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# Local Shannon entropy measure with statistical tests for image randomness

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## Abstract

In this paper we propose a new image randomness measure using Shannon entropy over local image blocks. The proposed local Shannon entropy measure overcomes several weaknesses of the conventional global Shannon entropy measure, including unfair randomness comparisons between images of different sizes, failure to discern image randomness before and after image shuffling, and possible inaccurate scores for synthesized images. Statistical tests pertinent to this new measure are also derived. This new measure is therefore both quantitative and qualitative. The parameters in the local Shannon entropy measure are further optimized for a better capture of local image randomness. The estimated statistics and observed distribution from 50,000 experiments match the theoretical ones. Finally, two examples are given, applying the proposed measure to image randomness among shuffled images and encrypted images. Both examples show that the proposed



method is more effective and more accurate than the global Shannon entropy measure. (C) 2012 Elsevier Inc. All rights reserved.

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