

# EYE-TRACKING SYSTEM FOR DIAGNOSIS OF VISUAL DEFICITS

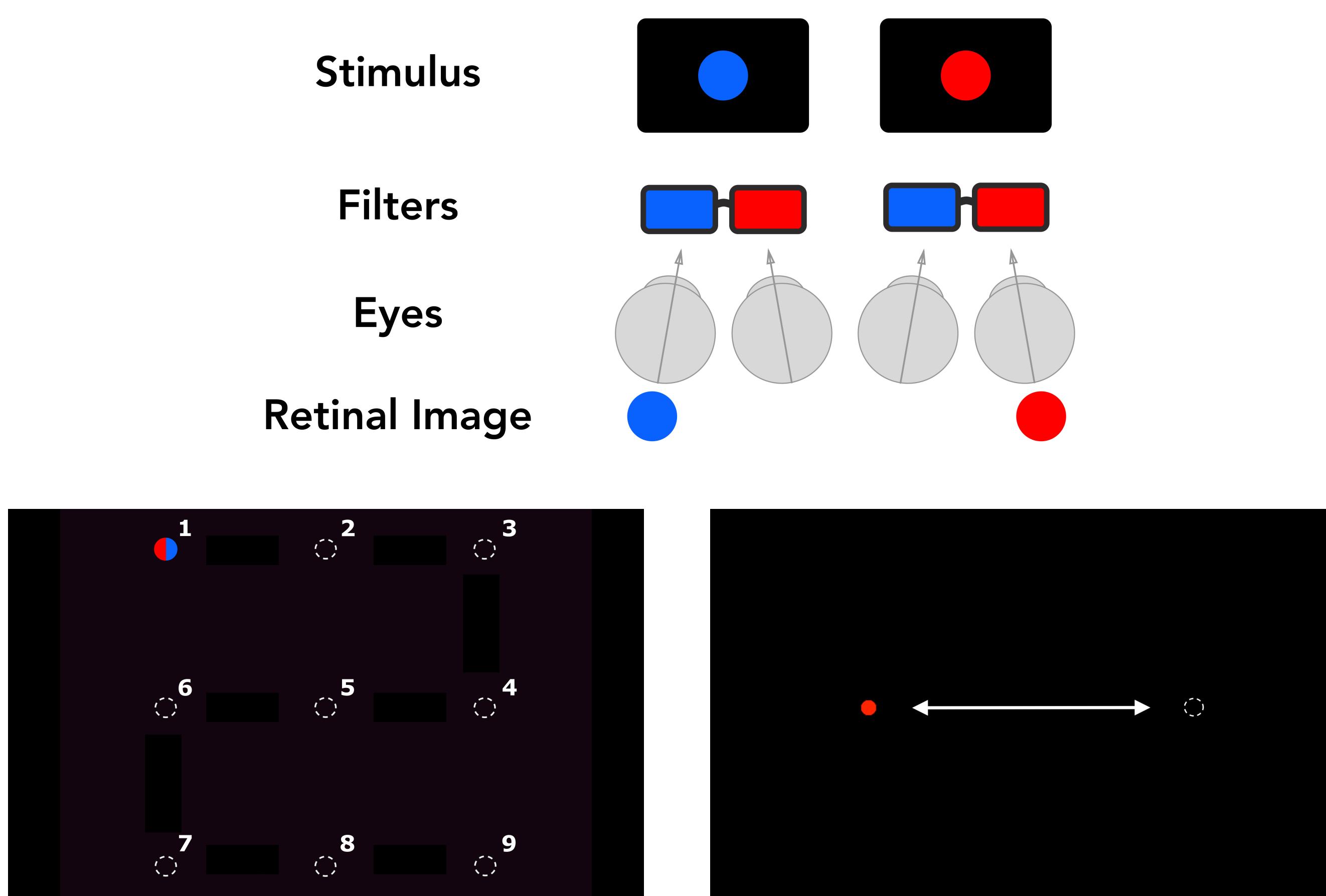
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## INTRODUCTION

Visual deficits in children require prompt attention; if left untreated a deficit may cause permanent, irreversible vision loss. Strabismus is a disorder involving misalignment of the eyes' optical axes which can result in permanent vision loss. Subjectivity in the manual diagnosis of strabismus may lead to low accuracy. Our research intent focuses on the development of an objective examination for strabismus.

