AbstractID: 3881 Title: Bandpass observer detection mechanisms in structured noise

Purpose:

The use of medical images to detect and classify disease involves interpretation of images with spatially correlated variability. These variations can arise from physical processes in detection such as electronic and quantum noise, from patient to patient variability (often referred to as "patient structured" or "anatomical" noise), and from image processing algorithms such as image reconstruction and contrast enhancement. A number of linear observer models have been suggested as predictive of human observer performance for the purposes of optimizing imaging systems for diagnostic performance in noise limited tasks. We investigate some of these models in three simple detection tasks in Gaussian textures with lowpass, highpass, and uncorrelated (white) power spectra.

Method and Materials:

We use a recently developed methodology to directly estimate a linear observer template in two-alternative forced-choice (2AFC) detection tasks with white noise, lowpass noise, and highpass Gaussian noise. In all cases the signal to be detected was a small Gaussian "lesion". After training, three human observers participated in the studies which involved 2,000 2AFC trials per condition.

Results:

The observed linear templates exhibit a bandpass structure in all cases. The peak of the spatial frequency band used by observer's shifts under different correlation structures. Various models, including Hotelling, Channelized Hotelling, Nonprewhitening, and Eye-filtered Nonprewhiteing models were compared to the human observer data.

Conclusion:

Human observers adopt different visual strategies in response to the correlation structure of images that is reasonably well modeled as a bandpass filter. Many suggested models of detection performance do not fully capture this filter.

Conflict of Interest (only if applicable):

None.