

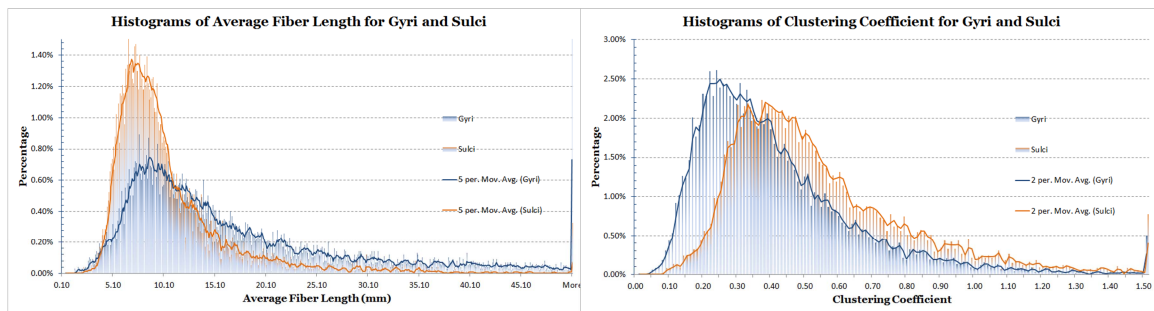
## Relationship between Cortical Folding Pattern and Brain Network Characteristics

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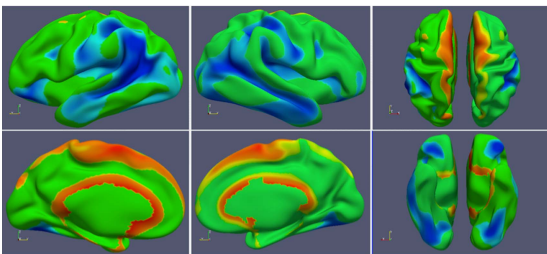
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**Introduction:** The cortical folding process of human brain and axon genesis are closely related [1]. Recently, it has been reported that the axon fibers derived from diffusion tensor imaging (DTI) mostly terminate on cortical gyri [2]. However, deterministic DTI fiber tractography might be biased toward tracts with small curvatures [3], and has limited capability to track crossing fibers [4]. In this study, we investigate the relationship between the cortical folding pattern and the characteristics of constructed structural brain networks via probabilistic fiber tractography of multi-shell high-resolution (1.25 mm isotropic) diffusion images [5].

**Methods:** Data from 53 subjects in the Q1 release dataset of the Human Connectome Project (HCP) were used in this study. All analysis was performed in HCP standard space. For each subject, cortical folding pattern is measured using curvature. To construct the structural brain network, whole-brain probabilistic tracking was conducted using the method described in reference [5]. Each vertex at the white matter and gray matter boundary was considered as a seed and tracked for 1200 times. The tracking was terminated when reaching the pial surface. Node degree, clustering coefficient, closeness centrality and average fiber length of the resultant networks were quantified and analyzed.



**Fig.1** Left: Histogram of average fiber length in mm. Right: Histogram of clustering coefficient. **Results:** 1) While reference [2], using deterministic fiber tracking of DTI data, showed that fibers mostly terminate on gyri, there is no significant difference between gyral and sulcal vertices in terms of node degree in this study. However, the average fiber length does exhibit significant difference ( $p < 0.01$ ) between gyri and sulci, as depicted in Fig.1. 2) A significant negative correlation was found between clustering coefficient and curvature: mean (-0.18), stdev (0.04), with  $p < 0.001$ . 3) Closeness centrality showed ununiform distribution across gyri and sulci, as shown in Fig.2. More specifically, precuneus, paracentral lobule, superior frontal gyrus, caudal middle frontal gyrus, and part of precentral gyrus show higher centrality while inferior part of precentral sulcus, inferior parietal lobule, superior temporal sulcus, orbitofrontal region, and inferior postcentral gyrus exhibit lower centrality.



**Fig.2.** Ununiform distribution of closeness centrality across the cortex. Red is for higher centrality and blue is for lower centrality.

**Conclusion:** In this study, we investigated the relationship between cortical folding pattern and structural brain network characteristics using the Q1 release dataset of HCP. Structural brain network was constructed using a multi-shell whole brain probabilistic fiber tracking [5]. Our result indicates that structural brain network may be closely related to cortical folding pattern.

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Reference: 1. Stahl et al., Cell, 2013, 153:535–549. 2. Nie et al., Cereb Cortex. 2012, 22(12):2831-9. 3. Sotiropoulos et al., ISMRM, 2013. 4. Mori and van Zijl, NMR Biomed. 2002,15(7-8):468-80. 5. Jbabdi et al., Magn Reson Med, 2012, 68(6):1846-55.