

Dynamic Exploration of DTI Volume Data

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Introduction

Diffusion MRI enables the extraction of directional information of brain white matter in vivo. Neuronal pathways are reconstructed using fiber tracking techniques. Integral curves represent the connectivity in the brain. Local tensor characteristics, like the degree of anisotropy are not demonstrated in conventional tractography techniques. However, characteristics of white matter tissue are of major medical interest, in case of brain tumors, MS, etc.

Motivation

- Combined visualization of global fiber tracts and local diffusion characteristics

Local anisotropy encoding in previous work:

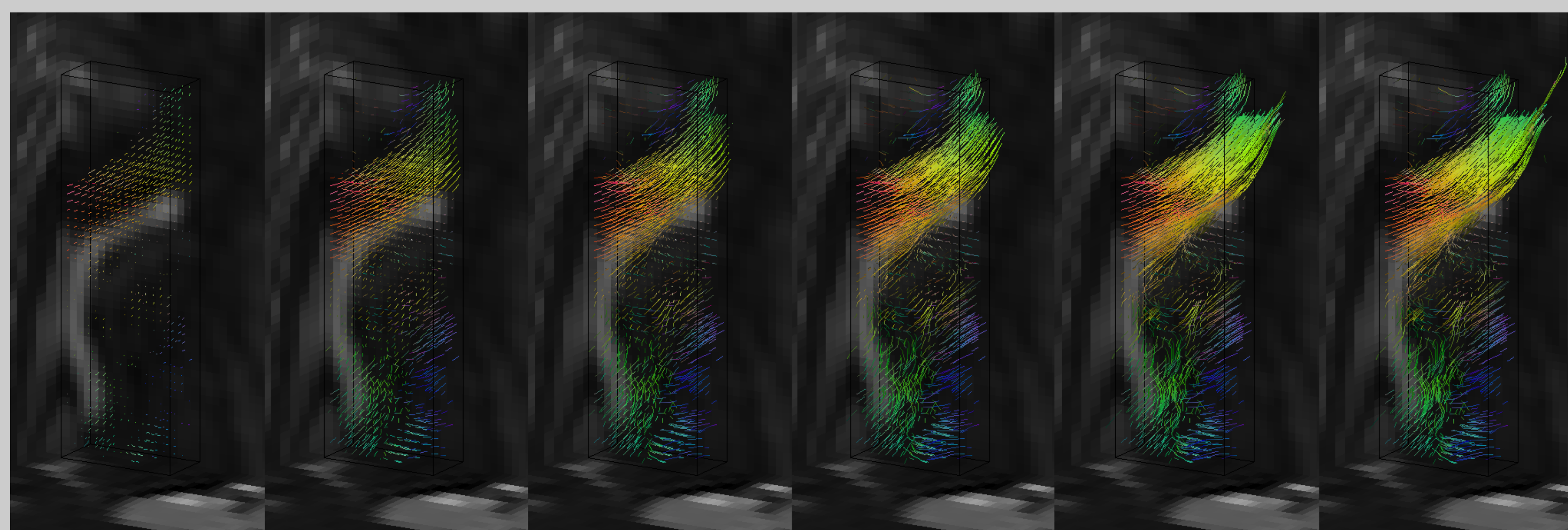
- Hyperstreamlines [DH93]
- Streamtubes and Streamsurfaces [ZDL03]
- Merging Ellipsoids [CZCT09]

