Other

Renyi Generalizations of the Conditional Quantum Mutual Information

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Abstract:

The conditional quantum mutual information I(A;B|C) of a tripartite quantum state on systems ABC is an information quantity which lies at the center of many problems in quantum information theory. Three of its main properties are that it is non-negative for any tripartite state, that it decreases under local operations applied to systems A and B, and that it obeys the duality relation I(A;B|C)=I(A;B|D) for a four-party pure state on systems ABCD. It has been an open question to find Renyi generalizations of the conditional mutual information, that would allow for a deeper understanding of the original quantity and find applications beyond the traditional memoryless setting of quantum information theory. The present paper addresses this question, by defining different Renyi generalizations of the conditional mutual information that all converge to the conditional mutual information in a limit. Furthermore, we prove that many of these generalizations satisfy the aforementioned properties. As such, the quantities defined here should find applications in quantum information theory and perhaps even in other areas of physics, but we leave this for future work. We also state a conjecture regarding the monotonicity of the Renyi conditional mutual informations defined here with respect to the Renyi parameter. We prove that this conjecture is true in some special cases and when the Renyi parameter is in a neighborhood of one. Finally, we discuss how our approach for conditional mutual information can be extended to give Renyi generalizations of an arbitrary linear combination of von Neumann entropies, particular examples including the multipartite information and
the topological entanglement entropy. This is joint work with Mario Berta (Caltech) and Kaushik Seshadreesan (LSU). This is based on the recent paper available at http://arxiv.org/abs/1403.6102

Speaker's Bio:

Mark M. Wilde is an assistant professor at LSU, holding a joint appointment in the Department of Physics and Astronomy and CCT. He received his PhD in electrical engineering from the University of Southern California, Los Angeles, California, in 2008. Before joining LSU, he was a postdoctoral fellow at the School of Computer Science, McGill University, Montreal, Quebec, Canada. He has published over 60 articles and preprints in the area of quantum information processing, and he is the author of the text "Quantum Information Theory," published by Cambridge University Press. His research interests are in quantum information theory, quantum error correction, quantum computational complexity theory, and quantum optics with applications to quantum communication.

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