Abstract

Predictions of Visual Performance from the Statistical Properties of Natural Scenes

Biologists and psychologists have long understood that there should be a tight relationship between the design of an organism’s sensory circuits, the organism’s natural tasks, and the stimulus properties relevant to those tasks. In the past two decades advances in physical measurement technology, computational power and statistical modeling have made it possible to begin exploring this relationship in detail. In this talk I will briefly summarize our recent efforts to determine what stimulus features are optimal for performance in specific visual tasks, how those features should be combined to optimally perform those tasks, and how human performance compares with optimal performance. Our methods for determining optimal stimulus features and performance are based on Bayesian statistical decision theory. Our results suggest that quantitative analysis of the natural scene statistics relevant for natural tasks can provide novel quantitative predictions of visual performance and deep insight into the design of the visual system.

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