0.1 ISFC

The ISFC is a process through which we find the stimulus-dependent activations in our fMRI dataset by cross referencing and averaging data from multiple subjects.

1. For each subject s, we find the average activation of all other subjects:

$$O_s = \frac{\sum_{i \neq s}^{N} S_i}{N-1}$$

where S_i represents the activation matrix for subject i and N represents the total number of subjects.

2. Find the correlation matrices between the voxel activations for each subject S_i and the average voxel activations of all other subjects O_i using the timecorr method with variance σ. To find the correlation between voxel activation S_t^i of subject S for voxel i at time t and voxel activation O_t^j of the average of other subjects for voxel j at timepoint t is obtained through the following equation:

$$C(S_t^i, O_t^j) = \frac{1}{Z} \frac{\sum_{l=0}^{T} (S_l^i - \bar{S_t^i}) \cdot (O_l^j - \bar{O_t^j}) \cdot \mathcal{N}(l|t,\sigma)}{\sigma_{S_t^i} \cdot \sigma_{O_t^j}}$$

Where

$$Z = \sum_{l=0}^{T} \mathcal{N}(l|t,\sigma)$$

$$\bar{S_t^i} = \frac{1}{Z} \sum_{l=0}^{T} S_l^i \cdot \mathcal{N}(l|t,\sigma)$$

$$\bar{O_t^i} = \frac{1}{Z} \sum_{l=0}^{T} O_l^i \cdot \mathcal{N}(l|t,\sigma)$$

$$\sigma_{S_t^i} = \sqrt{\frac{1}{Z} \sum_{l=0}^{T} (S_l^i - \bar{S_t^i})^2 \cdot \mathcal{N}(l|t,\sigma)}$$

$$\sigma_{O_t^i} = \sqrt{\frac{1}{Z} \sum_{l=0}^{T} (O_l^i - \bar{O_t^i})^2 \cdot \mathcal{N}(l|t,\sigma)}$$

3. Apply Fisher Z-transformation to every element r of the correlation matrices for each subject at each time points to obtain the corresponding Z-correlation matrices:

$$z = \frac{1}{2}\ln(\frac{1+r}{1-r})$$

4. Average the Z-correlation matrices Z_i across all subjects:

$$S_Z = \frac{1}{N}\sum_{i=1}^{N} Z_i$$

5. Apply inverse Z-transformation to the average Z-correlation matrix to obtain the Inter-subject Functional Connectivity (ISFC) mean correlation matrix:

$$ISFC = \frac{\exp(S_Z + S_Z^T) - 1}{\exp(S_Z + S_Z^T) + 1}$$