

**Title:****Evaluation of specific fiber bundles using brain mapping and registration of diffusion tensor data****Authors & affiliations:**D. Pai<sup>\*1</sup>, J. Hua<sup>1</sup>, and H. Soltanian-zadeh<sup>2,3</sup>

<sup>1</sup>Dept. of Computer Science, Wayne State University, USA; <sup>2</sup>Medical Image Analysis Lab, Henry Ford Hospital, USA; <sup>3</sup>University of Tehran, Iran  
[darshan@wayne.edu](mailto:darshan@wayne.edu)

**Abstract:**

**Introduction:** Diffusion Tensor Imaging (DTI) leverages the diffusion model to deduce neural interconnections in the brain. The diffusion tensor of a voxel reflects anisotropic properties of the tissue in the voxel. Recently, various studies have reported atrophy and diffusion changes of specific fiber bundles in patients with different neurological diseases. We studied these changes in 10 temporal lobe epilepsy patients and 10 normal volunteers.

**Methods:** We have developed volumetric brain mapping tools that use DTI data to automatically identify atrophy and diffusion changes of specific fiber bundles through comparative group analysis. To this end, we map images of a brain to a template utilizing conformal parameterization that provides one-to-one representation of brain data to a canonical curvature-constant domain for conformal-geometry based registration.

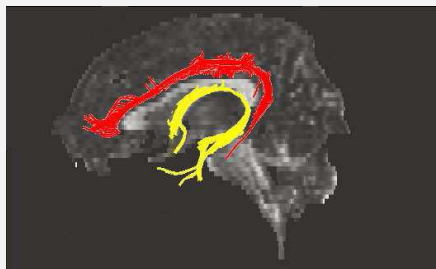


Figure 1: Fornix (Yellow) and cingulum (red) fiber bundle in human brain.

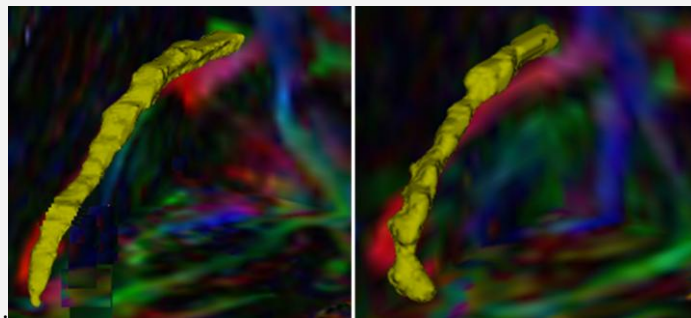


Figure 2: Shape differences in the cingulum bundle for a normal and a patient.

**Results:** Our studies of fornix and cingulum fiber bundles in temporal lobe epilepsy patients reveal lower connectivity strengths compared to normal subjects. They show a 35 % decrease in the Volume Ratio (VR) which is an indication of the relative anisotropy compared to a system under no diffusion. For fornix and cingulum, the mean VR is  $0.179 \pm 0.020$  for the normal subjects while it is  $0.116 \pm 0.011$  for the epileptic patients. Similarly, anisotropy of the fornix bundle in the patient group is 35 % lower than the normal group. In addition, anatomical shape studies show that the fornix bundle has a smooth appearance in the normal subjects while having bumps all over the bundle in the epileptic patients.

**Discussion:** Our proposed curvature-based shape descriptors of the bundles demonstrate significant shape variance between the normal and epilepsy patients. This is consistent with the changes in the VR measure.