

# Markov Random Field and application on fMRI Connectivity Analysis

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### 1 Experiment Results and Analysis

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**Goal:** Compute the 'connectivity' between any pair of voxels (or regions) in brain cortex. (the rigid definition of 'connectivity' is not available.)

**information available:**

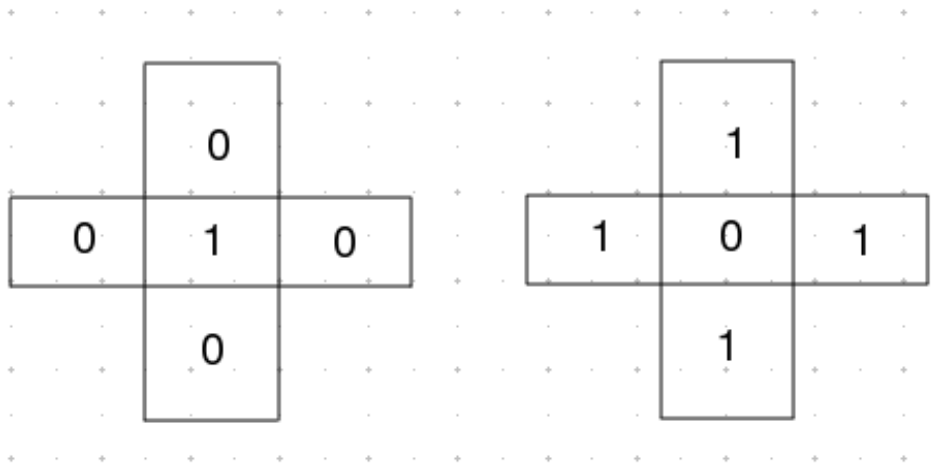
- Data. fMRI (time courses), DTI(tractography)
- Assumption: Connectivity should be smoothly changed.

**Method:** Bayesian Rule:

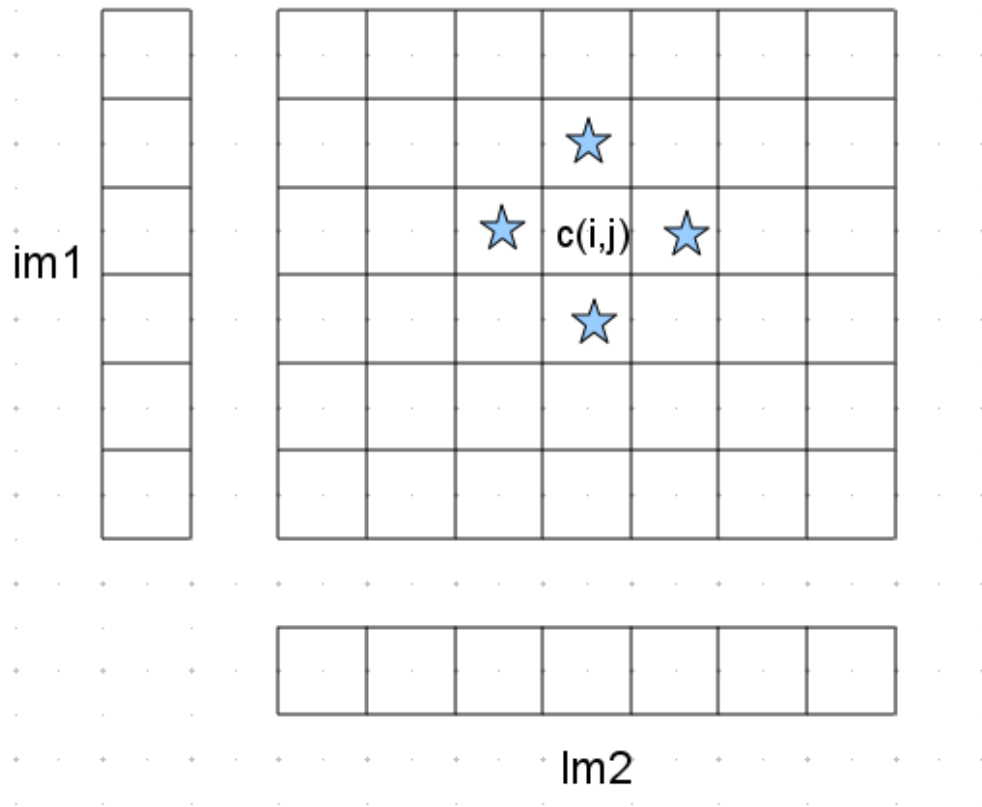
$$p(\text{connectivity}) \propto \text{prior}(\text{connectivity}) \cdot \text{likelihood} \quad (1)$$

**Prior:** 1) from neighbors connectivity. 2) from other voxels with DTI tract. **likelihood:** from data.

1) From neighbors connectivity.



