Vision Science III – Binocular Vision Module
Lab 5 - Eikonometry

INTRODUCTION TO EIKONOMETRY

Clinically significant aniseikonia may be difficult to predict or diagnose because it is caused by optical, anatomic, physiological, neurological, and subjective factors that combine to give a *perceived* difference in image size for the two eyes. In some cases of anisometropia, the person may have not aniseikonia; in other cases of **isometropia**, the person may have aniseikonia.

Instead of relying on spectacle magnification computations, which consider only the optical correction, the most reliable way to diagnose aniseikonia is to actually measure it. A clinical instrument was developed by the *American Optical Corporation* for this purpose—the **Space Eikonometer**™. It is based on extensive research done at the Dartmouth Eye Institute.

The basic components of aniseikonia (geometric, induced, oblique) each creates a particular kind of space distortion, and the Eikonometer uses this to estimate a person's aniseikonia. Specifically, the it measures the amount of horizontal, vertical and oblique magnification necessary to neutralize the perceived distortion in a test target. Recall the three types of space distortion originally described by Ogle (Lecture 20, page 2).

- **Geometric effect**: Horizontal magnification causes a fronto-parallel plane to appear tilted away and enlarged on that side.
- **Induced effect**: Vertical magnification causes the opposite perception.
- **Oblique effect**: Upward divergent aniseikonia causes upper portions of a plane to appear enlarged and tilted away. Downward diverging magnification causes the opposite effect.

BASIC EIKONOMETER PRINCIPLES

The Eikonometer measures horizontal, vertical and oblique aniseikonia by a nulling technique; that is, the error is specified in terms of the correction. We do this when we measure refractive error in a phoropter.

1) In the case of a *horizontal aniseikonia*, if the person perceives that a wall is enlarged and tilted away from his right side, which eye has greater horizontal magnification?

Which eye has the smaller horizontal image?
To which eye must you add horizontal magnification to neutralize the perceived space distortion?

The Eikonometer measures the horizontal aniseikonia by adding horizontal magnification to the eye with the smaller horizontal image size.

2) In the case of a *vertical aniseikonia*, if the person perceives that a wall is tilted away from his left side, which eye has greater vertical magnification?

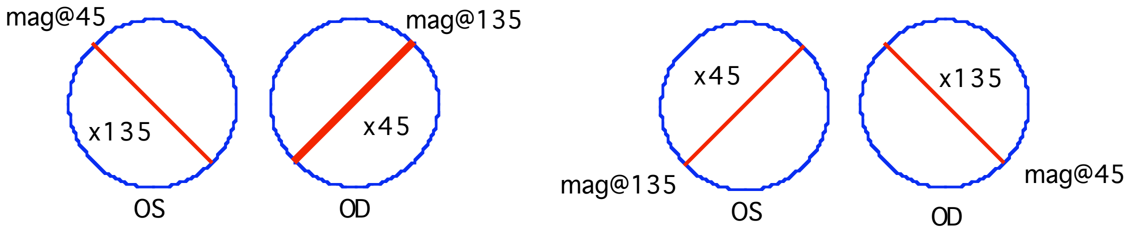
Which eye has the smaller vertical image?
To which eye must vertical magnification be added to neutralize the perceived space distortion?

The Eikonometer measures the vertical aniseikonia by adding vertical magnification to the eye with the smaller vertical image size.

3) In a symmetric oblique aniseikonia, the person may perceive that the top part of a wall is enlarged and tilting away from him. What kind of oblique aniseikonia would cause this? (See Fig. 1, below and note that the Eikonometer specifies the meridian of magnification in terms of its **axis**.)

- What kind of oblique magnification would correct this?

Oblique aniseikonia is quantified in terms of the declination, or upward (+) or downward (-) convergent magnification that must be added to neutralize the space distortion.



postive declination error, corrected by upward convergent (+) mag

negative declination error, corrected by downward convergent (-) mag

Figure 1. Two types of oblique magnification.