## METHOD

Eight visually normal subjects viewed visual stimuli. There were two testing procedures: a multi-point fixation test and a smooth pursuit tracking test. Using red and blue filters with red or blue dots, we stimulated a subject's left or right eye individually:



### Fixation Test:

Nine, red or blue circular fixation targets appeared at different positions on the monitor. At each of the nine target locations, the colour of the fixation target alternated between blue and red at a frequency of 1 Hz.

### Tracking Test:

A single blue or red target moved back and forth along the horizontal or vertical meridian repeatedly. The trajectories were slow to allow for measurements of smooth pursuit eye movements (without any corrective saccades).



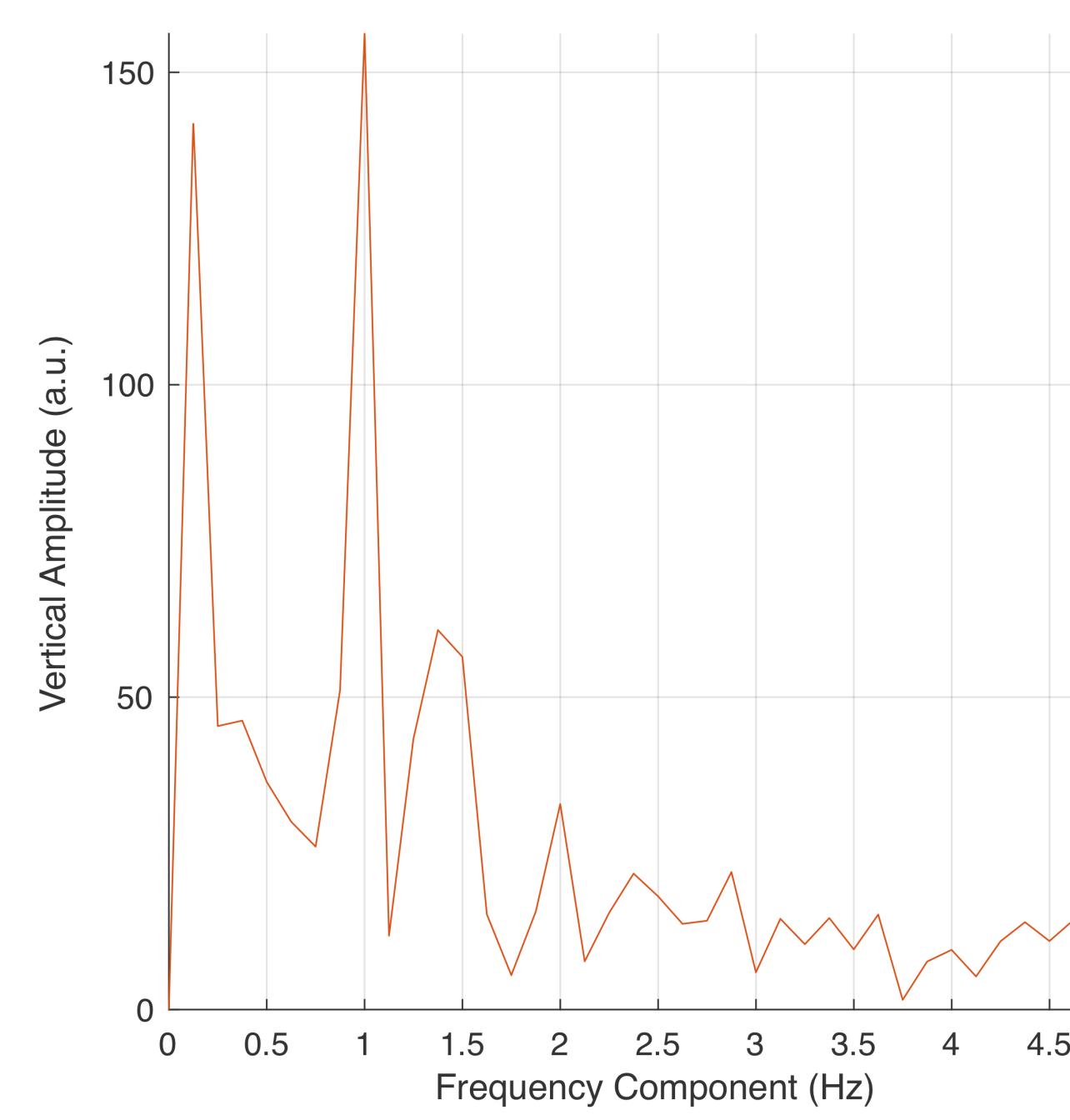
## RESULTS

The between-eye differences in performance of the eight visually normal subjects from the fixation and tracking tests showed interesting dynamics.

