

Entropy and random feedback

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Chapter 15 of *Open Problems in Mathematical Systems Theory and Control*, edited by V. Blondel, E. Sontag, M. Vidyasagar, and J. Willems, Springer-Verlag, pp.71-74, 1999.

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The gamma-entropy is a convex function of matrices that is closely related to the Frobenius and spectral (maximum singular value) norms. It comes up in several applications such as central H-infinity control and interior-point optimization with matrix norm constraints. In the book *Linear Controller Design: Limits of Performance*, Boyd & Barratt gave an interesting interpretation of the gamma-entropy of a scalar as the mean-square value of the closed-loop gain of a system with random feedback which is uniformly distributed on a disk of radius gamma. In this short note the gamma-entropy is defined, the basic inequalities are reviewed, and the following open problem is given: find a distribution on matrices such that the gamma-entropy is the mean-square value of the Frobenius norm of the closed-loop matrix, with random feedback matrix chosen from the given distribution.

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