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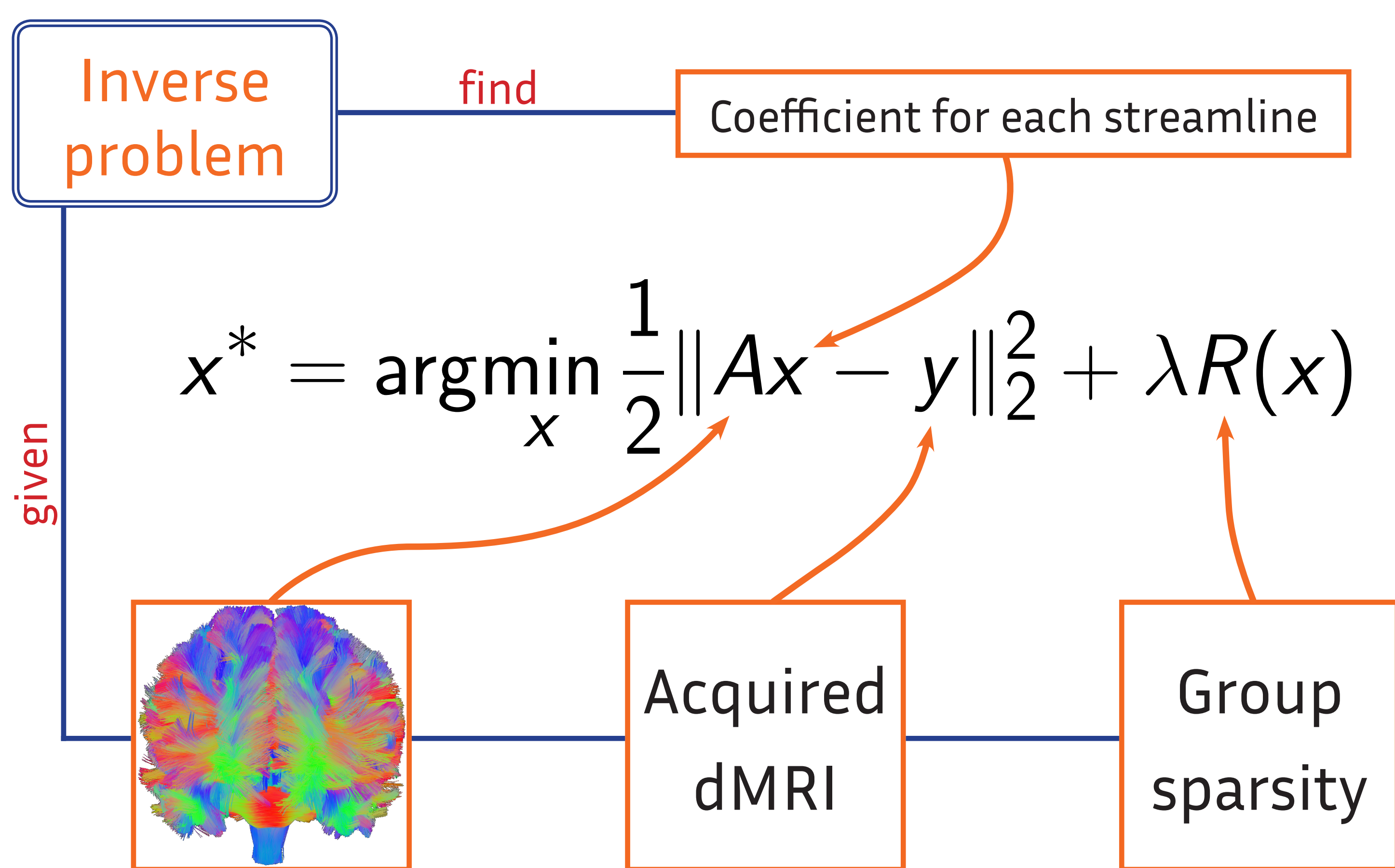
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**Abstract** Due to its ill-posedness, tractography generates a significant number of false positive connections [4] between brain regions. To reduce the number of false-positive connections we extend the COMMIT framework, where the diffusion MRI signal is modeled as a linear combination of local models associated with streamlines where the weights are identified by solving a convex optimisation problem. Streamlines with a weight equal to zero do not contribute to the diffusion MRI data and are assumed to be false positives. Removing these false positives yields a subset of streamlines supporting the anatomical data. However, COMMIT does not take into account the link between structural and functional information, thus weighs all bundles equally. Our method extends the COMMIT framework by injecting the functional information provided by functional MRI. The result is an integrative method for tractogram filtering.

