AbstractID: 7079 Title: Exploring the Effects of Photon Density and Object Size on Resolution using a Statistical Star Pattern

Purpose: Critical elements in the visual resolution of small objects are object size, contrast and statistical noise. The purpose of this study is to explore the relationship between the limit of resolution, object size and noise under conditions of high contrast using a statistical star phantom.

Method and Materials: In order to demonstrate the effects of photon density and spacing on resolution, software was written which generates a statistical star pattern, similar in form to the star phantoms used to determine focal spot size on x-ray machines. Initially, the viewer sees a black background on the monitor. After starting, randomly selected pixels are lit (representing photons) and a random pattern within a circular region appears. As the photon count increases, the spokes of the pattern begin growing out of the randomness from the edge of the region toward the center. The user may stop the process at any time, display a concentric ring, and alter its size to indicate the perceived limit of resolution.

Results: As the pixels light up, the pattern appears random and the radius of perceived order extends all the way to the border. At the limit of high density, the radius of perceived order is at its lower limit, due to the resolution of the monitor. In between, however, the radius appears to be inversely proportional to the number of lit pixels in the region. More specifically, the product of the number of photons, the radius of perceived order and the angle between the spokes of the star phantom is a constant. This is consistent with the Rose model of visual perception.

Conclusion: The statistical star pattern developed for this project demonstrates and quantifies, in a continuous fashion, the effect of photon density and object size on resolution.