**Small World Network Analysis of DTI-based Connectivity in Isolated Neural Ganglia**

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**Introduction**

 Diffusion Tensor Imaging (DTI) tractography can be used to characterize and quantify the structural connectivity within neural tissue (Figure 1). Here, DTI-based connectivity within isolated abdominal ganglia (ABG) of *aplysia Californica* is analyzed using network theory. For ABG, findings demonstrate preferential specific small-world properties when compared to simulated equivalent lattice and random networks.

**Methods**

 DTI was acquired at 50x50x150 m using four unweighted images and 18 diffusion weighted directions at 11.75 T. The graph properties [1] of experimental data (EXP) were extracted to obtain the clustering coefficients, local and global efficiency (Figure 2) of the binary adjacency matrices corresponding to unweighted, undirectional graphs. These properties were averaged for the structural networks of N=10 fixed ganglia.

**Results and Discussion**

In addition to a short characteristic path length compared to the lattice network (Figure 1c), EXP networks showed high clustering in closed neighborhoods and high total clustering when compared to random graphs (512 nodes) equivalent in degree (Figure 1d). These properties meet the definition of small-world networks [2]. Finally, the novel small-world metric (ω) [1] verifies that ABG structural connectivity exhibits small-world properties (=0.12) between the continuum of lattice (ideal =-1) and random (=+1) networks (Table 1).

**Conclusions**

 Network analysis of DTI tractography potentially can provide biomarkers for the neural connectome.

 

c. d.

**Fig. 1** (a Mean ADC map of an example *aplysia* ganglion; b & c) Inner-connections in the network; d) Clustering Coefficient

**Local Efficiency Global Efficiency**

**Table 1:** Novel Small-World Metric





 a. b.

**Fig. 2** a) The efficiency of the experimental graphs was high locally (as in the Watts-Strogatz (WS) lattice) and (b) globally as in a WS random network), which indicates an impressive balance between the transfer of information on bothlocal and universalscales.

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**References**

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[2] Watts, D.J., *et al.*, Nature, **393**, 440-442 (1998).