

OPTIMIZING PUPILLOGRAPHIC MULTIFOCAL OBJECTIVE PERIMETRY FOR GLAUCOMA



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ABSTRACT

PURPOSE: To investigate 10 variants of multifocal pupillographic perimetry in glaucoma.

METHODS: We tested 22 normal and 23 glaucoma subjects. Multifocal stimuli of four-minute duration were presented dichoptically with 24 regions/eye extending to 30 degrees eccentricity. Stimulus sets differed in the presentation rate per region (0.25, 1, 4, presentations/sec.), stimulus duration/presentation (66, 133, or 266 ms), flicker rate on each presentation (0, 15, or 30 Hz), and peak luminosity (80, 150, and 290 cd/m²).

RESULTS: The brightest, four presentation/sec. stimuli, with 30Hz flicker gave sensitivities and specificities of 95.5% using response amplitude and delay.

CONCLUSIONS: Good accuracy for test durations of two minutes/eye could be obtained from this objective method.

Author Disclosures: All authors are consultants to Seeing Machines and James and Maddess have IP licensed to Seeing Machines.

INTRODUCTION

- Automated perimeter test-retest variability is high^[1-3]
- 10% fail catch trials (reducing sensitivity and specificity)^[4,5]
- So objective perimetry would be nice but, mfERG, mfVEP poorly tolerated, and so far have been too slow^[6,7]
- Recent work shows the human pupil is partly driven by visual cortex and therefore by the optic nerve^[8]
- Multifocal pupil perimetry has been demonstrated but low SNR, blinks, fixation losses a problem^[9,10]
- We have recently demonstrated that sparse multifocal stimuli improve can so reduce recording time, possibly making pupillo-graphic multifocal perimetry possible^[11-13]
- Multiple regression methods for estimating the multifocal responses mean we can eliminate the effects of data losses due to fixation losses, blinks etc. ^[11-13]
- Can test both eyes concurrently, with consensual responses obtain 4 visual fields at once.

METHODS

TEST PROTOCOLS

Ten stimulus protocols were examined in two blocks of experiments

- Block one contained 22 normal and 23 glaucoma subjects
- Block two: 20 normal and 20 glaucoma subjects

All subjects were examined with

- HFA achromatic, SWAP and Matrix 24-2 perimetry
- Stratus OCT
- slit lamp and tonometry

In all protocols multifocal stimuli were presented concurrently to both eyes with a dartboard layout, having

- 24 independent test regions/eye extending to 30 deg eccentricity (T30-24, pattern)
- The test recording duration for each of the 10 protocols was 4 minutes, divided into eight 30 s segments

Stimuli in each protocol could differ in

- the presentation rate per region (0.25, 1, 4 presentations/s)
- stimulus duration/presentation (66, 133 or 266 ms)
- flicker rate on each presentation (0, 15, or 30 Hz)
- or maximum luminosity (80, 150 and 290 cd/m²)
- Background luminance was 10 cd/m²



FIGURE 1:

The P6 prototype of the Truefield Analyser (TFA) that is on display at the Seeing Machines booth #5421 in Hall I2 near the technology pavilion and WiFi Zone.

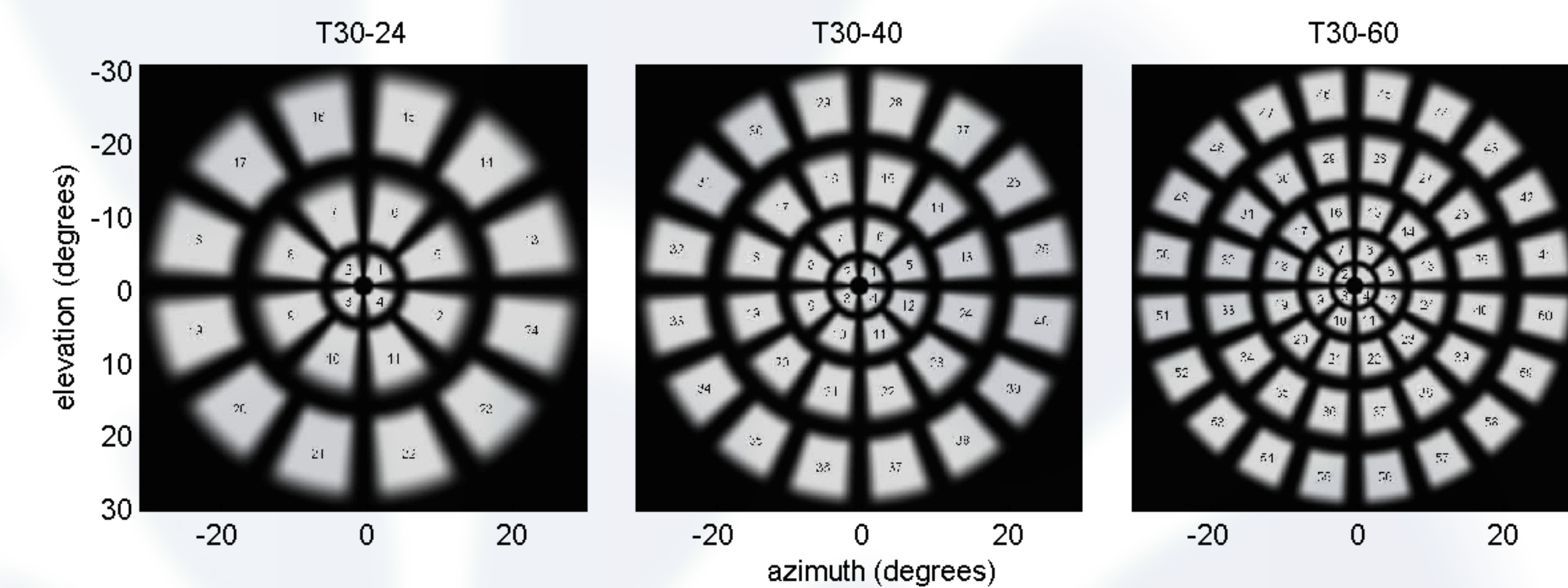


FIGURE 2:

Depictions of the multifocal stimulus arrays used in our studies shown as if all the stimuli were on simultaneously. All stimuli extend to 30 degrees retinal eccentricity. The current study used the 24 region/eye T30-24 pattern.

RESULTS

Since both pupils responded to stimuli from both eyes, 48 responses/eye were obtained giving 96 contraction amplitude and 96 delays for each 4 min test.

block	Lmax cd/m ²	rate(/s)	duration(ms)	flicker(Hz)	Amplitude %	Amplitude + delay %
1	290	4	66	0	80.1	78.4
1	150	1	266	15	73.6	85.3
2	150	0.25	133	15	61.9	57.9
2	150	1	133	15	80.5	78.2
2	150	1	133	30	71.1	78.2
2	290	4	66	30	91	95.5

TABLE 1:

The right two columns report the percent accuracies (simultaneously highest sensitivities and specificities) for either contraction amplitude alone, or for a linear discriminant models that included response delay. The best performance was obtained at, shorter presentation durations, and the highest presentation rates, flicker rates and luminances.

CONCLUSIONS

- Sensitivities and specificities up to 95% possible using amplitude and delay measures
- The faster, rapidly flickering, brighter stimuli had the best diagnostic accuracy
- The visual fields of both eyes are sampled concurrently providing a good statistical basis for comparison
- One in >800 tests produced a failure of quality controls

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