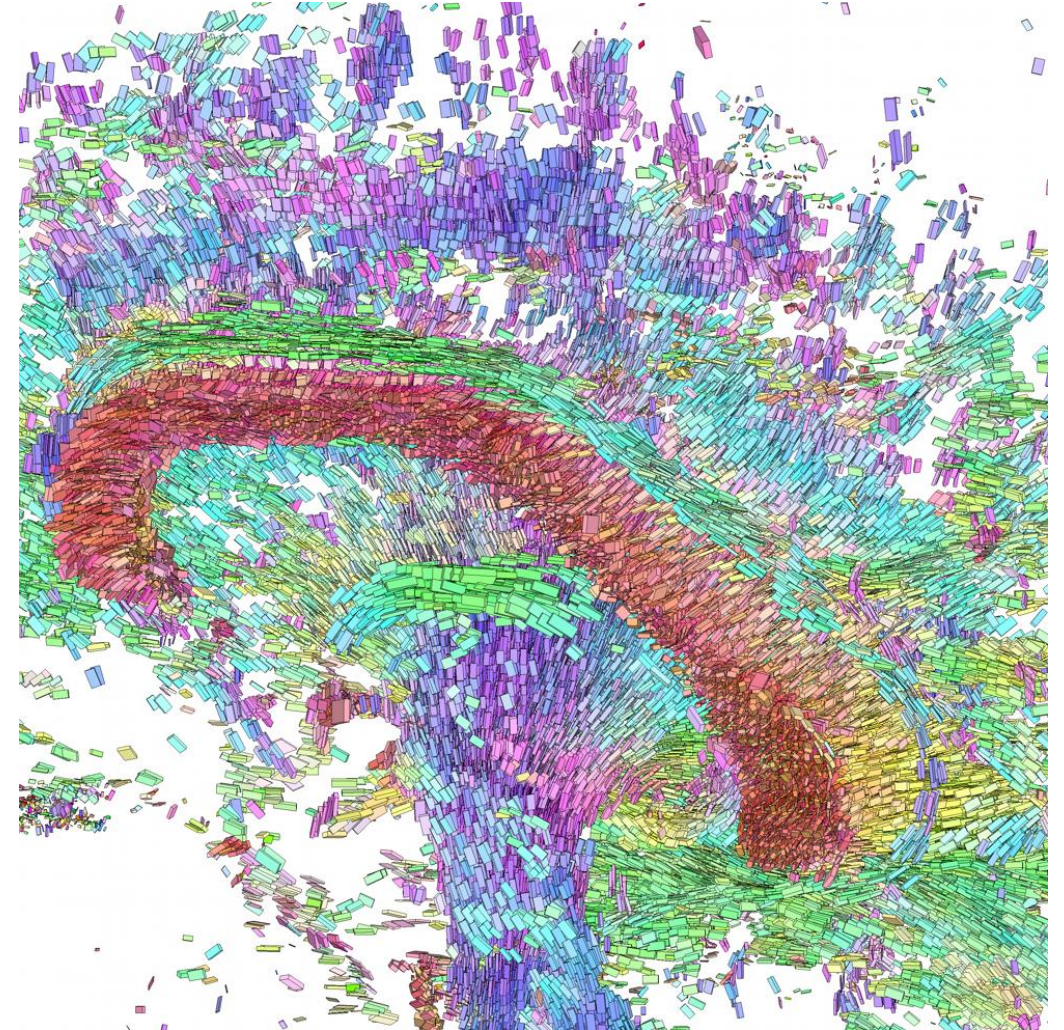