EIKONOMETER TEST STIMULUS

Figure 2 illustrates the Eikonometer target. If the person has normal stereopsis, he should see:

- two near vertical green lines, parallel to the face
- a red X and central yellow line a bit further away and parallel to the face
- two vertical yellow lines further away and parallel to the face

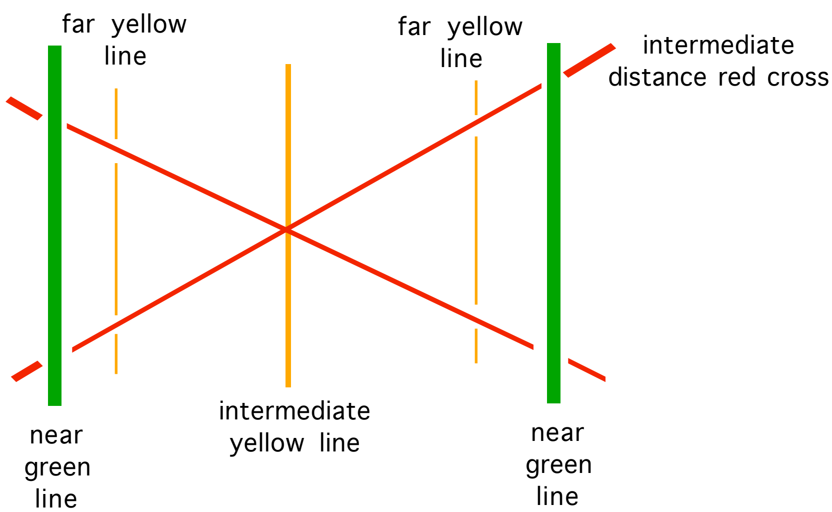


Figure. 2. Eikonometer target.

The vertical lines are used to detect horizontal aniseikonia only.
The cross is used to detect horizontal, vertical or oblique aniseikonia.

EIKONOMETER CONTROLS

- Right lever increases R or L horizontal magnification.
- Left lever increases R or L vertical magnification.
- Side lever increases upper convergent (+) declination (red) or lower convergent (-) declination (black).

TABLE 2. Eikonometer space distortions caused by different types of aniseikonia.

Aniseikonia type		Vertical lines	Cross
OD image larger	Horiz mag (axis 90)	Right side farther away	Right side farther away
	Vertical mag (axis 180)	Not affected	Left side farther away
	Overall mag	Right side further away	Not affected
OS image larger	Horiz mag (axis 90)	Left side farther away	Left side farther away
	Vertical mag (axis 180)	Not affected	Right side further away
	Overall mag	Left side farther away	Not affected
Equal meridional mag at oblique angles	Mag diverging upward	Not affected	Upper half farther away
	Mag converging upward	Not affected	Lower half farther away

EXERCISE 1

1) Adjust the PD, set all three settings to zero and observe the Eikonometer target. Do the lines appear to be positioned as described in Fig. 2? In theory, the cross should appear to be about 10 feet away.

2) Adjust the aniseikonia levers and try create each of the types of aniseikonia conditions listed in Table 2. Do this to verify the geometric, induced and oblique effects. Also see if SILO works.

3) Measure your partner's horizontal, vertical and oblique aniseikonia in that order and record the results. Refer to Table 2.

4) For each of the eight kinds of aniseikonia listed in Table 2, you should understand why it gives the listed perception. You should also understand how you would set the Eikonometer to measure that type of aniseikonia.

5) You should be able to explain why there be no perceived affect on the location of the vertical lines with a vertical aniseikonia?

6) For an overall right magnification, you should be able to explalin why the right side appears farther away, while the cross appears unchanged?

EXERCISE 2

Finally, for this lab, read about software that has been developed to test and prescribe for aniseikonia. Read the web page description and view entire the demo movie. (http://www.opticaldiagnostics.com/products/ai/)