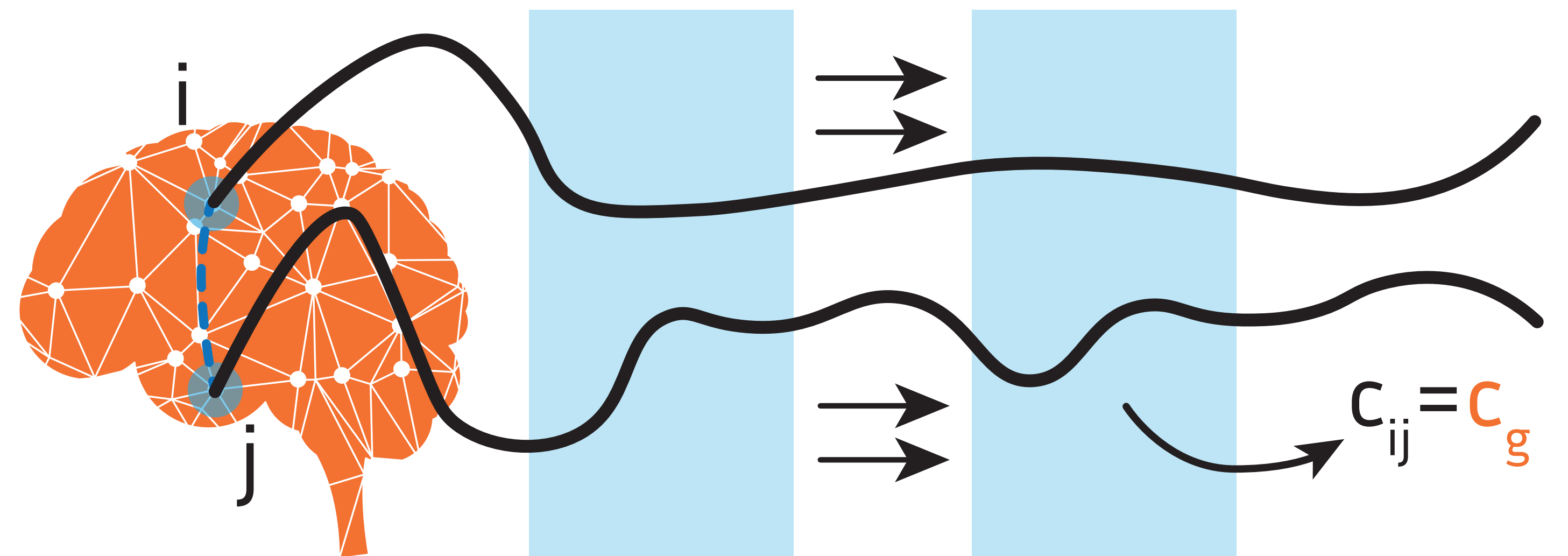
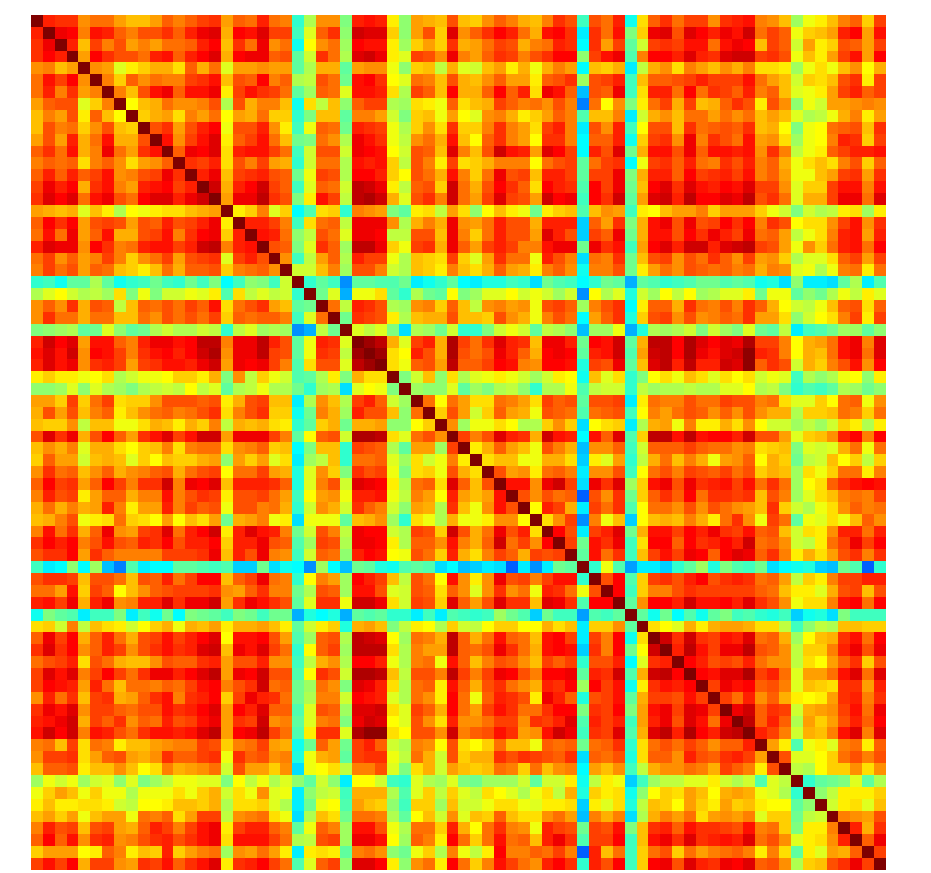
## 1. COMMIT