**Figure 1:** Without data, the connectivity value at a point depends on its neighbors.



**Figure 2:** Connectivity between any voxel pairs of two 1-D image.

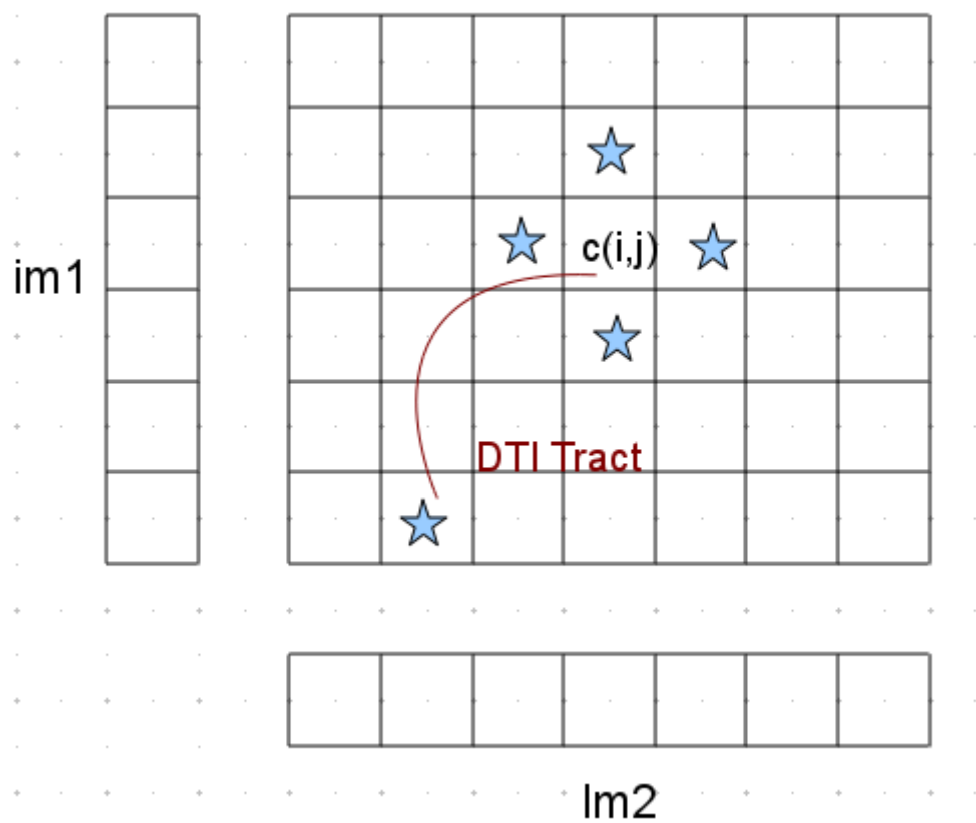
A dynamic plot can be found here: <http://www.sci.utah.edu/~weiliu/research/intro/postConn.gif>

**What questions can we answer:**

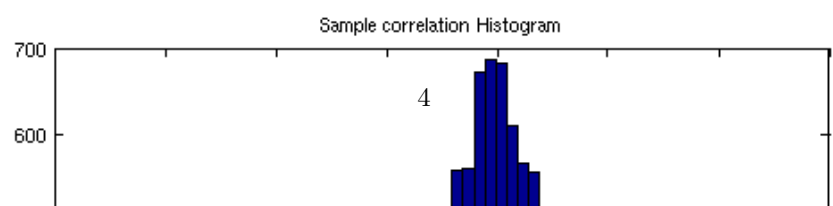
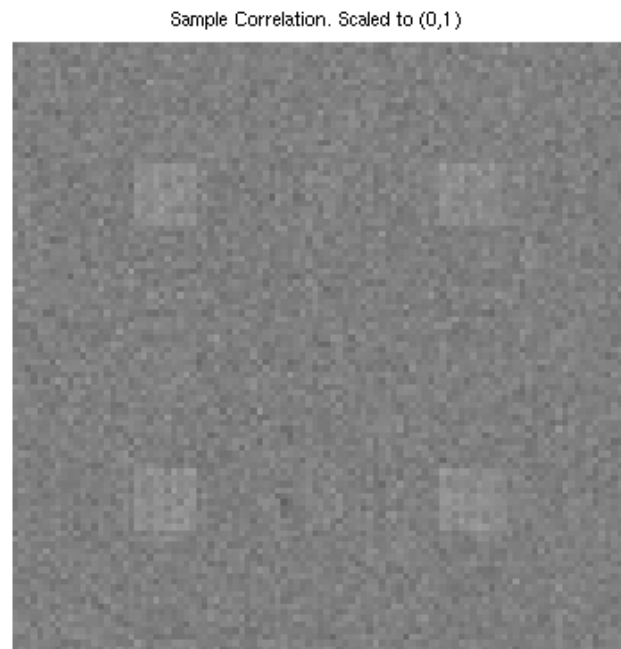
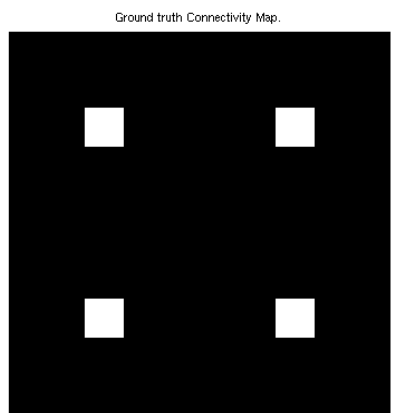
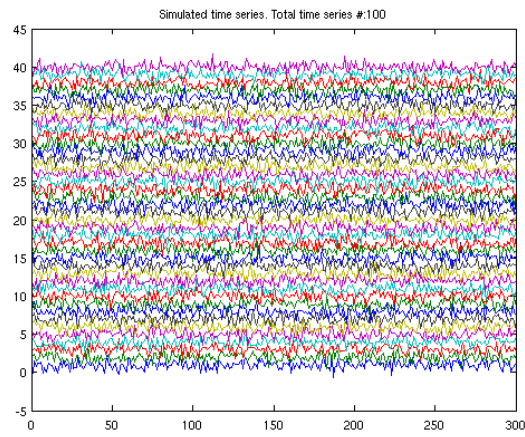
- Build resting state brain network? Hayasaka and Laurienti [2010]
- find similar connectivity among groups??
- causality?

