

$$\text{sl_fc}(\pi, \boldsymbol{\xi}^\pi) = \left[\tanh f_{\sigma \rightarrow \boldsymbol{\xi}^\pi} \tanh^{-1} \text{corr}_{\boldsymbol{\eta}} \left[\text{corr}_t \left[\mathbb{E}_{|\boldsymbol{\xi}^{\sigma\pi}| \in \sigma} B^\pi(\boldsymbol{\xi}^{\sigma\pi}, t), B^\pi(\boldsymbol{\eta}^\pi, t) \right], \right. \right. \\ \left. \left. \tanh \mathbb{E}_{\gamma \in C} \tanh^{-1} \text{corr}_t \left[\mathbb{E}_{|\boldsymbol{\xi}^{\sigma\gamma}| \in \sigma} B^\gamma(\boldsymbol{\xi}^{\sigma\gamma}, t), B^\gamma(\boldsymbol{\eta}^\gamma, t) \right] \right] \right]$$

is a functional connectivity, expressed as a correlation tensor for patient or subject π at parenchymal voxels positions $\boldsymbol{\xi}^\pi$.

For patient or subject π , the BOLD times-series for parenchymal voxels, $\boldsymbol{\xi}$, enclosed by sphere $\sigma \in \text{set } S$, which spans the parenchyma, is $B^\pi(\boldsymbol{\xi}^{\sigma\pi}, t)$. The expectation over those σ voxels, $\mathbb{E}_{|\boldsymbol{\xi}^{\sigma\pi}| \in \sigma}$, aims to provide nonlocal aggregation of functional information. The BOLD time-series for cortical voxels, $\boldsymbol{\eta}$, is $B^\pi(\boldsymbol{\eta}^\pi, t)$. The correlation matrix contracted over times, t , has size $|S| \times |\boldsymbol{\eta}^\pi|$.

Similarly, for each subject $\gamma \in \text{control cohort } C$, the BOLD times-series for the expectation of parenchymal voxels enclosed by sphere σ is $\mathbb{E}_{|\boldsymbol{\xi}^{\sigma\gamma}| \in \sigma} B^\gamma(\boldsymbol{\xi}^{\sigma\gamma}, t)$, and the BOLD time-series for cortical voxels is $B^\gamma(\boldsymbol{\eta}^\gamma, t)$. The averaging over the control cohort is denoted by the innermost $\tanh \mathbb{E}_{\gamma \in C} \tanh^{-1}$, producing a correlation matrix of size $|S| \times |\boldsymbol{\eta}^\gamma|$.

The outermost $\text{corr}_{\boldsymbol{\eta}}$ contracts over all cortical voxels $\boldsymbol{\eta}^\pi$ for the single subject with all cortical voxels $\boldsymbol{\eta}^\gamma$ which have already been averaged over the control cohort, producing a correlation vector of length $|S|$.

The outermost $\tanh f_{\sigma \rightarrow \boldsymbol{\xi}^\pi} \tanh^{-1}$ surjectively maps all spheres back to parenchymal voxels positions, thereby producing for each parenchymal $\boldsymbol{\xi}^\pi$ a measure of similarity of the FC of patient or subject π with all subjects from the control cohort C .