- Describe the dMRI signal by means of a tractogram
- Forward model from tractography to dMRI signal [1]
- Find the minimal subset of streamlines explaining the signal



## 2. Functional Connectivity

- For each subject we used the resting state fMRI [5] to compute the functional connectivity between each pair of regions
- The chosen marker is the maximal correlation between sliding windows of the average time series of each pair of regions [3]



## 3. Injecting functional information

- Goal
- promote sparsity bundle-wise [3]
  - preserve fiber bundles that show high functional correlation

$$R(x) = \sum_{g \in \mathcal{G}} \frac{1}{w_g} \|x_g\|_2$$

Non Functionally informed

$$w_g = \sqrt{N}$$

Functionally informed

$$w_g = \sqrt{N}(1 + c_g)$$

## RESULTS

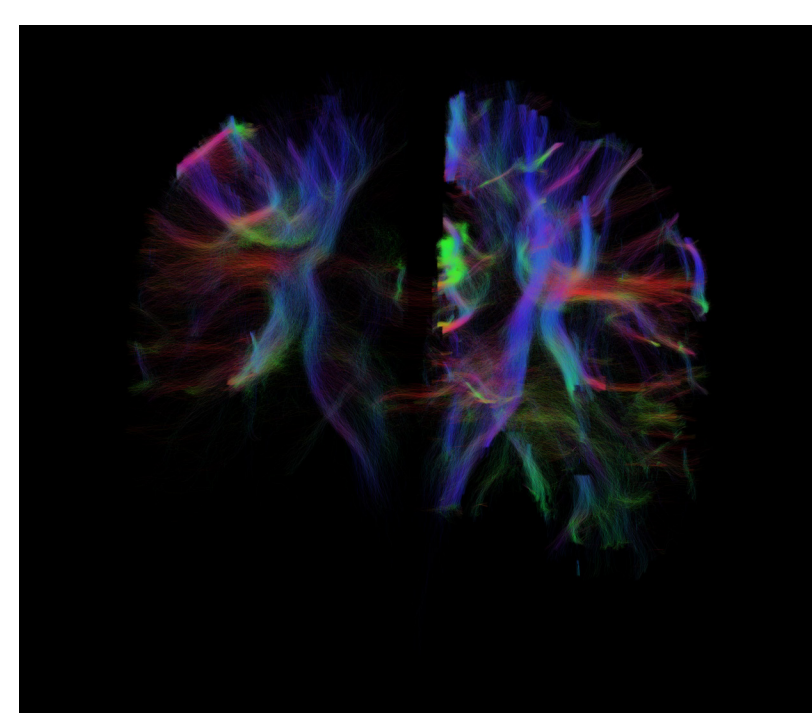
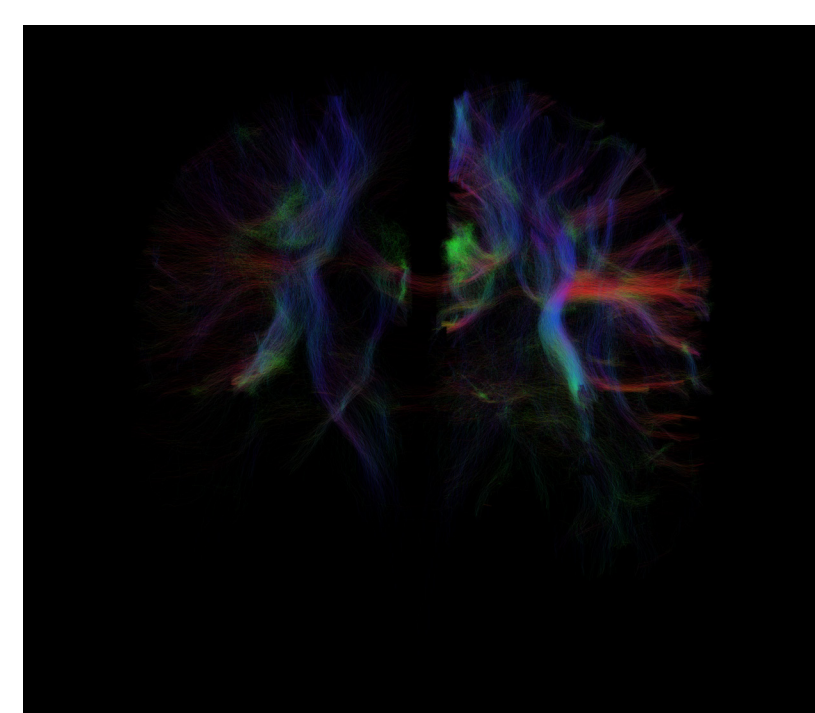
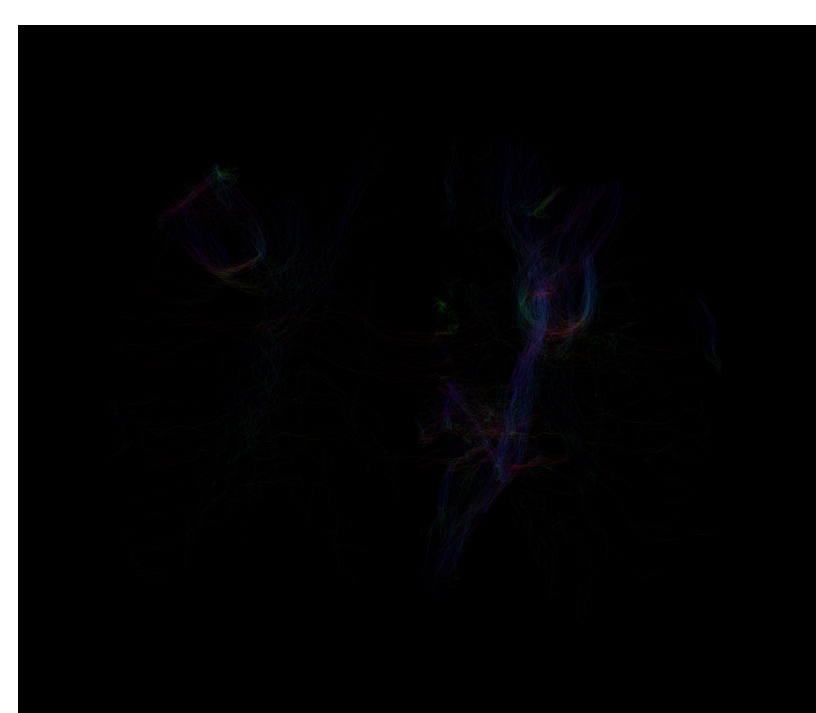
	Without Functional		With Functional	
	%removed	residual	%removed	residual
Subject 1	12.26	958.47	16.01	931.07
Subject 2	18.85	828.58	24.19	808.27
Subject 3	13.55	847.07	16.35	828.95

