**Dynamic functional analysis on brain networks - 02/06/2020 video call**

**Key aims of the project**

1) Compute metrics able to reflect normal brain organisation fluctuations (i.e., change in the modular partition) over time using graph theory
    - Their hypothesis is that there will be abnormalities during resting state between healthy patients and patients with chronic pain
2) Investigate sex differences and/or age-effects on brain network dynamic
    - Is there a difference between males and females (ie. is there a difference between the time series when applying dynamic modular analysis?)
    - Research frequently looks at differences between health patients and diseased patients, but is there a difference between healthy ones of different sex?

**Question:** Does Renaud have any ideas of how to approach the question?

**Possible starting point:** Module allegiance matrix as found in Karolina Finc's paper "Dynamic reconfiguration of functional brain networks during working memory training" (https://www.nature.com/articles/s41467-020-15631-z - see page 16/17, code found on GitHub https://github.com/kfinc/wm-training-modularity)

**Patient brain data**

- The brain activity data (MEG data) is in the form of time series - Camille has pre-processed data for two subjects
- 1 matrix for each of the 6 functional bands, for each of the 28 time frames for each patient. The functional bands are considered independent
- They have currently performed static analysis but want to find a way to represent the network changing over time, as they realise the brain changes over time (even in resting state - which this data is from)

**Analysis to perform**

- The goal is to use dynamic modular analysis to create a time variable view (i.e. view fluctuations over time)
- They want to compare health patients vs patients with chronic pain
    - They can't share patient data for chronic pain patients, but healthy data is public

**PowerPoint shared by Camille**

- Camille has has performed some initial analysis - see slide 10 of attached Camille PowerPoint
    - 'Multi-layer community detection', where the time series is split into slices and you assess each layer in conjunction with the previous layer (community assignment etc.)

    - Second method uses Hidden Markov Models - Mark Woolwich

**Other work to check out**

- Dimitri Van Der Ville - Camille will share a PowerPoint
    - He split time series into layers, made a matrix for each one and applied modular detection. Used multislice graph where nodes of subsequent time frames are connected
- Karolina Flic (with Danielle bassett) - Camille shared the Github location where the code can be found for the paper “Dynamic reconfiguration of functional brain networks during working memory training”
    - Github link: https://github.com/kfinc/wm-training-modularity
    - Link to paper: https://www.nature.com/articles/s41467-020-15631-z
    - Some of these MATLAB scripts may have been developed with Renaud?
- Camille will share some other papers to have a look through