Abstract: Anchor-Constrained Plausibility
A Novel Concept for Assessing Tractography and Reducing False-Positives

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The problem of false positives in fiber tractography is one of the grand challenges in the research area of diffusion-weighted magnetic resonance imaging (dMRI). Facing fundamental ambiguities especially in bottleneck situations, tractography generates huge numbers of theoretically possible candidate tracts. Only a fraction of these candidates is likely to correspond to the true fiber configuration, posing a difficult sensitivity-specificity trade-off. Current methods address this issue either by focusing exclusively on well-known fiber bundles using prior knowledge or by using tract filtering techniques based on the image signal. Currently, the link between these two choices of purely data driven and prior knowledge based approaches is missing.

We propose a novel concept that rigorously exploits prior knowledge about the existence of anatomically known tracts (anchor tracts) to reduce the degrees of freedom of a successive data-driven filtering of the remaining candidate tracts: anchor-constrained plausibility (ACP). This approach is based on the hypothesis that information about the presence or absence of each anchor influences the plausibility of the candidates and thereby reduces the ambiguities in the problem.

We demonstrate the potential of this concept in a series of phantom experiments: ACP significantly improved the tractography sensitivity-specificity trade-off in such controlled settings (AUC 0.91). The direct assessment of false-positive reduction rates requires a ground truth, which does not exist *in vivo*. *In vivo*, we therefore concentrated on assessing the capabilities of ACP in a structured and objective tractogram analysis of 110 subjects of the Human Connectome Project (HCP) young adult study, providing detailed data-driven insights into what we might be missing when focusing only on anatomically known tracts. This work has previously been published at MICCAI 2018 [1].

References

1. Neher PF, et al. Anchor-constrained plausibility (ACP): a novel concept for assessing tractography and reducing false-positives. Proc MICCAI. 2018;11072:20–27.