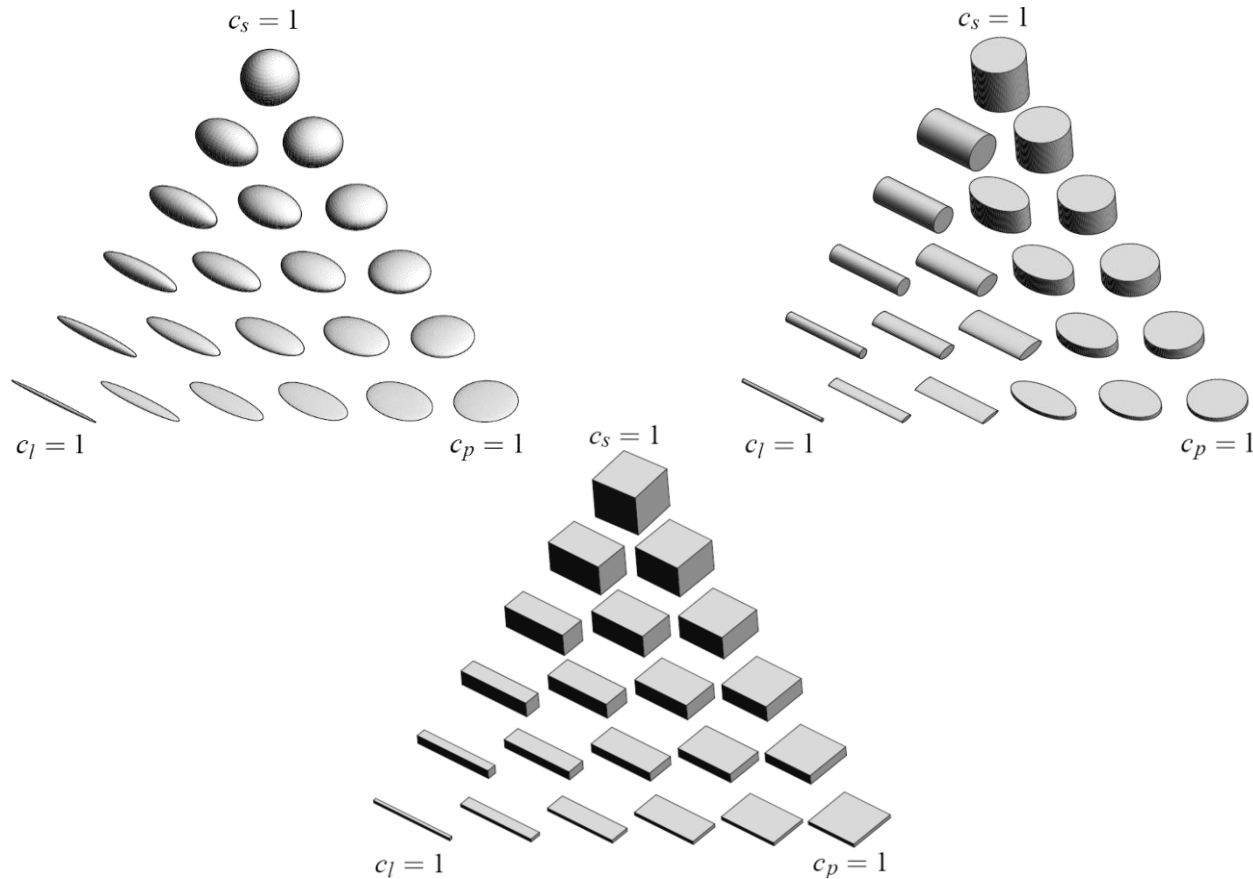
Diffusion Tensor

