On the Injective Norm of Random Tensors and Quantum States

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The injective norm is a natural generalization to tensors of the operator norm of a matrix. In quantum information, the injective norm is one important measure of genuine multipartite entanglement of quantum states, where it is known as the geometric entanglement. In this paper, we give a high-probability upper bound on the injective norm of real and complex Gaussian random tensors, corresponding to a lower bound on the geometric entanglement of random quantum states, and to a bound on the ground-state energy of a particular multispecies spherical spin glass model. For some cases of our model, previous work used ε -net techniques to identify the correct order of magnitude; in the present work, we use the Kac–Rice formula to give a one-sided bound on the constant which we believe to be tight.

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