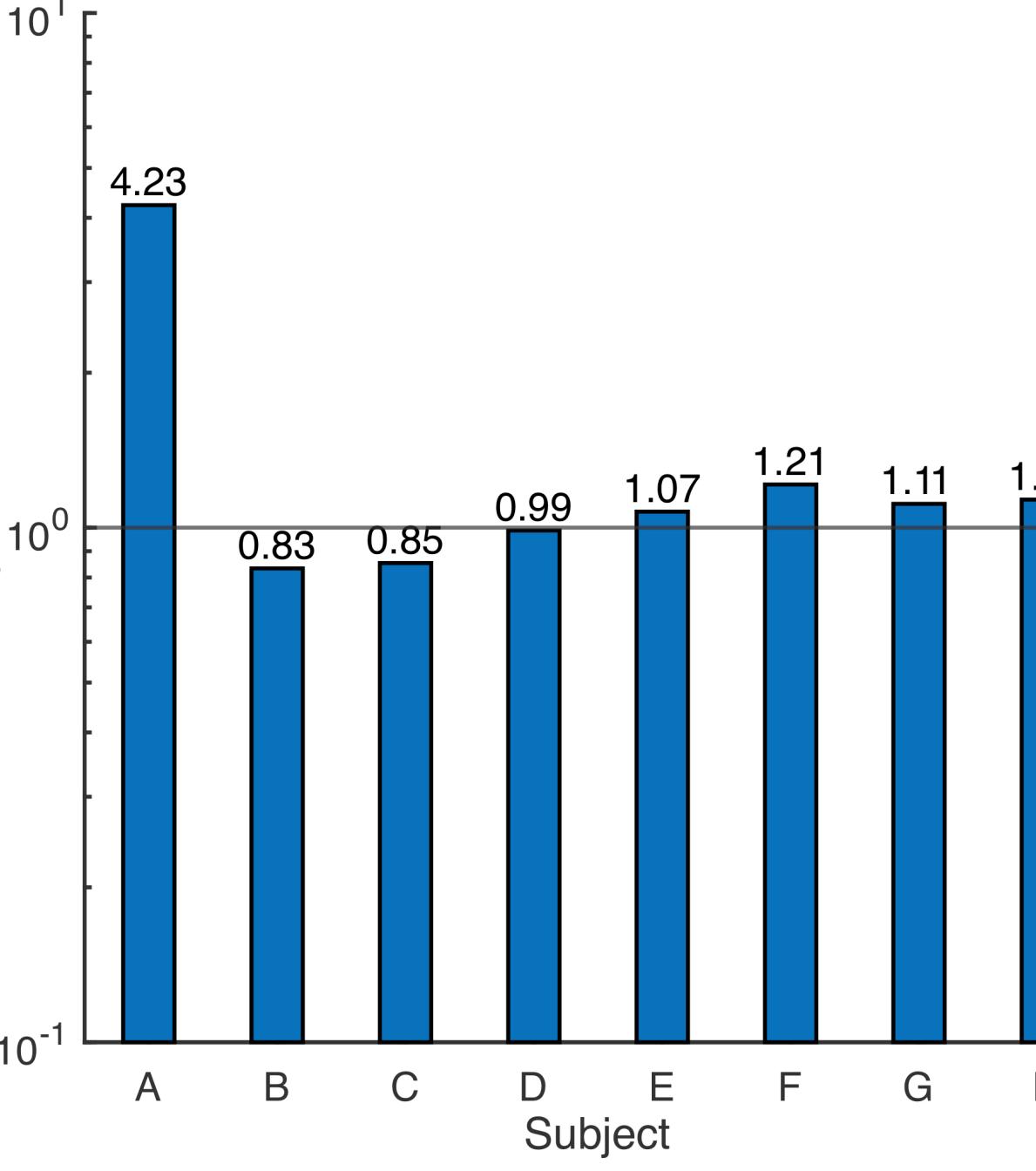
### Fixation Test:

- Fourier analysis indicates that one subject exhibits large oscillations at 1 Hz in the vertical direction. All other subjects showed only small vertical and horizontal oscillations when fixating.
- The fixation test provided adequate sensitivity for the detection of deviations in the visual axes. We would expect strabismic subjects to exhibit an oscillation in their gaze response with larger amplitudes/deviations.

