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Distinguishing classically indistinguishable states and channels

For a given classical n-point probability vector p we describe the set of pure quantum states of order n which decohere to p. In particular, we analyze the question, how many mutually orthogonal quantum states decohere to the given classical state p. In other words, we ask, how many quantum states can be perfectly distinguished, eventhough their classical counterparts are indentical and thus indistinguishable. A similar problem can also be posed for channels: For a given classical map corresponding to a stochastic transition matrix T we look for quan- tum channel Φ, which induces the same classical transition matrix T , but is ”more coherent”. To quantify the coherence of a channel Φ we measure the coherence of the corresponding Jamiolkowski state J\_Φ. We show that a classical transition matrix T can be coherified to a reversible unitary dynamics if and only if T is unistochastic. Otherwise the Jamiolkowski state J\_Φ of the optimally coherified channel is mixed, and the dynamics must necessarily be irreversible. We find optimal coherifications for all one-qubit channels and provide a non-optimal coherification procedure that works for an arbitrary quantum channel and reduces its rank (i.e. the minimal number of required Kraus operators) from n^2 to n.

References

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