



## Introduction



The 3-D Computer-Automated Threshold Amsler Grid Test is a five-minute vision test using a laptop computer with a touch-sensitive screen that can help diagnose the onset of eye diseases and even certain types of brain tumors, both on Earth and in space.

With one eye covered, a person sits in front of a computer screen divided into a grid. The subject stares at a central spot on the touch-sensitive screen and, using a finger, outlines missing areas of the grid. The computer records, processes and displays a 3-D image of the subject's visual field. The test for each eye takes about 4 to minutes.

Below is a detailed technical description of this breakthrough technology, followed by a depiction of the examination setup and typical test results.

Click [HERE](#) for the official press release.

## Abstract

**Purpose:** Development and implementation of a computer-automated system for near threshold central visual field acquisition in establishing 3-D displays of (central) visual fields (hill-of-vision). The patient will indicate the visible perimeter of vision in a variety of contrast presentations. This will not only reveal relative as well as absolute scotomas but permit the calculation of the slope of the depression.

**Methods:** We have developed a computerized test program that displays an Amsler grid at a preselected greyscale level and

### Jointly developed by:

[Jet Propulsion Laboratory](#)

[California Institute of Technology](#)

[Doheny Eye Institute at the University of Southern California](#)

## Scientific Contact

Wolfgang Fink, PhD  
[Machine Learning Systems \(MLS\) Group](#)  
[Jet Propulsion Laboratory \(JPL\)](#)

Pasadena, California 91109,  
 USA

Fax: (818) 393-5244

also:

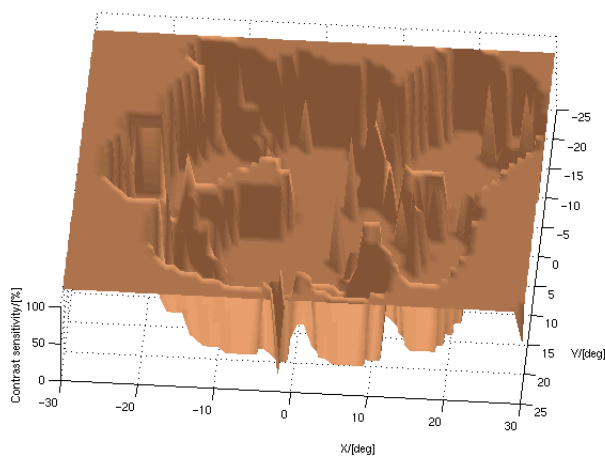
[W. K. Kellogg Radiation](#)

preselected angular resolution on a computer screen at a fixed distance. The patient, with the Troxler effect suppressed centrally, is able to mark the areas on the Amsler grid that are missing from his field of vision. The same procedure is then repeated at various greyscale levels - simulating increasing degrees of contrast - and the respective results are recorded and later automatically displayed by the computerized test program. A total of approximately 4-5 minutes per eye is required. With these results, a 3-D depiction of the (central) visual field is obtained, describing the location, extent, slope, depth, and shape of the scotomas.

**Conclusions:** This new, completely computer-based test, offers a novel method for evaluating the central visual field with the additional parameter of depth. This test provides several advantages over conventional perimetry including: 1) additional information through 3-D rather than 2-D depiction of scotomas, 2) superior angular resolution, and 3) direct patient interaction with a computerized system in a much shorter examination time.

## Depiction of Examination Results

### Optic Neuritis:



### Laboratory California Institute of Technology

Pasadena, California 91125,  
USA

Fax: (626) 564-8708

E-mail:  
[wolfgang.fink@jpl.nasa.gov](mailto:wolfgang.fink@jpl.nasa.gov)

