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# Bi-dimensional Multiscale Entropy: Relation with Discrete Fourier Transform and Biomedical Application

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## Abstract

The multiscale entropy ( $MSE_{1D}$ ) measure is now widely used to quantify the complexity of time series. The development of complexity measures for images is also a long-standing goal. Recently, the bi-dimensional version of  $MSE_{1D}$  has been proposed ( $MSE_{2D}$ ) to analyze images. The interpretation of  $MSE_{2D}$  curves and the applications to real data are still emergent. Because the coarse-graining step in the  $MSE_{2D}$  computation changes the frequency content of the image, we hypothesized a possible dependence between  $MSE_{2D}$  and the discrete Fourier transform (DFT). To analyze this dependence, synthetic as well as biomedical images are analyzed. Our results reveal that i) the profile of  $MSE_{2D}$  is sensitive to both the amplitude and phase of the DFT; ii)  $MSE_{2D}$  could find applications in the biomedical field. This work brings valuable information for  $MSE_{2D}$  interpretation and opens possibilities to study images from an entropy point of view through spatial scales.

*Keywords:*

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