2018/11/9 논문1 resting state fMRI functional connectivity

Brain connectivity는 크게 2가지로 나뉜다(이것이 정확히 나뉜다고는 볼 수 없으나 일단은 편의상 이렇게 표현하겠다). i)Structural connectivity ii)Functional connectivity. Structural connectivity는 Anatomical 구조를 파악하는, 예를 들어 Neural fiber를 Spatially(3D) estimate 하거나 topology를 analyze한 connectivity라고 하겠다. Functional connectivity는 []

우리는 connectivity를 분석하기 위하여 통계적인 estimation and measurement를 진행하는데, infinite size인 population(모집단)에서 sample(표본)을 추출하여 여러가지 parameter들을 분석하는 것이 기본적인 방법이다. For example, there are mean, variance, correlation and so on.

In order to understand the definition of corrrelation, we have to understand the covariance first. Covariance is defined as E[(X-u\_x)(Y-u\_y)] and u means mean. If it is divided by sqrt(E(X-u)^2\* E(Y-u)^2), it is normalized and come in the range of [-1,1]. This is called correlation coefficient and it indicates correlation E[XY].

Functional connectivity is defined as temporal dependency of neural activation patterns of anatomically separated brain regions. It says that structural connectivity is a core of functional connectivity. it also have a link with cognition and we can diagnose the neurodegenerative disease by measuring, estimating FC.

To process Resting state fMRI data, there are two types of method. First is model-dependent (Seed method)and second is model- free(ICA PCA). Recent study of examining the overall structure of the brain network, is graph analytical method.

\*\*Functional connectivity 는 정확히 뭘까?

\*\*Graph theory 논문을 읽으며 더 공부하자. 개념을 정립하자.

논문2 Complex network measures of brain connectivity: uses and interpretations

Brain connectivity - complex network analysis

neurobiologically meaningful and easily computable measures.

structural connectivity, functional connectivity, effective connectivity

1)node와 link로 brain network 이룸.

node- region of brain cortex, parcellation

link - connections 1)anatomically: connection strength, size ,density, coherence

2)functionally: magnitude of correlational interaction

degree : number of links connected to that node

2)Brain network measures

1. functional segregation

clustering coefficient: fraction of triangles around and individual node,

fraction of the node's neighbors that are also neighbors of each other

transitivity: classical variant of the clustering coefficient

modularity: The degree to which the network may be subdivided into such clearly delineated and nonoverlapping groups is quantified by a single statistic.

2. functional integration

characteristic path length: average shortest path length

global efficiency : average inverse shortest path length

regular, random, small-world

CPL CC 각각 크기 비교

3.network motif

zscore : measuring frequency of occurrence,

motif fingerprint: reflect the functional role of the corresponding brain region

4. centrality

degree

within-module degree z-score : locallized, within module version of degree centrality

participation coefficient: diversity of intermodular interconnections of individual nodes

closeness centrality : inverse of the average shortest path length from one node to all other nodes in the network

betweenness centrality: fraction of all shortest paths in the network that pass through a given node

5. network resilience

degree distribution

assortativity coefficient: correlation coefficient between the degrees of all nodes on two opposite ends of a link

comparison : between subject, one subject of structural and functional connectivity

1. time series: a large number of fMRI images collected at different points of time
2. subject: a participant in a research study
3. session: a single visit to the scanner by a subject
4. run: an uninterrupted presentation of an experimental task. usually 5-10 minutes
5. volume: a single image of the brain , consisting of multiple slices and voxels
6. slice : a single slab of an imaging volume
7. voxel: a three- dimesional volume element
8. translation : The movement of an object along an axis in space. rotation과 대조되는 개념

Feat

1. Motion correction

succesive image volumes in the time series are coregistered to a single reference volume

cost function

realignment of parameter:

spatial interpolation:

filtering technique: ICA

1. slice timing correction

ascending/descending slice acquisition: 1,2,3,...,12

interleaved slice acquisition: 13579,24681012

good: minimize the influence of excitation pulses upon adjacent slices

bad: adjacent parts of thebrain are acquired at non-adjacent time points within the TR

->temporal interpolation

1. brain extraction

두뇌 추출. ???

1. spatial smoothing

->gaussian lowpass filtering

good:

matched filter : using a filter of the same frequency as the signal of interest maximizes SNR.

spatial correlation ->filter

validity of statistical technique

bad

imperfect match between filter width and activation extent

filter too large: meaningful activation attenuated

filter too small: littele positive effect on SNR

benefit to voxelwise analysis but little effect on ROI.

1. intensity normalization : 평균 달리짐?

intersubject comparison(between subject): 다른 뇌 크기. 일반화 필요.

1. temporal filtering

filter physiological signal

lowpass filter: filter high frequency

highpass filter: 언제 필요할까?

temporal autocorrelation

1. registration

co-registration: spatially aligning two image volume

-> structural and functional coregistration important: functional은 저해상도. 그러한 activiation이 anatomy에 어떻게 부합하는지 알아야 함.

task-related change is really small compared with the temporal spatial variability

SNR : depends on amplitude of the BOLD signal, depends on the area being measured

내일 temporal filtering , brain extraction, summary 읽기.

12/07

roi analysis를 위한 registration 과정.

goal: fMRI image에 ROI 를 씌우고 싶은것.

3가지 요소 : native fMRI image, T1 image, standard image

fMRI와 T1 image: same subject

standard 와 T1: 여러 subject들의 T1을 평균을 낸 것이 standard

contrast 와 resolution이 좋은 쪽으로 registration해주는것이 좋음.

그렇기 때문에 native image->T1 으로 registration 하고 그것의 역함수를 취해주고,(T1 resolution good)

T1 image -> standard으로 registration 하고 그것의 역함수를 취해주는 것이다.(standard가 contrast가 좋음\_> 조금 더 공부가 필요한 부분.)

fMRI image와 T1 image를 연달아 이어서 찍었다- 크기가 같다고 가정하고 해.

-> linear registration만으로 충분함.

T1 image와 standard image: 모양도 다름.

-> nonlinear registration

ROI는 겹치면 안된다.