

# Dissertation: Background and Literature

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## 1 Generative network models

These models were first developed and applied to connectome data by Betzel et al. (2016).

### 1.1 Evaluation

$$E = \max(KS_k, KS_c, KS_b, KS_e)$$

to quantify the difference between the synthetic and observed data using the Kolmogorov-Smirnov statistic. The corresponding statistic is computed for every vertex, and then the distributions are compared.

- $KS_K$  Nodal degree = Number of edges that are incident to a vertex
- $KS_C$  Clustering (coefficient) = Measure of the degree to which nodes in a graph tend to cluster together, proportion of possible connections realized among the neighbors of a vertex (Where the neighbor of a vertex are all the other connected vertices)
- $KS_b$  Betweenness centrality = Measures the centrality of a vertex by investigating the number of shortest paths that pass through the vertex (For every pair of vertices there exists a shortest path between them minimizing either the number of edges or the summed weights of the edges)
- $KS_e$  Edge length = Sum off al the edge length that are incident to a vertex

### 1.2 Optimization

### 1.3 Rules

#### 1.3.1 Geometric

- Promotion of low cost connections is promoted, but forming only the shortest connections, produces lack of long distance connections, which increases path length, and reduces efficiency
- Problems in reproducing clustering and edge length distributions simultaneously ( $KS_c, KS_e$ ), this is because strong distance penalty required to make high clustering but then lacking long distance connections

#### 1.3.2 Degree

#### 1.3.3 Clustering

#### 1.3.4 Homophilic

##### 1.3.4.1 Matching index

- Normalized measure of the overlap in two vertexes neighborhoods

- that eta and gamma seem to trade off with each other, such that a connectome is either shaped by geometry or non-geometric constraints

## 2 Graphs

### 2.1 Rich clubs

- Measure the extent by which well connected nodes are connected to each other
- Networks of high rich-club coefficients have many connections between nodes of high degree

## References

Betz, Richard F., Andrea Avena-Koenigsberger, Joaquín Goñi, Ye He, Marcel A. De Reus, Alessandra Griffa, Petra E. Vértes, et al. 2016. “Generative Models of the Human Connectome.” *NeuroImage* 124 (January): 1054–64. <https://doi.org/10.1016/j.neuroimage.2015.09.041>.