Alfredo A. Sadun, MD PhD  
Doheny Eye Institute and  
Keck School of Medicine at

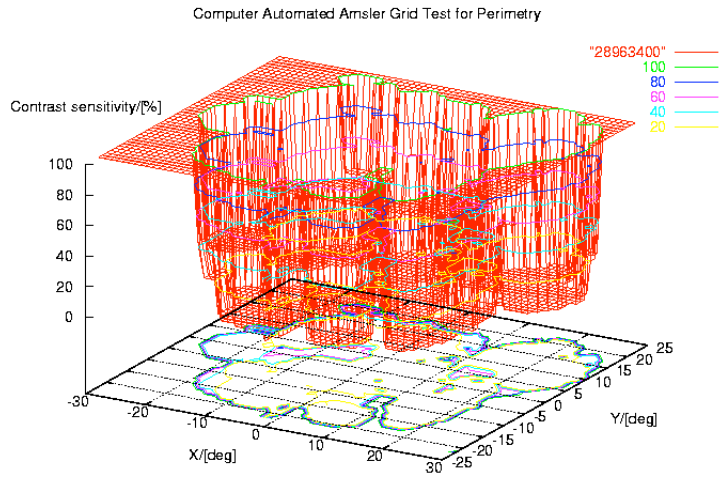
USC

Los Angeles, California  
90033, USA

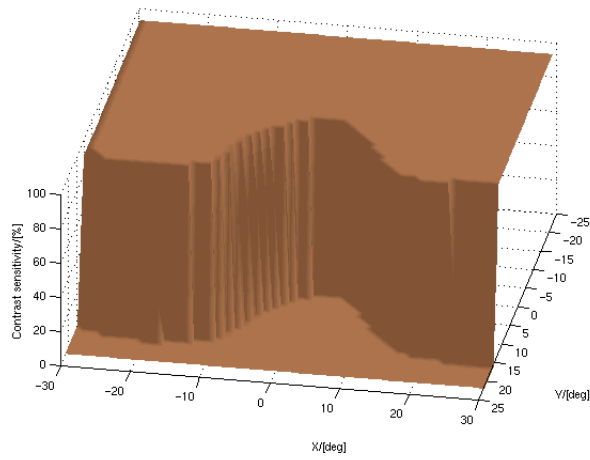
E-mail:  
[ASADUN@HSC.USC.EDU](mailto:ASADUN@HSC.USC.EDU)

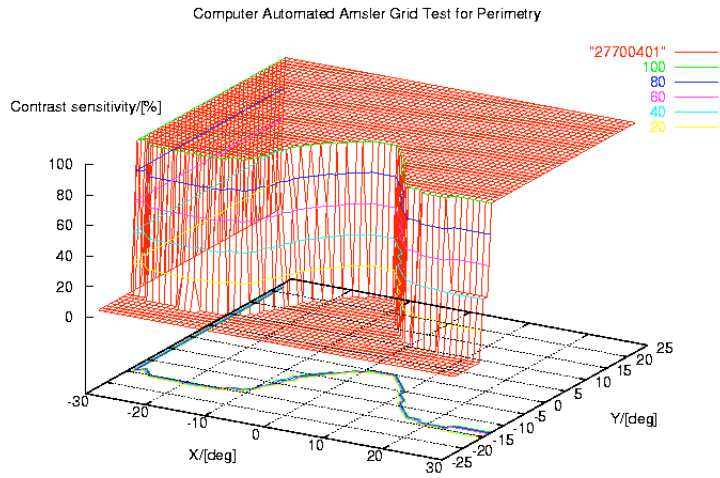
## Licensing Contact

Office of Technology  
Transfer at Caltech

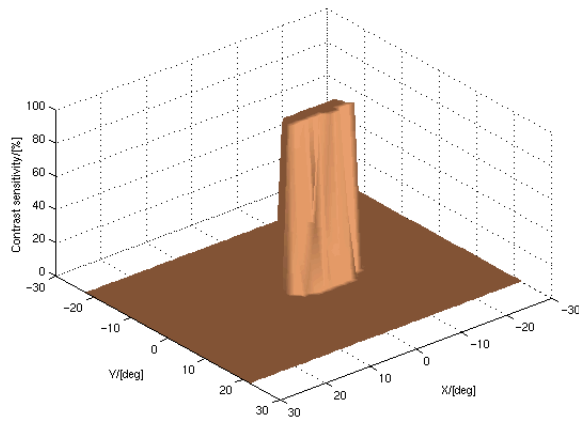


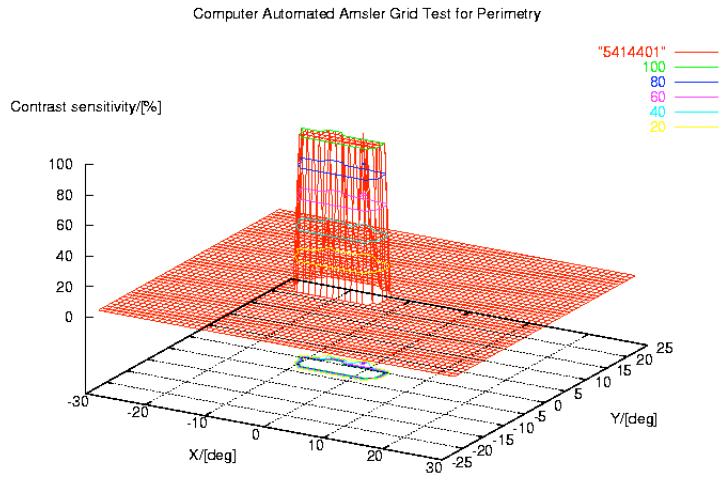
### Anterior Ischemic Optic Neuropathy (AION):