- Symmetric diffusion matrix can be diagonalized:
 - Real eigenvalues $\lambda_1 \geq \lambda_2 \geq \lambda_3$, eigenvectors are perpendicular
- Isotropy / anisotropy:
 - Spherical: $\lambda_1 = \lambda_2 = \lambda_3$
 - Linear: $\lambda_2 \approx \lambda_3 \approx 0$
 - Planar: $\lambda_1 \approx \lambda_2$ and $\lambda_3 \approx 0$



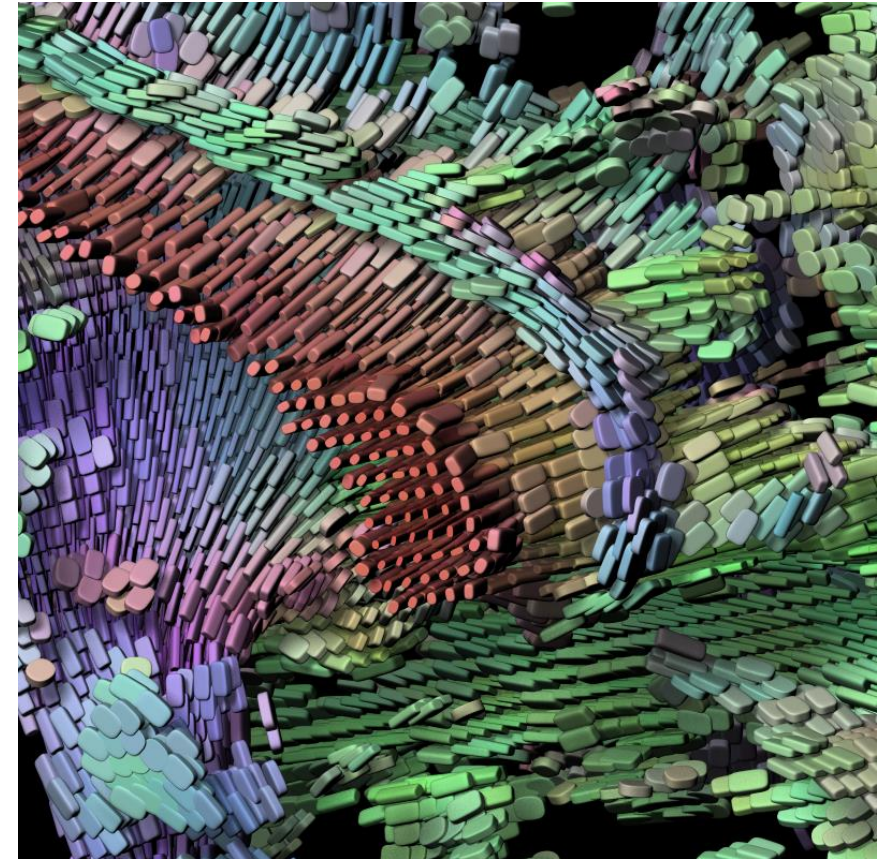
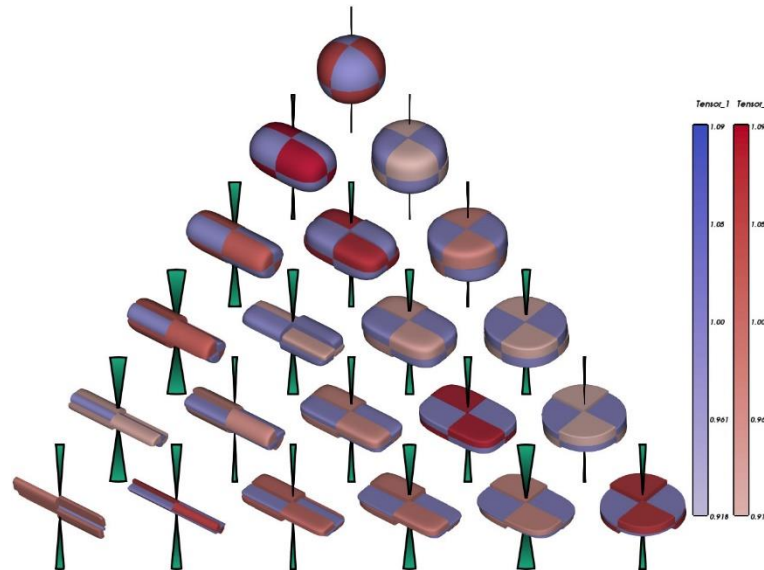
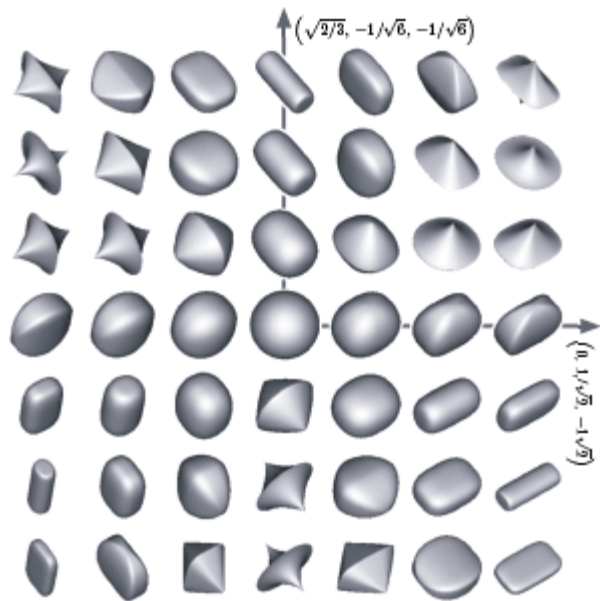
Glyph-Based Mapping Techniques