Removed only by non functionally informed

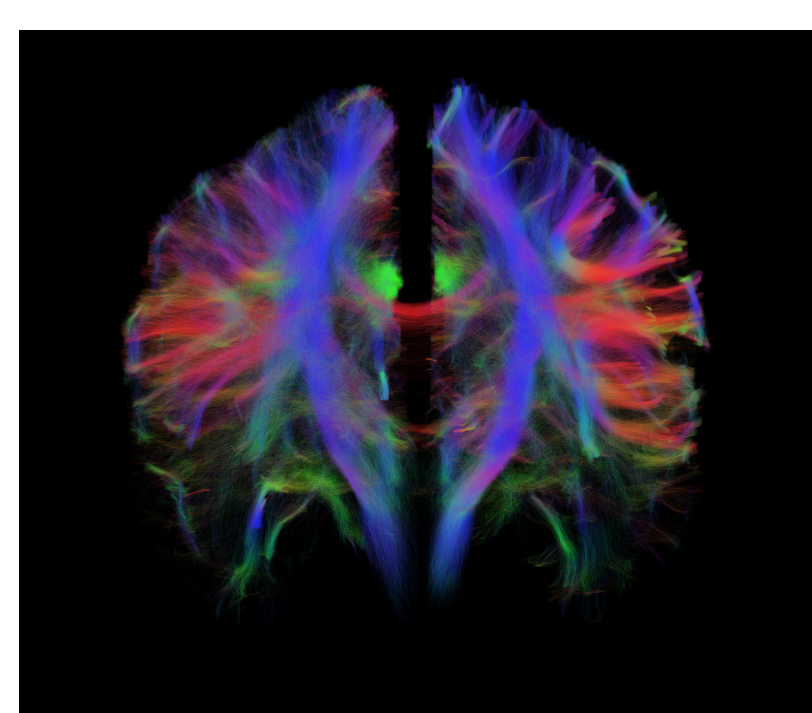
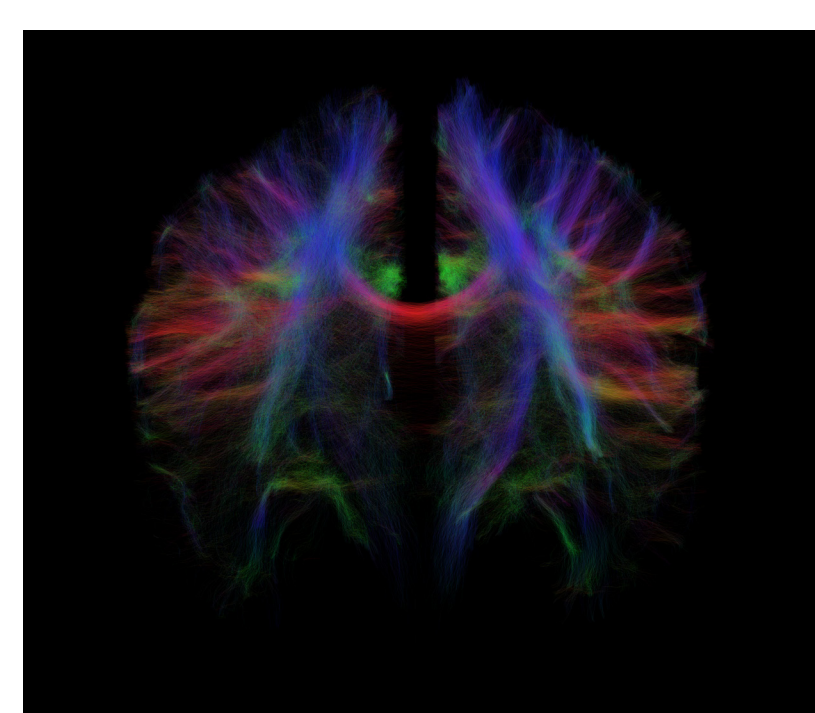
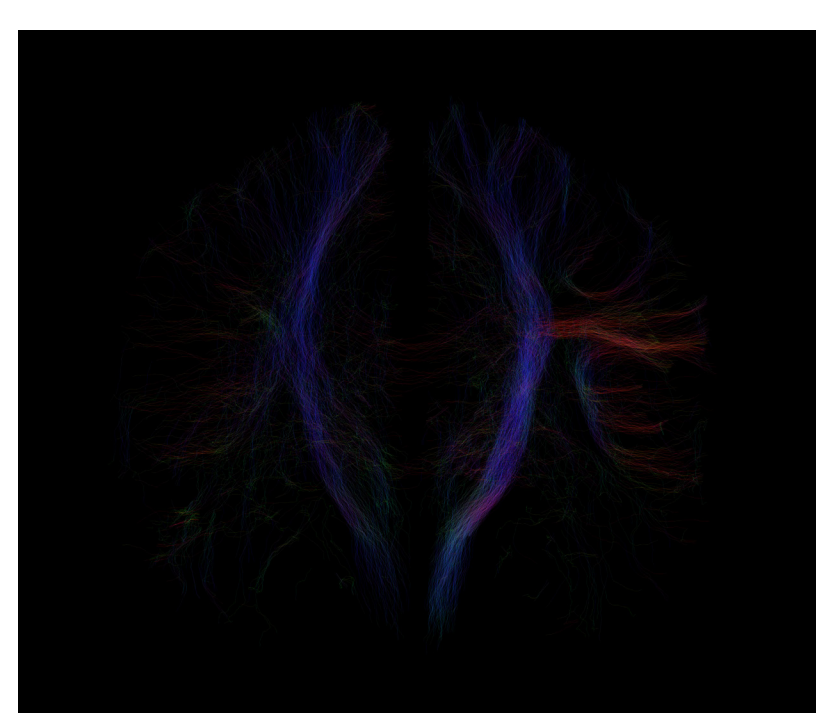
Removed only by functionally informed

