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Fractal analysis in irregular regions of interest

Fractals have been successfully applied in many areas of science and technology. One of the most prominent applications is fractal analysis in medicine, especially in analyses of different kinds of images. For medical images diagnostically important information often lies in the texture. Fractal dimension may be used as an index of irregularity. In this paper we describe the application of the intensity difference scaling method for assessment of the fractal dimension in the irregular regions of interest (irregular ROI-s). Near boundary between different tissues or structures the values of fractal dimensions changed significantly. The values of fractal dimensions were calculated on synthetic fractal textures which ranged in fractal dimension from 2.05 to 2.95 (2.05, 2.10, 2.20, 2.30, 2.40, 2.50, 2.60, 2.70, 2.80, 2.90, 2.95). For each value of fractal dimension thirty 64-by-64 images were obtained. The mean squared error (MSE) for the 330 samples for each algorithm was assessed. We tested 7 methods of computing of fractal dimension of surfaces: rectangular prism surface area method (MSE = 0.0054), triangular prism surface area method (MSE = 0.0098), power spectral density method (MSE = 0.0241), method based on mathematical morphology (MSE = 0.0093), variogram analysis (MSE = 0.0054), intensity difference scaling method (MSE = 0.0020), and our adaptation of intensity difference scaling method in irregular ROI-s (MSE = 0,0017). Our experiments for dental radiovisiographic images, pantomograms and nuclear medicine scans showed that it is difficult to fit the entire regular region of interest within the examined organ with simultaneous inclusion of the relevant fragment avoiding the influence of boundaries and other kinds of unnecessary structures at the same time. Our method of assessment of fractal dimension in irregular regions of interest solves these difficulties.