- Simple glyphs: ellipsoids, rods, boxes



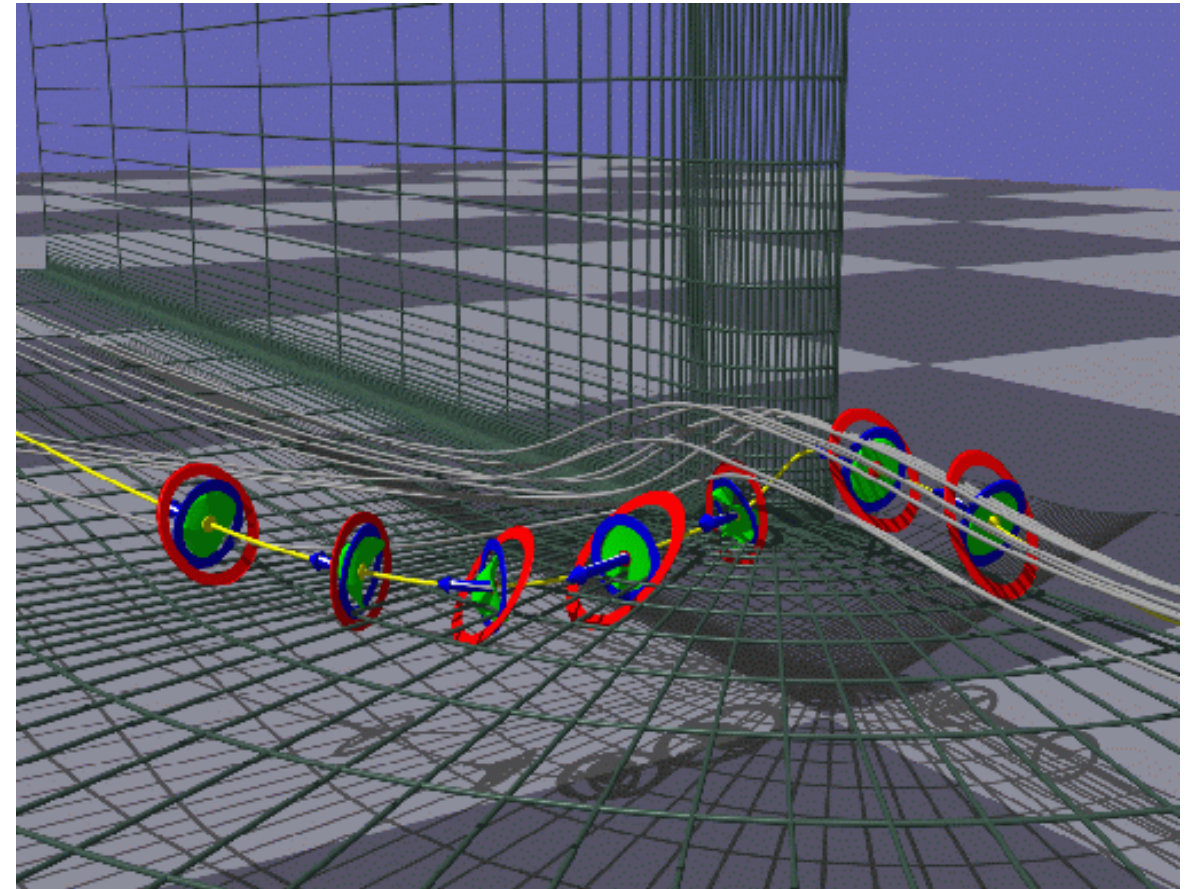
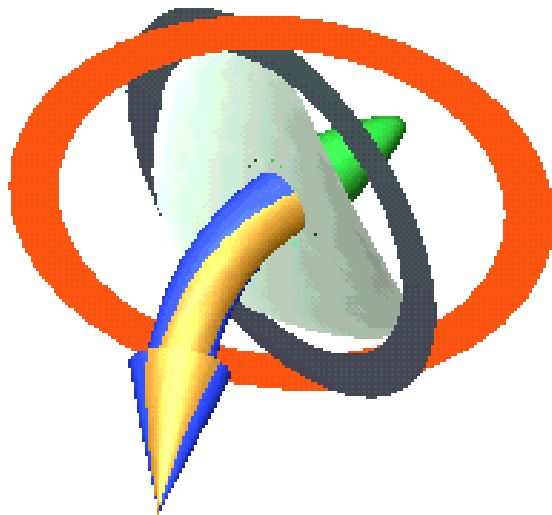
Glyph-Based Mapping Techniques

