Low-level Fixation Search in Natural Scenes by Optimal Extraction of Texture-Contrast Information

Raghu G. Raj Department of Electrical and Computer Engineering, University of Texas at Austin, USA
Alan C. Bovik Department of Electrical and Computer Engineering, University of Texas at Austin, USA
Lawrence K. Cormack Department of Psychology, University of Texas at Austin, USA

Abstract

We construct the beginnings of a low-level theory of visual fixations in natural scenes by the formulation and verification a Barlow-type hypothesis for fixation selection—where the fixation patterns are designed to maximally contrast and textural information. We first briefly overview optimum contrast-based fixation strategies in natural scenes [1] and thereafter develop an optimum texture-based fixation selection algorithm based on our computational theory of non-stationarity measurement in natural images. In particular it is shown how a simple relative coding error measure between sub-patches of a window (that defines the image scale of analysis) can effectively measure the non-stationary structure of natural scenes which subsequently can be employed for the optimal extraction of textural information. Finally we propose a simple coupling of the optimal texture-based and contrast-based fixation algorithms which exhibits robust performance for fixation selection in natural images. The performance of the fixation algorithms are evaluated for natural images by comparison to actual human fixations performed on the images. The fixation patterns thus obtained outperform randomized, Gaffe-based [2], and Itti [3] fixation strategies in terms of matching human fixation patterns in terms of mutual information. These results also demonstrate the important role that contrast and textural information play in low-level visual processes in the HVS.

History

Citation

[1] R.G. Raj, W.S. Geisler, R.A. Frazor, and A.C. Bovik, "Contrast statistics for foveated visual systems: Fixation selection by minimizing contrast entropy," *J. Opt Soc Amer A,* vol. 22, pp. 2039-2049, Oct 2005.
[2] U. Rajashekar, I. van der Linde, A.C. Bovik, and L.K. Cormack, "GAFFE: A gaze-attentive fixation finding engine," *IEEE Trans Image Processing*, to appear, 2008.
[3] L. Itti, C. Koch, A saliency-based search mechanism for overt and covert shifts of visual attention, *Vision Res,* vol. 40, no. 10-12, pp. 1489-1506, May 2000.

Keywords
Texture, Contrast, Natural Scene Statistics, Human Visual System, Visual Information, Fixation selection, Psychophysics.

On-Line Presentation
None