Vision Correction in the Developing World
Perhaps the largest application of Adaptive Optics?

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Abstract
The global unmet need for corrective eyewear is very large - at least 1 billion people. To achieve correction to 20/20 vision, that need is arguably more like 3 billion people. The current global effort in terms of diagnostics is largely significant in the number ranges is to be achieved.
The Centre for Vision in the Developing World (CVDW) is a new research group dedicated to pursuing research relevant to tackling this unmet need. In particular, for the very large number of people in the world who cannot access eye care professionals or certain prescription medications.

To address these challenges, our vision is to: (1) improve the availability, accessibility, and quality of eye care services; (2) increase the number of eye care professionals; and (3) develop new technologies and new paradigms for eye care.

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Self Refraction
A potential solution is the short-sighted eye care professional in developing countries is to use self-refraction with a digital vision chart. Adjustable refractors offer the user the ability to change the power of their lenses. This type of refractor is known as a self-refraction adjustable refractor. Adjustable refractors thus have the potential to provide a means of both measuring and correcting refractive error in regions where access for the ordinary refractor is not easily available. The accompanying figure demonstrates the outcomes of self-refraction for three different refractive errors and three self-refraction error magnitudes (see below). The test results were recorded for each self-refraction protocol.

1. Pollock/AutoX: The subject begins the self-refraction protocol with the adjustable lens set to +6D and is instructed to adjust the lens power to their highest vision.
2. Adjustability: The subject begins the self-refraction protocol with the adjustable lens set to +6D and is instructed to adjust the lens power to their highest vision.
3. Pollock/AutoX: The subject adjusts the Pollock/AutoX procedure. Once completed the subject is instructed to slowly increase the lens power and they perceive the optimal degree of correction.

The valid decrease test indicates the subject’s mean refraction as measured using a Halos Top420©autorefractor. The broken black lines indicate replicability limits of these data (±3D) at the 95% confidence level.

Conventional approaches to correcting refractive error

1. The traditional method of delivering vision correction is to fit a person with a pair of eyeglasses.
2. The modern lens approach is to fit a person with a pair of contact lenses.
3. The lens approach is to fit a person with a pair of intraocular lenses.

Self-adjustable eyeglasses

As mentioned above, a potential solution to the unmet need for the correction of refractive error is to develop eyeglasses that can adjust their power automatically. A self-adjusting eyeglasses can then be adjusted by the wearer who follows a defined protocol in order to allow a good approximation of their personal correction. The use of self-adjusting eyeglasses can help in the case of people who cannot access an eye examination and may be more appropriate for people who have regular vision problems and who can help both be more efficient, hypoallergenic, and more comfortable.

The self-adjusting eyeglasses can be divided into two problems: (1) it requires a sensor for measurement by a trained refractor, which is crucial for regions with few eye care facilities; and (2) the detection of the user’s vision condition is important for a successful self-adjustment of the eyeglasses.

Another possible use of variable power lenses is to provide ongoing adjustment to a desired range of power. For example, a self-adjusting eyeglasses can provide a "universal" reading glasses that could then be stored in a number of users' eyes, such as members of a family. A device that fulfills this requirement is a learning completion.

Child Vision Study
The problem of detecting accommodation as part of the self-refraction process is that children, especially young children, can be very difficult to get to work with such tests. For example, even though a child can count many individual letters of the alphabet, they are unlikely to be able to screen for such individual as part of a self-refraction protocol without the need for further work aids.

There are many challenges related to deployment, as well as obvious differences in the way of children’s vision. Among these challenges are the use of a number of psychometric barriers. Nevertheless, despite these challenges we have seen much more encouraging results. The diagnostic accuracy of self-refraction is improved for high vision and we are optimistic that with adequate resources we could help millions of people to see clearly.