Introduction
Structural connectivity research in the human brain in vivo relies heavily on fiber tractography in diffusion-weighted MRI (DWI). The accurate mapping of white matter (WM) pathways would gain from images with a higher resolution than the typical ~2 mm isotropic DWI voxel size. Recently, high field gradient echo MRI (GE) has attracted considerable attention for its detailed anatomical contrast even within the white and grey matter (GM). Susceptibility differences between various fiber bundles give a contrast that might provide a useful representation of white matter complementary to that offered by DWI.

Structure Tensor Informed Fiber Tractography (STIFT) is proposed as a method to combine DWI and GE.

Methods
MR data acquisition:
- GE at 7T (Erwin L. Hahn Institute, Essen, Germany)
  - 3D FLASH; TR/TE/TI=36/23 ms; flip angle=15º; BW 120 Hz/pix; AF=3
  - 0.5 mm
- DWI at 3T (Donders Institute, Nijmegen, Netherlands)
  - SE-EPI; TR/TE=8300/95 ms; 61 directions at b=1000 s/mm²; AF=2
  - 2.0 mm
- T1 at 3T (Donders Institute, Nijmegen, Netherlands)
  - MPRAGE; TR/TE/TI=2300/3/1100 ms; AF=2
  - 1.0 mm

STIFT pipeline:

Structure tensor:
- Structure tensor (ST): describes GE image features in a local neighborhood through its intensity gradients
- ST’s first eigenvector (Fig3) captures fiber sheet orientation
- Data-adaptive ST: edge-enhancing diffusion filter smooths small inhomogeneities, while enhancing fiber sheets (Fig2ab)

STIFT algorithm:
- Tractography algorithms (Camino) were adapted to incorporate the structure tensor by directly influencing the tracking direction
- The adapted tracking direction PDSTIFT is calculated as follows: the original Q-ball tracking direction PQBALL is rotated towards the plane orthogonal to the ST’s first eigenvector PDGE and proportional to its first eigenvalue
- Masking of large veins and cortex (Fig2d-f; within the mask PD DWI is used)