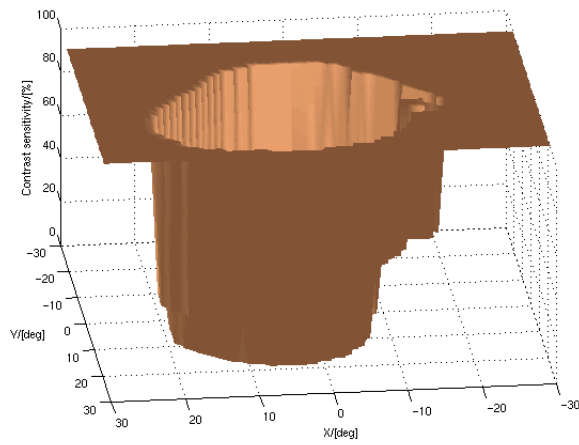


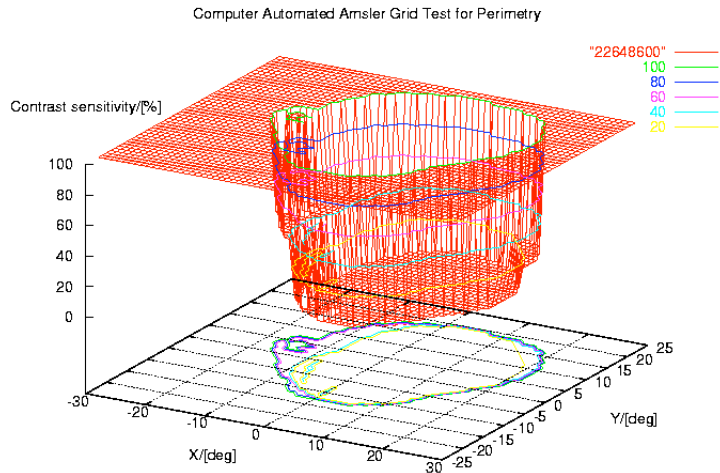
### Glaucoma:





## "Dry" Macular Degeneration:





## Method & Examination Procedure

The examination with our computerized test program should take place in a separate examination room with well-defined ambient brightness.

After dark adaptation the patient will be positioned in front of the computer monitor at a fixed distance - determining the angle of the visual field - by means of both a chin- and head-rest.

The eye not under examination will be totally covered with an eye-cover. If need be, a necessary refractive correction has to be applied by means of the patient's eye-glasses or contact lenses, or correction glasses.

Our computerized test program then displays an Amsler grid at a preselected greyscale level and preselected angular resolution on the computer screen.

The patient, with the Troxler effect suppressed centrally, is able to mark the areas on the Amsler grid that are missing from his field of vision. He does that by either circumscribing/outlining the missing areas (scotomas) directly on the touchscreen, by using a lightpen or similar pointing device. If necessary, a mouse or even the keyboard would work in lieu of a touchscreen.

The same procedure is then repeated at various greyscale levels - simulating increasing degrees of contrast (contrast sensitivity levels) - and the respective results are recorded and later automatically displayed by the computerized test program.

A total of approximately 4-5 minutes per eye is required. With these results, a 3-D depiction (hill-of-vision) of the (central) visual field is obtained, describing the location, extent, slope, depth, and shape of the scotomas.

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## Slide Show of Examination Device



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## Discussion

Conventional perimetry and even campimetry provides information pertaining to the borderline between seeing and non seeing areas. At most, in some forms of automated perimetry, a mean sensitivity to light within a scotoma is displayed. The present techniques, however, do not provide the extra information inherent in a region of visual depression that is available by our system: Our system displays the area of depression in X and Y axis (relative to visual fixation) but also, on the Z axis in regard to visual contrast sensitivity.

Not only does 3-D information permit further distinctions between certain visual disorders (ARMD might cause an absolute scotoma while macular edema only produces a relative scotoma) but the 3-D shape of each visual depression has the potential for

the development of a library of shapes and slopes that are likely to be signature patterns for various ophthalmological conditions. Our new, completely computer-based test, offers a novel method for evaluating the central visual field. This test provides several advantages over conventional perimetry including:

- additional information through 3-D (includes depth) rather than 2-D depiction of scotomas
- superior angular resolution
- direct patient interaction with a computerized system in a much shorter examination time
- use of regular computer equipment (no additional equipment necessary)
- distributability over the Internet
- interactive accessibility over the Internet
- portability via laptop
- software package can easily be updated/modified.

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