CLASSIFICATION IMAGES FOR MOTION PERCEPTION

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We used variants of the classification image paradigm to reveal possible features and strategies used by observers in a simple motion detection (no motion versus rightward motion) and a motion discrimination (leftward versus rightward) task. In the classification image paradigm, observers judge the presence or absence of a target embedded in relatively high-amplitude noise, and properties of the noise that cause correct and incorrect responses reveal the mechanisms responsible for detection [Beard and Ahumada, 1998]. In our experiments, the stimulus consisted of a signal, a moving, temporally windowed luminance increment, embedded in dynamic white noise. The observers' task on each trial was thus similar to determining whether there was a bright spot moving rightward across a detuned television set (motion detection), or determining whether the spot moved rightward or leftward across a detuned television set (motion discrimination). For each experiment, the noise (only) components of the stimuli were sorted into four groups based on signal detection theory. For the detection task, these were hits, misses, false alarms, and correct rejections. For the discrimination task, these were S_rR_r (stimulus rightward, response rightward), S_lR_l, S_rR_l, and S_lR_r. Averaging the noise within the various response conditions revealed the linear contribution of each pixel (in space and time) to the observers' response. Qualitatively, a movie of the average noise (only) from the hit and miss conditions clearly revealed motion along the stimulus trajectory, indicating that the technique can be used to probe mechanisms of motion perception.

More quantitative analyses were done in both the 2D space-time and spatio-temporal frequency planes. This was accomplished by extracting 2D slices (representing time and the horizontal spatial dimension) of noise from each of the 3D noise samples (thus the vertical spatial dimension, which was irrelevant to the task, was ignored). The results from both experiments indicate the use of a motion template which was closely aligned with the stimulus trajectory. In general, the center of the trajectory (as opposed to the onset or offset) was weighted most heavily. In the second experiment, rightward motion was weighted more heavily than leftward motion, which could represent a strategy common to both observers rather than an asymmetry in sensitivity. Most interestingly, both experiments revealed templates which were close to but not exactly aligned with the velocity of the stimulus, which probably does not reflect a conscious response strategy but rather a property of the motion system or the interaction of the stimulus noise with this system.

Reference:

B.L. Beard, A.J. Ahumada, Jr., **Technique to extract relevant image features for visual tasks**, in Human Vision and Electronic Imaging III, ed. B.E. Rogowitz and T.N. Pappas, Proc. Vol., 3299, pp.79-85, SPIE, San Jose, CA, 1998.