- *Superquadric glyphs* (G. Kindlmann) use additional sharpness value



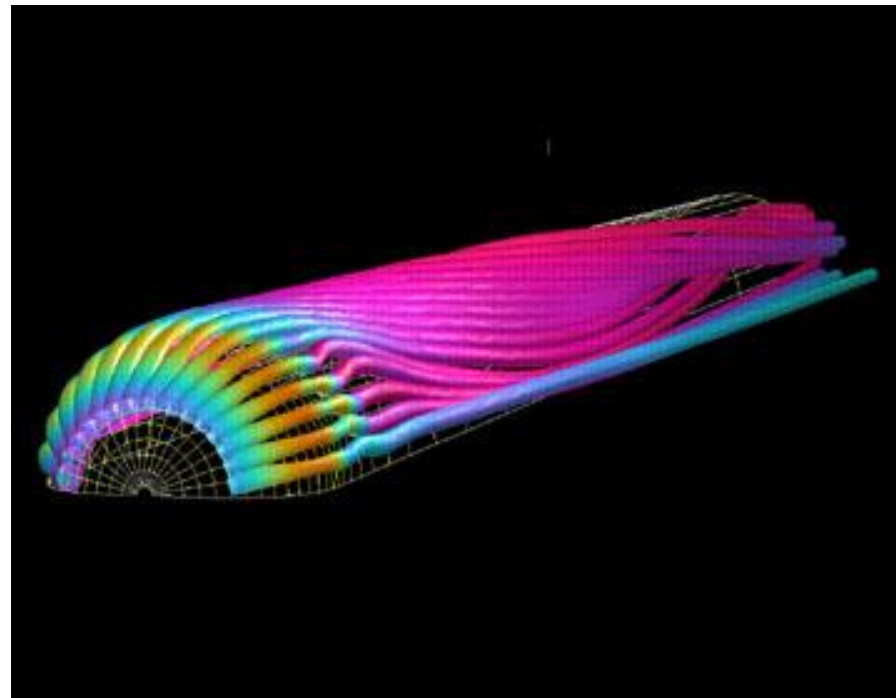
Glyph-Based Mapping Techniques

- Glyph probe for local flow field visualization [Leeuw, Wijk 1993]
 - Arrow: particle path
 - Green cap: tangential acceleration
 - Orange ring: shear (with respect to gray ring)



Hyperstreamlines

- Hyperstreamlines [Delmarcelle, Hesselink 1993]
 - Representation of tensor field lines with tubes
 - Elliptic cross section, radii proportional to other two eigenvalues





“That’s all Folks!”