Nonextensive entropies from information content and stabilities

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The present developments on a nonextensive entropy in physics force us to revisit the issue on an appropriate nonextensive form of information entropy which is consistent with the source coding theorem and the channel capacity. We can not proceed the formal generalization only in physics by ignoring this consistency with Shannon’s information theory. We have still no adequate understanding and lack awareness.

In this presentation, we show that we can construct nonextensive entropies from a self information under some constraints[1]. Since a self information is a fundamental quantity to construct an entropy in information theory, this consideration may give an insight into connection to coding scheme. As an example, Tsallis nonextensive entropy can be seen as a consequence of the constant ratio of the first derivative of a self-information per unit probability to the second variation of it. If we regard the probability distribution as the gradient of a self-information, this constancy holds. By considering the form of the nth derivative of a self-information with keeping this constant ratio, we arrive at the general class of nonextensive entropies.

Another point which deserves presenting is the issue of a stability of entropies constructed. We reconsider a stability property known as the Lesche condition in the literature which has been used for supporting validity of a generalized entropy over the others in recent papers. We show that a local stability analysis for the generalized entropies does not lead to the same conclusion as the one derived from the Lesche condition[2, 3]. In stead of putting much emphasis on the criterion in the sense of Lesche we expect that the validity of a generalized entropy lies in the information theory.