Statistical image analysis and percolation theory

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Abstract:
We develop a novel statistical method for detection of signals and reconstruction of images in the presence of random noise. The method uses results from percolation and random graph theories. We specifically address the problem of detection of objects with unknown shapes in the presence of strong nonparametric noise. The noise density is assumed to be unknown and can be very irregular.

We view the object detection problem as a nonparametric hypothesis testing problem within the class of discrete statistical inverse problems. We present an algorithm that allows to detect objects of various shapes in noisy grayscale images. The algorithm substantially differs from wavelets-based algorithms (see Arias-Castro et.al. (2005)). We prove results on consistency and algorithmic complexity of our procedures.

Keywords:
Image analysis; signal detection; nonparametric noise; percolation; noisy image.

References:
Arias-Castro, E. and Donoho, D. and Huo, X. (2005). Near-Optimal Detection of Geometric Objects by Fast Multiscale Methods, *IEEE Trans. Inform. Theory 51*, no. **7**, 2402-2425.