**Reading Notes: Nicholas Timme, Wesley Alford, Benjamin Flecker, and**

**John M. Beggs (2014). Synergy, redundancy, and multivariate information**

**measures: an experimentalist’s perspective, J Comput Neurosci 36:119–140**

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**Summary**

In this paper, the authors provide an overview on existing methods to calculate discrete information measures from multivariate data, with a special focus on measures to quantify synergy and redundancy. Measures for uni- and bivariate data are not covered, as they have been extensively covered in the literature, and are generally agreed on in terms of their interpretation, which is not the case for multivariate data. Hence this paper. After an introduction on general properties of information measures, the authors introduce the terms "synergy" (information that is only available if several variables are known together) and "redundancy" (information that is available in any of several variables), which, despite a straightforward definition in colloquial terms have to date no single agreed-upon definition in rigorous mathematical terms. The authors then list and describe various multivariate information measures, sorted by measures for groups of variables, and groups of variables and a separate target variable.

For information in groups of variables about themselves, they describe multivariate mutual information (which requires grouping the variables into at most two sets of variables), interaction information (which assumes that synergy and redundancy are two mutually exclusive qualities of a data-relations, which is later, when the concept of partial information decomposition is introduced, shown to be wrong), total correlation, and dual total correlation.

For information in groups of variables about a target variable, they describe ΔI, the redundancy-synergy index, Varadan's synergy and, importantly, partial information decomposition.

The authors then illustrate the various measures, their commonalities and differences, at various examples, from simple logical gates and simple network models to real-world data from the neurosciences.

**How this might be useful**

* This is a very readable and comprehensive overview (especially Table 8) on multivariate information measures, suitable for newcomers and experts alike, which very nicely explains the commonalities among and (sometimes subtle) differences between various information measures. This helps to decide which measure to take for a task at hand, and it supports cautious use and comparison of information measures.