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Recovery map stability for the Data Processing Inequality

The Data Processing Inequality (DPI) states that the Umegaki relative entropy is non-increasing under the action of completely positive trace preserving (CPTP) maps. A theorem of Petz says that there is equality in DPI if and only if both states can be recovered perfectly after passing through a CPTP map. Such recovery map is called Petz recovery map. A standing problem is to obtain a proper lower bound on the difference between relative entropies of input and output states. We provide a quantitative version of Petz's theorem, where the lower bound contains a distance between a state and its Petz's recovered state. The novelty of the result is that for the first time the distance measure contains the original Petz recovery map. Moreover, I will present stability bounds for the quasi-relative entropies defined in terms of an operator monotone decreasing functions, which also includes the distance measure of the state and its Petz's recovered state. The present treatment is developed in the context of finite dimensional von Neumann algebras where the results are already non-trivial and of interest in quantum information theory. (*Joint work with Eric A. Carlen)*