Subject A - FFT of Vertical Gaze Response from Fixation Test



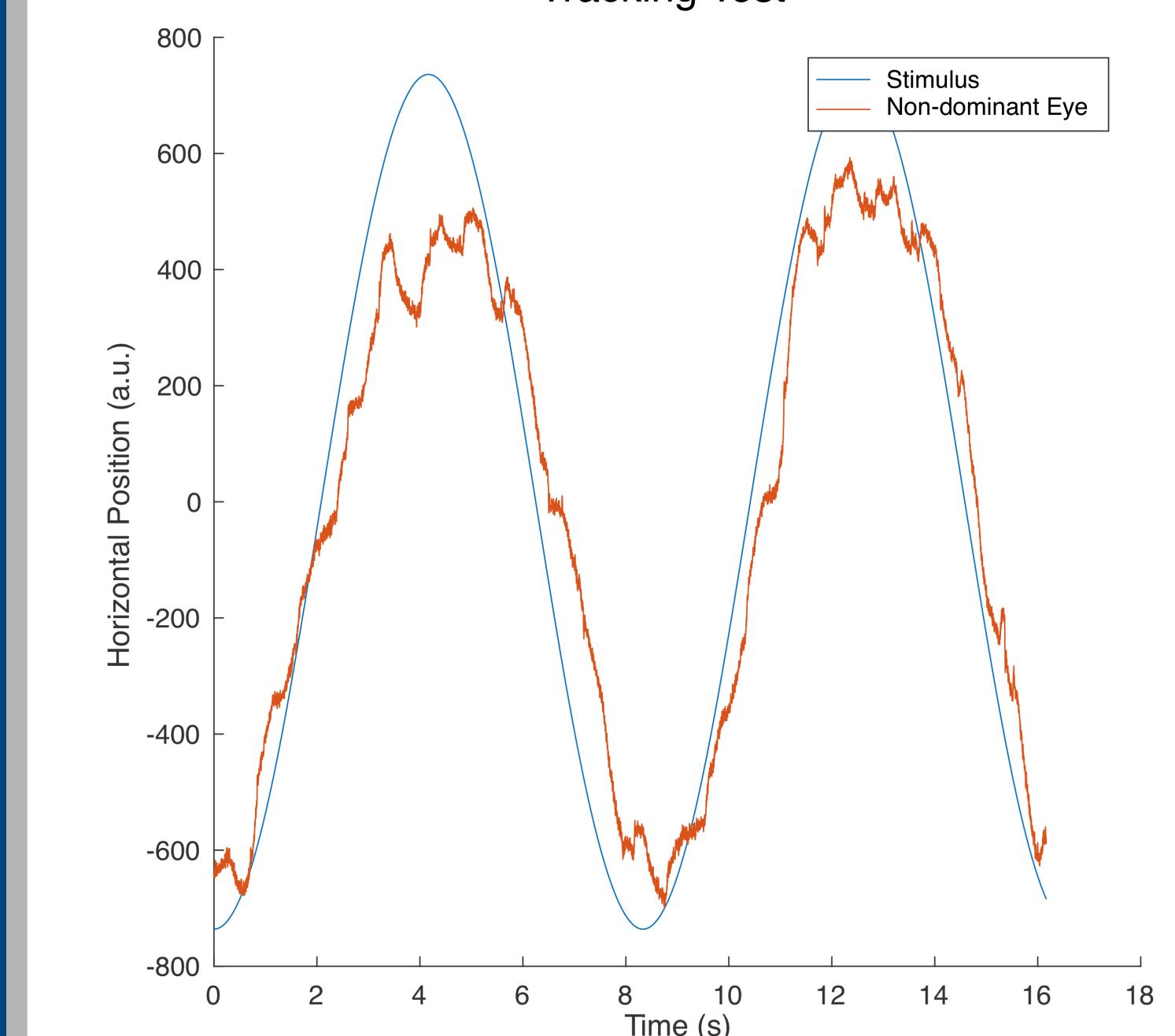
Subject Cohort - Oscillations in Gaze Response from Fixation Test



