Introduction

Surface complexity is commonly described using the gyrification index (GI) or fractal dimension (FD). One advantage of the FD metric is that it is independent of surface area. Usually, FD is measured using a box-counting approach. Here, we propose to use spherical harmonic (SPH) reconstructions to measure FD.

Methods

Surfaces: two von Koch surface meshes, three complexity levels.

(a) Box-counting: The surface is resampled at progressively lower resolution, using a regular Platonic solid.

(b) 24 resolutions: 64 to 2097152 triangles

Log-log plot: surface area vs. dimension

(c) 1/sqrt(#triangles)

10 reconstructions: maximum l-values from 2 to 1024

Log-log plot: surface area vs. maximum l-value

Power spectrum: The coefficients at each l-value are summed and squared.

Results

Power spectrum

Application to Cortical Surfaces

Discussion

It is possible to extract a valid complexity metric from SPH analysis. The GI can depend on the outer hull shape, whether the measure is taken in 2D or 3D, etc. These issues are circumvented in SPH. Cortical surface complexity may be a valid clinical marker for schizophrenia (Narr et al., 2004), Williams’s syndrome (Gaser et al., 2006), bipolar disorder (McIntosh et al., 2009), and obsessive-compulsive disorder (Ha et al., 2005). Because complexity metrics based on SPH have fewer limitations than previous approaches, it has the potential to provide more accurate clinical data.

Acknowledgements

R.A.Y. & C.G. are supported by the German BMBF grants 01EV0709 and 01GW0740. P.T. is supported by NIH grants EB008432, EB008281, EB007813, HD050735.

References


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