"Information flow in the brain: shortcuts and bottlenecks"

Daniele Marinazzo
Ghent University, Belgium

Measuring directed interactions in the brain in terms of information flow is a promising approach, mathematically treatable and amenable to encompass several methods.

I will present two results obtained in this framework.

I will first present two simple dynamical network models which describe the limited capacity of nodes to process the input information. For a given range of the parameters, the information flow pattern is characterized by exponential distribution of the incoming information and a fat-tailed distribution of the outgoing information, as a signature of the law of diminishing marginal returns. The same analysis, applied to effective connectivity networks from human EEG signals, reveals that the incoming information is exponentially distributed whilst the outgoing information shows a fat tail. This suggests that overall brain effective connectivity networks may also be considered in the light of the law of diminishing marginal returns.

I will then propose a formal expansion of the transfer entropy to put in evidence irreducible sets of variables which provide information for the future state of each assigned target. Multiplets characterized by a large contribution to the expansion are associated to informational circuits present in the system, with an informational character (synergetic or redundant) which can be associated to the sign of the contribution.