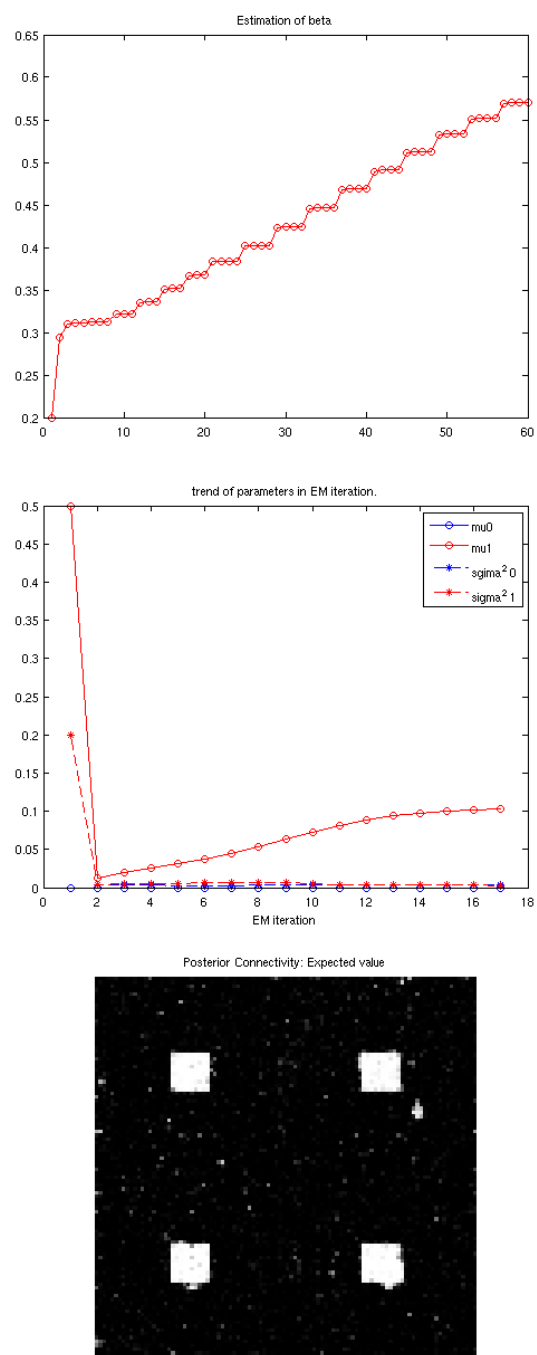
## References

Satoru Hayasaka and Paul J. Laurienti. Comparison of characteristics between region-and voxel-based network analyses in resting-state fMRI data. *NeuroImage*, 50(2):499–508, April 2010. ISSN 1053-8119. doi: 10.1016/j.neuroimage.2009.12.051. URL <http://www.sciencedirect.com/science/article/B6WNP-4Y05DJ6-D/2/64b68c47b7e27b59d8e2d69a56151f2f>.



**Figure 3:** Connectivity between any voxel pairs of two 1-D image, with DTI tract.





**Figure 5:** Use Markov Random Field to estimate connectivity.