Removed by both

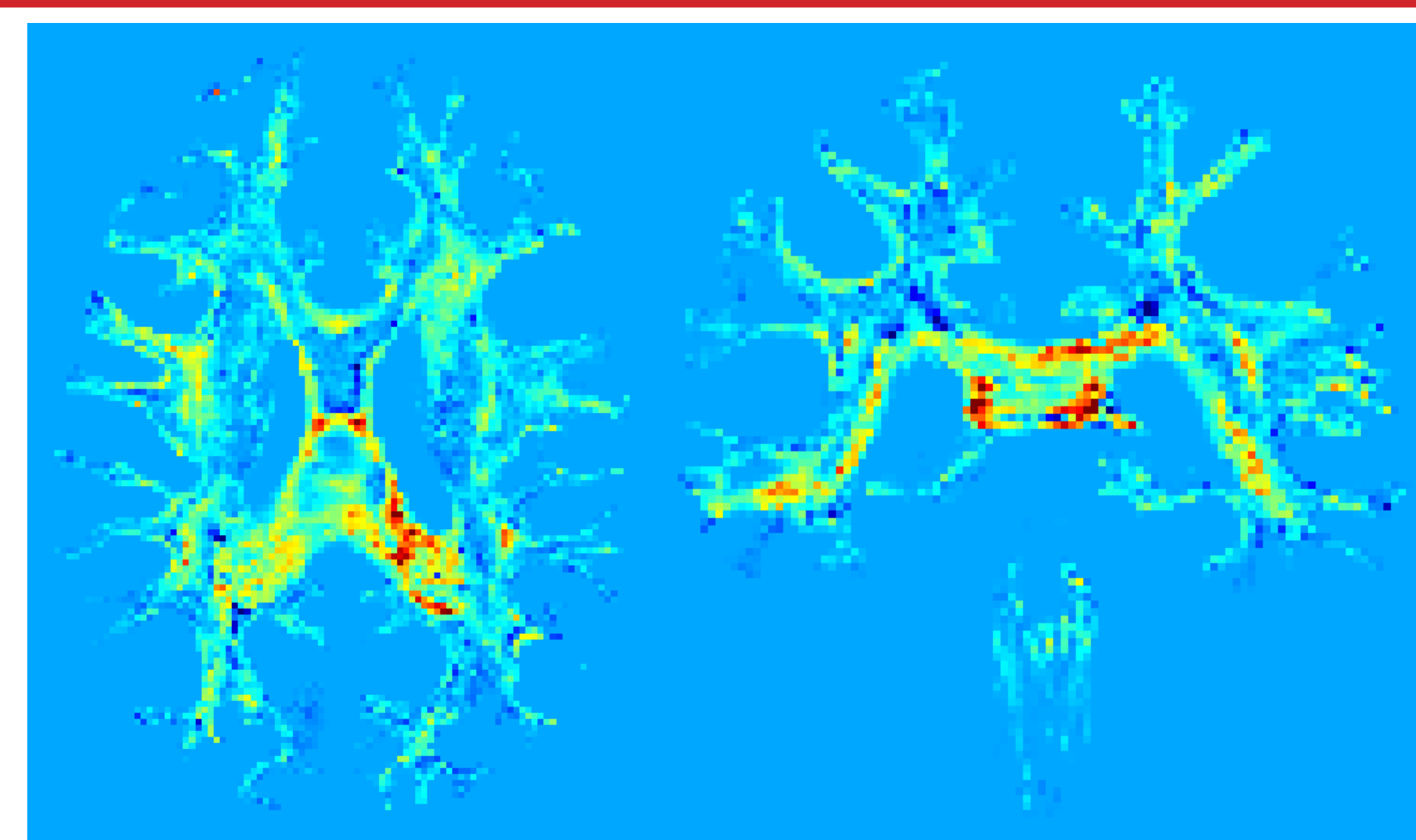
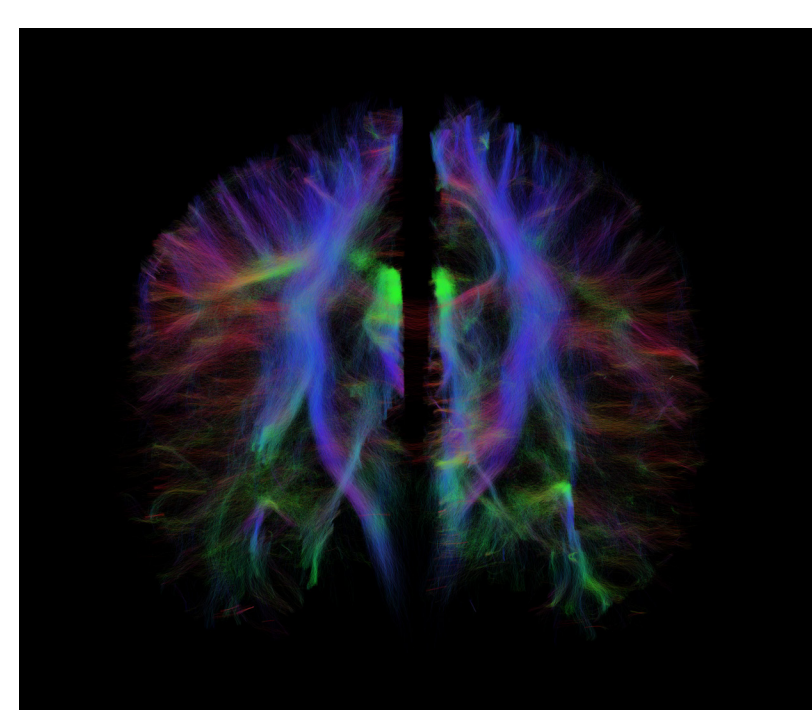
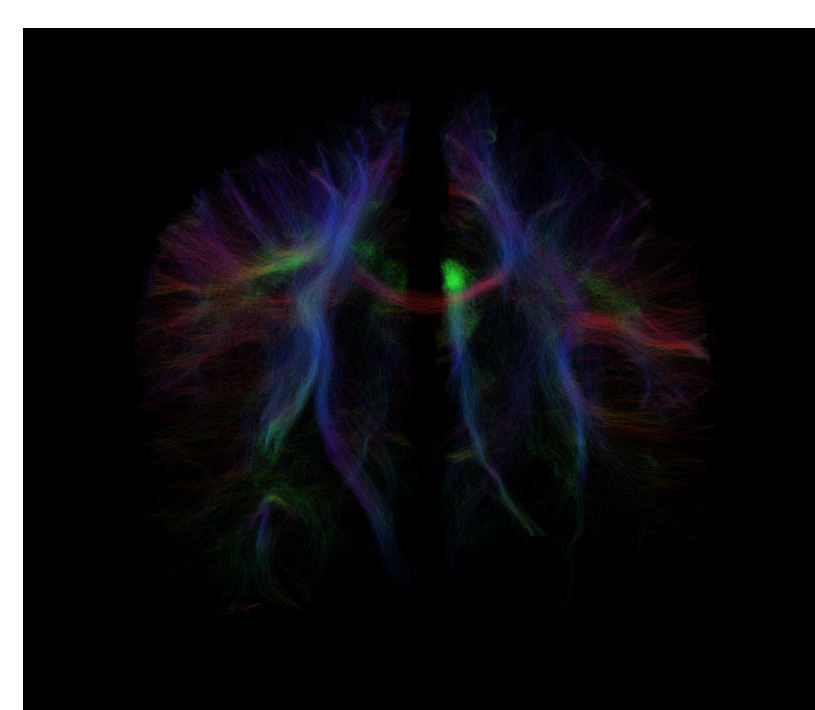
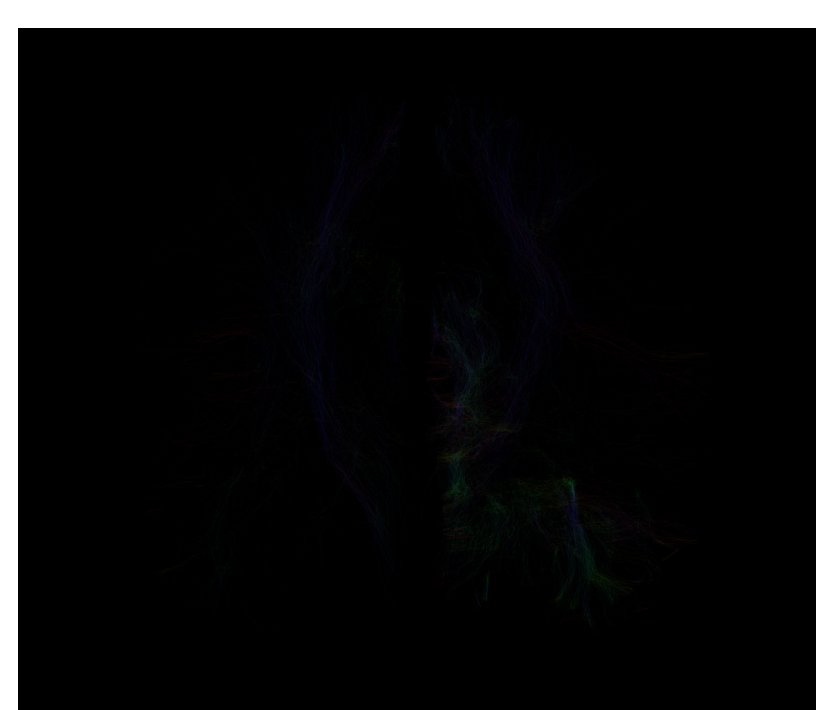
Subject 1



Subject 2



Subject 3



Map of the difference between the NRMSE of the results obtained through the functionally-informed and the non functionally-informed algorithms. Warm colours represent regions where the functionally-informed algorithm performed better than the non functionally-informed one.

These images confirm that functional information leads to better fitting, as shown in the table.

## TAKE-HOME MESSAGE

- False-positive connections are pervasive in tractography.
- Post-processing of tractograms can help build better connectomes.
- The intrinsic bundle structure can be exploited while detecting false-positive connections.
- Injecting functional information enhances tractogram filtering.

**References** 1.Daducci et al. "COMMIT: convex optimization modeling for microstructure informed tractography." IEEE TMI (2015); 2.Frigo, et al. "Hierarchical Tractography Optimisation." CoBCom 2017; 3.Gallardo et al. "Groupwise structural parcellation of the whole cortex: A logistic random effects model based approach." Neuroimage (2017); 4.Maier-Hein, et al. "The challenge of mapping the human connectome based on diffusion tractography." Nature communications (2017); 5.Van Essen et al. "The Human Connectome Project: a data acquisition perspective." Neuroimage 62.4 (2012).

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