Balduzzi, David

On the information-theoretic structure of distributed measurements. (English)


Summary: The internal structure of a measuring device, which depends on what its components are and how they are organized, determines how it categorizes its inputs. This paper presents a geometric approach to studying the internal structure of measurements performed by distributed systems such as probabilistic cellular automata. It constructs the quale, a family of sections of a suitably defined presheaf, whose elements correspond to the measurements performed by all subsystems of a distributed system. Using the quale we quantify (i) the information generated by a measurement; (ii) the extent to which a measurement is context-dependent; and (iii) whether a measurement is decomposable into independent submeasurements, which turns out to be equivalent to context-dependence. Finally, we show that only indecomposable measurements are more informative than the sum of their submeasurements.

For the entire collection see [Zbl 1445.68018].

MSC:

94A15 Information theory (general)
18F20 Presheaves and sheaves, stacks, descent conditions (category-theoretic aspects)
37A50 Dynamical systems and their relations with probability theory and stochastic processes
37B15 Dynamical aspects of cellular automata
60B20 Random matrices (probabilistic aspects)

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