The University of Chicago
Department of Statistics

The Bahadur Memorial Lectures

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On the Peculiar Statistics of Natural Images

THURSDAY, May 8, 2008, at 4:00 PM at
133 Eckhart Hall, 5734 S. University Avenue

Refreshments will be served in Eckhart 110.

ABSTRACT

Take a digital photo of a natural outdoor scene. For simplicity, convert the photo from color to black and white. The photo can be reduced, or scaled, to make a new (smaller) picture, say half the size in both dimensions. The new picture is of a scene in which each of the original objects, and in fact every imaged point, has been relocated twice as far from the camera. This "stretching" is artificial in that it does not correspond to any movement of the camera in the real world. Yet the picture looks perfectly normal, and the local spatial statistical structure (e.g. the distribution of values of horizontal or vertical derivatives) is largely indistinguishable from the local spatial statistical structure of the original. "Images of natural scenes are scale invariant." On the other hand, mathematical models of images, or more generally of spatial processes, are never scale invariant unless they are trivial (constant gray level, i.e. blank pictures) or exotic (lacking a direct definition in terms of image intensities). The source of scale invariance in natural images is an enduring mystery. I will propose some explanations and make some connections to perception and image coding.