National Aeronautics and Space Administration

technology opportunity

# SPATIAL STANDARD OBSERVER

A Tool to Measure Visibility in Tasks, Displays, and Interfaces

An unmanned aerial vehicle (UAV) can use spatial standard technology to obtain clearer images on missions that are then relayed back to central command.

The Spatial Standard Observer (SSO) was developed to predict the detectability of spatial contrast targets such as those used in the ModelFest project. The SSO is a lumped parameter model basing its predictions on the visible contrast generalized energy. Visible contrast means that the contrast has been reduced by a contrast sensitivity function (CSF). Generalized energy means that the visible contrast is raised to a power higher than 2 before spatial and temporal integration. To adapt the SSO to predict the effects of variations of optical image quality on tasks, the optical component of the SSO CSF needs to be removed, leaving the neural CSF. Also, since target detection is not the typical criterion task for assessing optical image quality, the SSO concept needs to be extended to other tasks, such as Sloan character recognition.

## Benefits

- Satisfies an increasing need for a rapid, objective means of estimating degrees of visibility and discriminability of visual elements in scenes observed, not only by humans, but also by robotic vision systems, under a variety of circumstances
- Simple and efficient design that produces an accurate visibility metric with a relatively few calculations
- Avoids the need for complicated spatial frequency filter banks, with a corresponding gain in simplicity and computational efficiency
- Permits accurate visibility predictions of the visibility of oblique patterns such as half-toning and rasterizing artifacts
- Avoids the need for complicated spatial frequency filter banks, with a corresponding gain in simplicity and computational efficiency

## Applications

- Evaluating vision from unmanned aerial vehicles
- Predicting outcomes of corrective laser eye surgery
- Inspection of displays during the manufacturing process
- Estimation of the quality of compressed digital video
- Evaluation of legibility of text
- Predicting discriminability of icons or symbols in a graphical user interface
- Measuring visibility of damage to aircraft and to the shuttle arbiter

## Technology in Detail

The Spatial Standard Observer (SSO) provides a tool that allows measurement of the visibility of an element, or visual discriminability of two elements. The device may be used whenever it is necessary to measure or specify visibility or visual intensity. The SSO is based on a model of human vision, and has been calibrated by an extensive set of human test data. The SSO operates on a digital image or a pair of digital images. It computes a numerical measure of the perceptual strength of the single image, or of the visible difference between the two images. The visibility measurements are provided in units of Just Noticeable Differences (JND), a standard measure of perceptual intensity. A target that is just visible has a measure of 1 JND.

The SSO will be useful in a wide variety of applications, most notably in the inspection of displays during the manufacturing process. It is also useful in for evaluating vision from unpiloted aerial vehicles (UAV) (Figure 1), predicting visibility of UAVs from other aircraft, estimating visibility from the control tower of aircraft on runways, measuring visibility of damage to aircraft and to the shuttle orbiter, evaluation of legibility of text, icons or symbols in a graphical user interface, specification of camera and display resolution, inspection of displays during the manufacturing process, estimation of the quality of compressed digital video, and predicting outcomes of corrective laser eye surgery. NASA has applied for a patent on SSO technology.

## Patents

NASA has secured a patent for the Spatial Standard Observer (U.S. Patent No. 7,783,130). Reference No. ARC-14569

## Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to inquire about the licensing possibilities for the Spatial Standard Observer for commercial applications.

## For More Information

If you would like more information about this technology, please contact:

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