# Adaptive Optics Vision Analyzer: a visual optics lab in a box

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## Purpose

Many research and clinical applications in the area of visual optics are based in three key points: getting an objective characterization of the eye's optics, evaluating different psychophysics functions related to visual performance, and testing the adequacy of different optical solutions to improve vision. Here, we present a new instrument that offers advanced options for these three key capabilities. Voptica, a spin-off company emerging from the Laboratorio de Optica de la Universidad de Murcia (LO·UM), has developed the Adaptive Optics Visual Analyzer (AOVA) [1].

## Methods

Wave-front sensor technology [2] allows an accurate and objective characterization of the eye's optics. However, both researchers in visual optics and eye-care professionals agree that the accuracy provided by this technology should be ideally complemented with a subjective analysis of the subejct's visual performance. In fact, the current practice in eye-test examination mostly relies on the subjective evaluation of Visual Acuity (VA), and in some cases Contrast Sensitivity (CS). For addressing this situation, the AOVA combines advanced wavefront sensing with the complementary capability of performing a complete set of visual tests, including VA and CS, at different object-distances and, more important, under fully controlled optical conditions. This is achieved by using Adaptive Optics (AO) for correcting or manipulating the eye's optical properties [1]. The apparatus incorporates in a single box, a programmable phase modulator using liquid crystal on silicon (LCOS) technology for wavefront modification, a Hartmann-Shack wavefront sensor and a stimulus generator based on a high luminance micro display in order to perform visual testing through the modified optics.

## Results

The outcome of a battery of visual tests performed while the patient is seeing through an AO-induced optical element design can be used as a feedback to refine and customize the design. These tests can include particularly demanding visual conditions (night driving, near vision under low luminance, low contrast reading test, etc). By selecting a different battery of tests, adapted to the particular visual requirements of the patient, improved optical solutions can be fully personalized.

The AOVA opens many new possibilities to users. They can get access to new research lines in advanced and more sophisticated topics on visual optics, and its use at the clinic empowers the activity of the vision-care professional, providing a more accurate and a technologically upgraded eye-test procedure.

Voptica has developed a clinical prototype of the AOVA (Fig1). The accumulated know-how of the LO·UM in ocular optics, AO, visual simulation and psychophysics, is now all condensed inside this box. And while the technology inside is complicated, the outside look is similar to other instruments in the field and the operational modes are easy and user friendly.

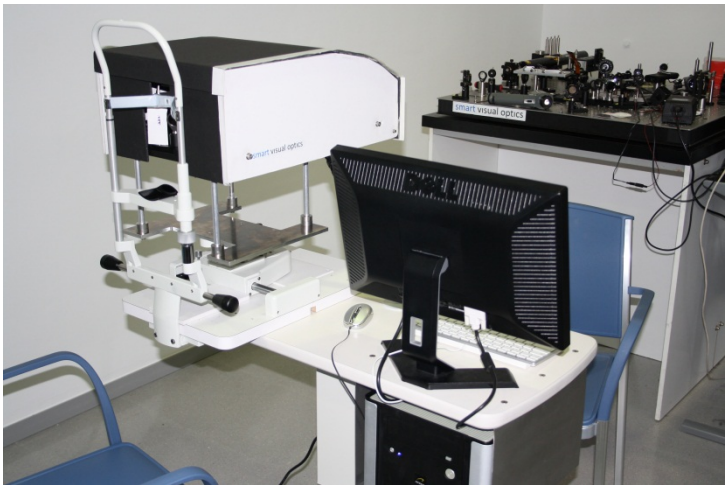


Fig. 1. AOVA prototype.

## Conclusions

The Voptica AOVA will allow researchers to devise and perform new experiments in visual optics [3-5] and, at the same time, it could become the new standard for vision testing in clinical settings.

## References

1. E. J. Fernández, S. Manzanera, P. Piers, P. Artal, "Adaptive optics visual simulator", J. Refrac. Surgery 18, 634-638 (2002).

2. P. M. Prieto, F. Vargas-Martín, S. Goelz, P. Artal, "Analysis of the performance of the Hartmann-Shack sensor in the human eye". J. Opt. Soc. Am. A, 17, 1388-1398 (2000).

3. S. Manzanera, P. M. Prieto, D. B. Ayala, J. M. Lindacher, P. Artal, “Liquid crystal adaptive optics visual simulator: application to testing and design of ophthalmic optical elements”. Opt. Express, 15, 16177-16188 (2007).

4. E. J. Fernández, P. M. Prieto, P. Artal, "Binocular adaptive optics visual simulator", Opt. Lett., 34, 2628–2630 (2009).

5. E. J. Fernández, P. M. Prieto, P. Artal "Adaptive optics binocular visual simulator to study stereopsis in the presence of aberrations", J. Opt. Soc. Am. A, 7, A48-A55 (2010).