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Estimation of fractal dimension in radiographs

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Abstract

In the last decade, the fractal dimension has become a popular parameter to characterize image textures. Also in radiographs, various procedures have been used to estimate the fractal dimension. However, certain characteristics of the radiographic process, e.g., noise and blurring, interfere with the straightforward application of these estimation methods. In this study, the influence of quantum noise and image blur on several estimation methods was quantified by simulating the effect of quantum noise and the effect of modulation transfer functions, corresponding with different screen –film combinations, on computergeneratedfractalimages. The results are extrapolated to explain the effect of film-grain noise on fractal dimension estimation. The effect of noise is that, irrespective of the noise source, the fractal dimension is overestimated, especially for lower fractal dimensions. On the other hand, blurring results in an underestimation of the dimensions. The effect of blurring is dependent on the estimation method used; the dimension estimates by the power spectrum method are lowered with a constant value, whereas the underestimation by the methods working in the spatia domain is dependent on the given dimension. The influence of the MTF and noise on fractal dimension estimation seriously limits the comparability of fractal dimensions estimated from radiographs which differ in noise content or MTF. Only when the power spectrum method is used, it is possible to correct for the influence of different MTFs of screen–film combinations. It is concluded tha only when using the same object–focus distance, the same exposure conditions, the same digitizer at the same resolution, can fractal dimensions as estimated in radiographs be reliably compared.

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