General problems: Visual cluttering, clarity of presentation

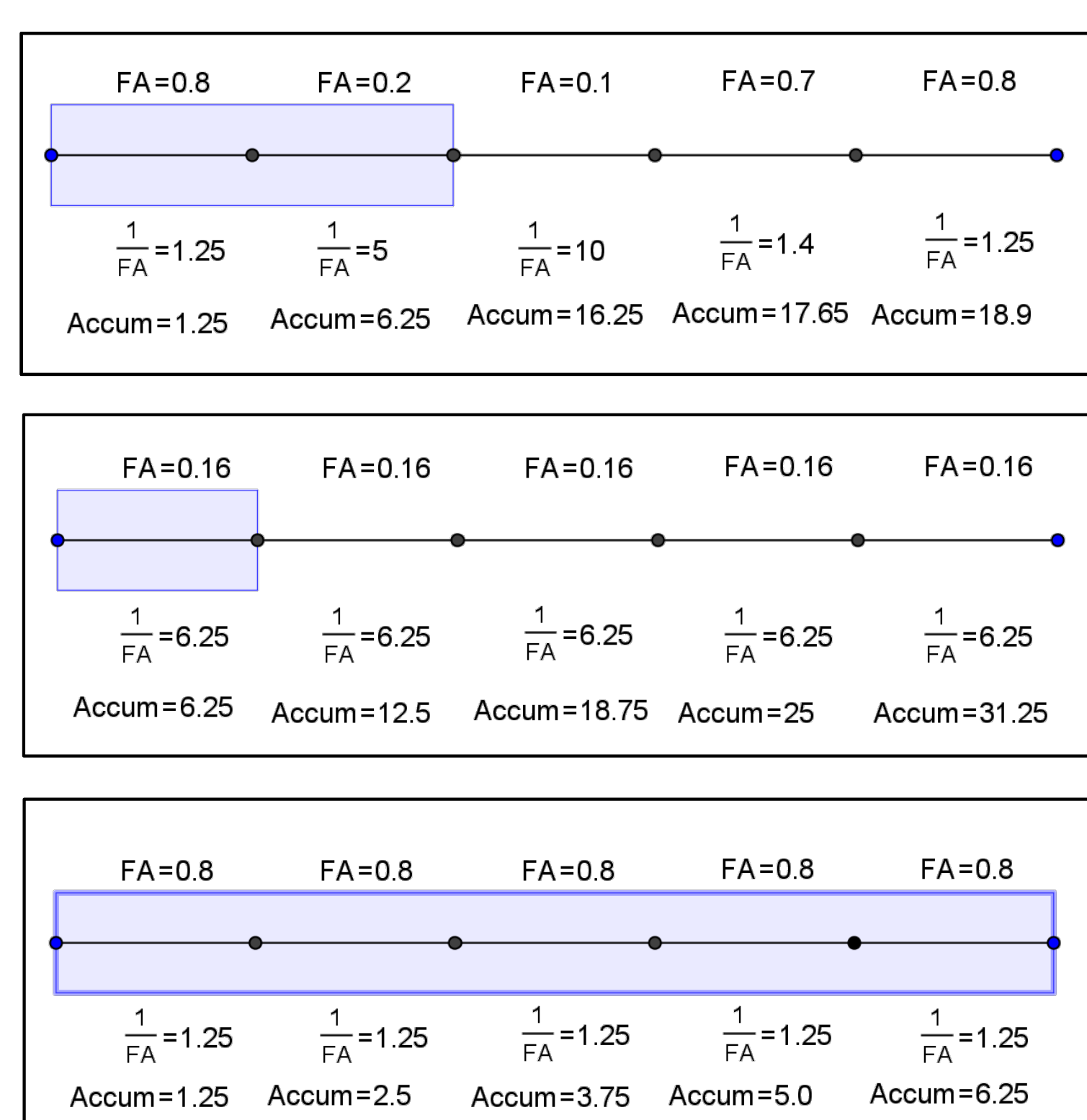
Our Approach

Dynamic DTI Volume exploration with fiber-growing

- Encoding of local diffusion behaviour into streamline visualizations
- VOI definition for tract-specific examination
- Time-dependent evolution:
 - Basis: deterministic tractography approach
 - Local diffusion characteristics: velocity proportional to FA-value
 - Anisotropic regions lead to faster progression than isotropic



Fiber Growing



Conclusions

Clinical applications:

- Visualization-focus on anisotropic tracts
- Integrity-based examination (brain tumor, MS)
- Inside information about fiber integrity

Future work:

- Presentation of more quantitative parameters
- Clustering methods, based on velocity
- Incorporation of multimodal data (e.g. fMRI)
- Examination of stopping criteria
- Integration of HARDI data

References

[CZCT09] CHEN W., ZHANG S., CORREIA S., TATE D. F.: Visualizing diffusion tensor imaging data with merging ellipsoids. Visualization Symposium, IEEE Pacific 0 (2009). [DH93] DELMARCELLE T., HESSELINK L.: Visualizing second-order tensor fields with hyperstreamlines. IEEE Computer Graphics and Applications 13 (1993). [ZDL03] ZHANG S., DEMIRALP C., LAIDLAW D. H.: Visualizing diffusion tensor MR images using streamtubes and streamsurfaces. IEEE Transactions on Visualization and Computer Graphics 9, 4 (2003).