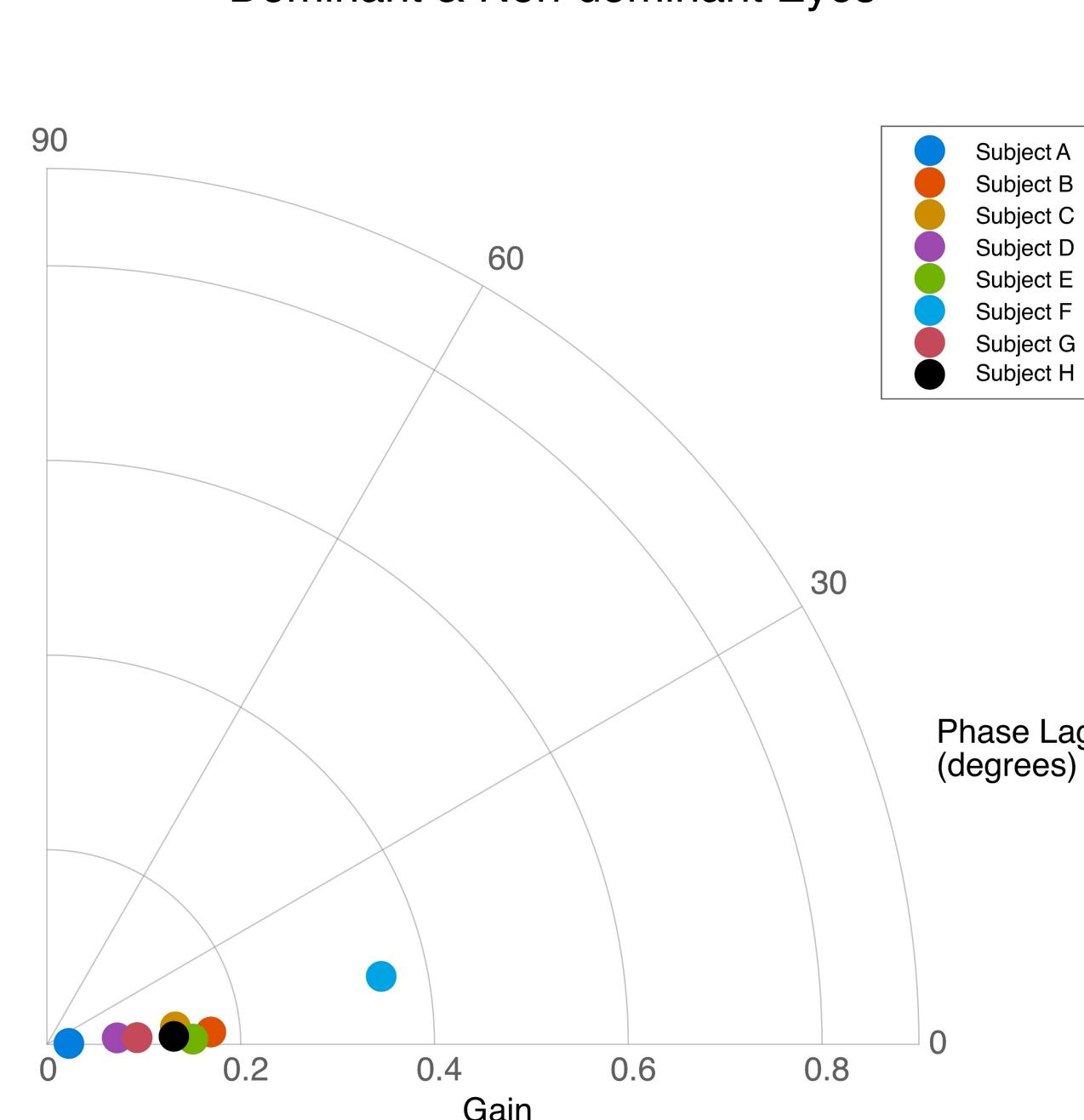
### Tracking Test:

- Subject B's non-dominant eye exhibited more phase lag (cf. dominant eye) and low gains. All other subjects showed gains near unity and phase lags that were similar between eyes.
- Between-eye differences in tracking performance can be stimulated and measured effectively in visually normal subjects through the tracking test. This gain and phase difference may be indicative of interesting between-eye differences, however further investigation is needed.

Subject B - Gaze Response vs Stimulus Trajectory from Tracking Test



Subject Cohort - Gain/Phase Difference Between Dominant & Non-dominant Eyes



## CONCLUSION

- The fixation and tracking tests allowed us to examine the between-eye differences in a visually normal cohort through a quantitative and objective method.
- The simplicity of our stimuli in the fixation and tracking tests have the potential to be used in children, as an alternative to reading traditional optotypes.
- In future work, acquiring gaze data from strabismic patients will be highly insightful for an extensive analysis of eye movements between strabismic and visually normal subjects.
- In addition, it would be beneficial to enhance the interface of the fixation and tracking tests further to generate more information on subjects' ocular behaviour.