

# Counting Temporal Classes in a RS- fMRI Data

## Exploring Volumes Organization

Alberto Arturo Vergani

Middlesex University London, Department of Computer Science

a.vergani@mdc.ac.uk

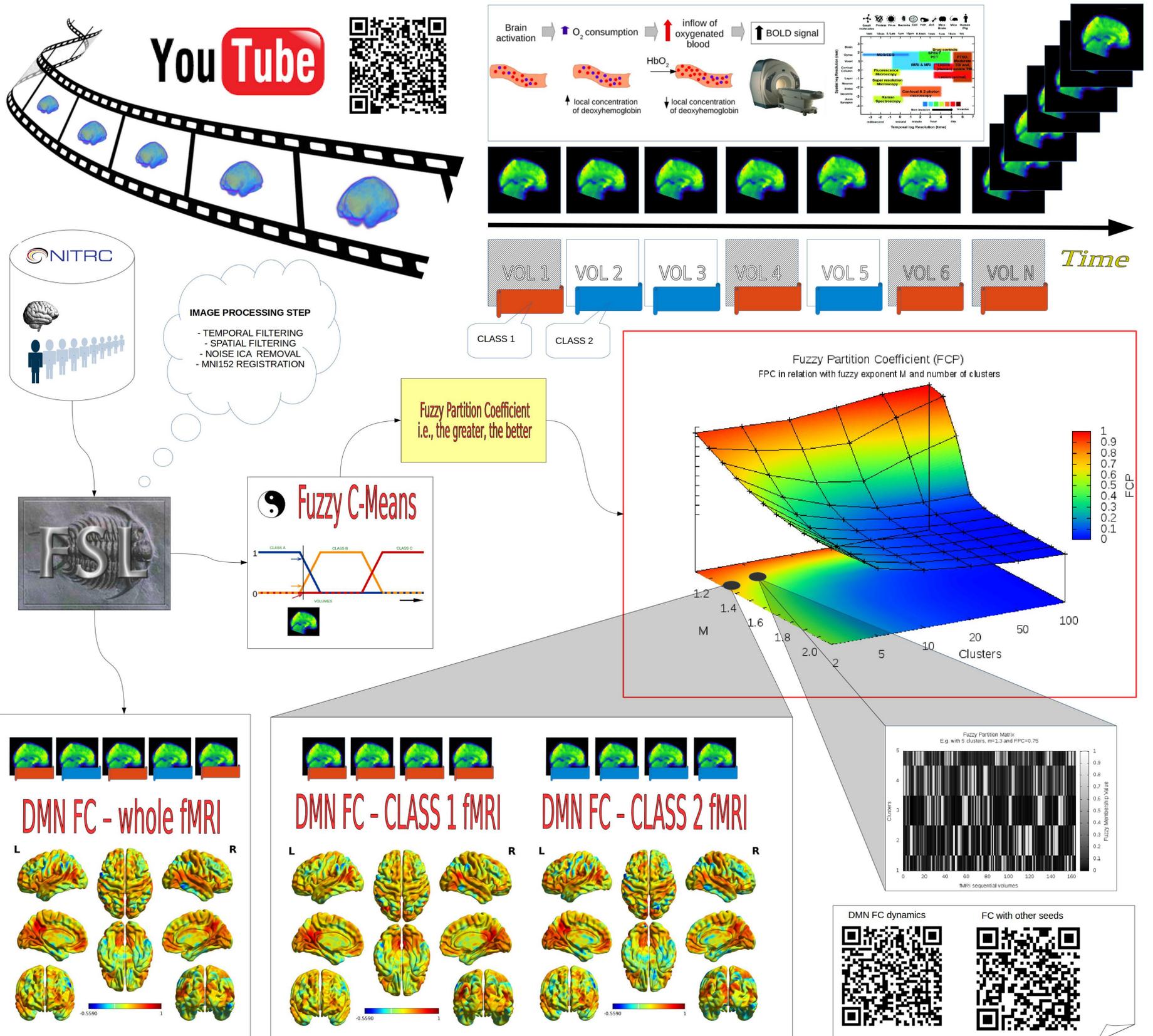


### Highlights

- The RS-fMRI data is about one subject (Female, 31 years-old, healthy, [3]).
- Fuzzy C-Means clustering algorithm [1] is evaluated by the Fuzzy Partition Coefficient [4]
- There is the assumption that a fMRI sequence of volumes has classes.
- The number of optimal temporal classes is within 2-5 range.

### Key-words

- RS-fMRI is a functional passive paradigm in which subject does nothing in the scanner [2].
- Temporal clustering is the partition of the fMRI volumes in classes [5].
- The fMRI temporal class is a set of clustered volumes.
- Fuzzy C-Means clustering algorithm finds classes by using many-values logic framework [1].



### Some formalities ...

The FCM minimizes the following objective function  $J_m$ :

$$J_m = \sum_{i=1}^N \sum_{j=1}^C u_{ij}^m \|x_i - c_j\|^2 \quad \text{with } 1 \leq m \leq \infty \quad (1)$$

where  $u_{ij}$  and  $c_j$  are:

$$u_{ij} = \frac{1}{\sum_{k=1}^C \left( \frac{\|x_i - c_j\|}{\|x_i - c_k\|} \right)^{\frac{2}{m-1}}} \quad \text{and} \quad c_j = \frac{\sum_{i=1}^N u_{ij}^m \cdot x_i}{\sum_{i=1}^N u_{ij}^m} \quad (2)$$

The Functional Connectivity is computed with  $CC_{Pearson} = \frac{COV(X,Y)}{SD(X) \cdot SD(Y)}$

### References

- [1] James C Bezdek, Robert Ehrlich, and William Full. Fcm: The fuzzy c-means clustering algorithm. *Computers & Geosciences*, 10(2-3):191–203, 1984.
- [2] BB Biswal, M Mennes, X Zuo, S Gohel, C Kelly, Steve M Smith, Christian F Beckman, J S Adelstein, RL Buckner, S Colcombe, et al. Toward discovery science of human brain function. *Proceedings of the National Academy of Sciences*, 107(10):4734–4739, 2010.
- [3] David N Kennedy, Christian Haselgrove, Jon Riehl, Nina Preuss, and Robert Buccigrossi. The nitrc image repository. *Neuroimage*, 124:1069–1073, 2016.
- [4] E Trauwaert. On the meaning of dunn's partition coefficient for fuzzy clusters. *Fuzzy sets and systems*, 25(2):217–242, 1988.
- [5] AA Vergani, S Martinelli, and E Binaghi. Clustering functional mri patterns with fuzzy and competitive algorithms. In *International Symposium Computational Modeling of Objects Represented in Images*, pages 129–144. Springer, 2018.