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Information transfer in the brain: Insights from a unified approach

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

I will present two results obtained in this framework. I will first show how implementing simple dynamical models on different architectures will reveal 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.

A similar behavior is observed when dynamical models are implemented on the human connectome structural matrix and in EEG recordings. 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.

This approach allows an efficient and reliable reconstruction of directed networks and reveals specific patterns of informative multiplets in different physiological states.

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References

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