StabilEyes - New Assistive Technology for Nystagmus to Produce a Stabile Real-Time Video Image

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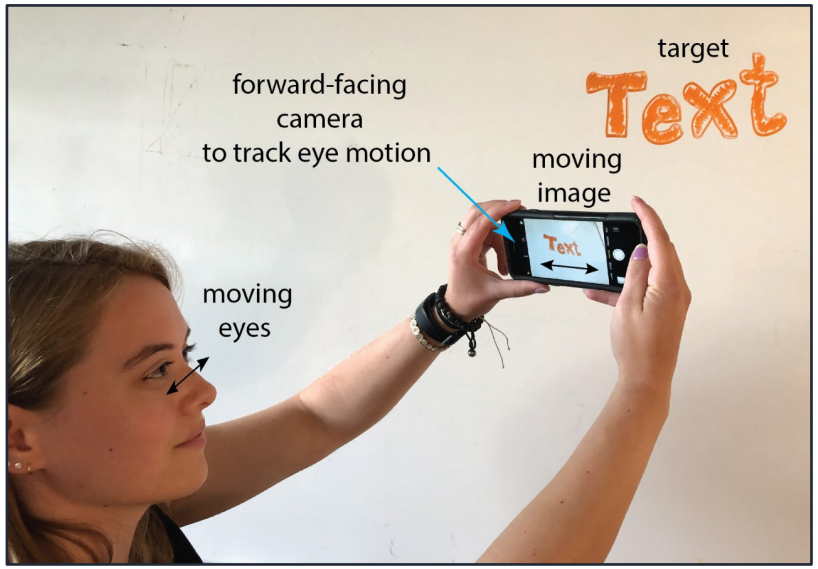
Background

- Nystagmus: visual impairment in which the eyes make involuntary, repetitive motions
  - Perception of unstable visual field
- Current treatments: corrective eyeglasses, medications, surgery, rehabilitation therapy
  - Often ineffective and/or inaccessible
- *StabilEyes*: aide for acquired pendular nystagmus
  - Free mobile application for smart devices to stabilize user's everyday environment

Purpose of Study

- *Investigate the use of first-order moment calculations in tracking periodic eye motion*



Methods

Algorithm Overview

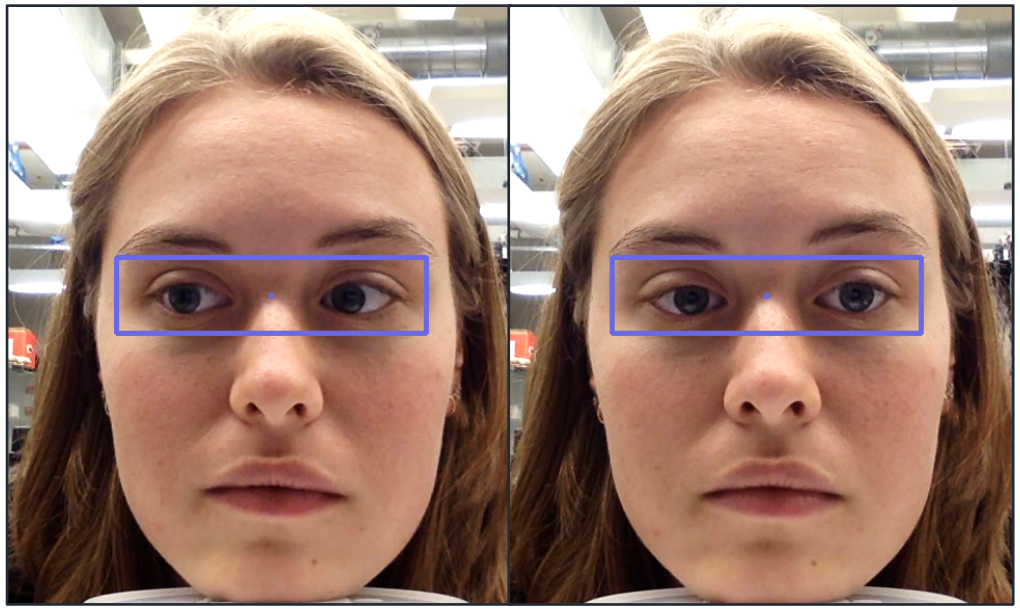
- Identify area containing eyes with face classifier,
  - Track with sum-absolute-difference method
- Calculate first-order moment of area in each frame
- Extract frequency, phase to move image on screen

"Pseudo-Nystagmus" Test Videos

- 16 videos using 3 volunteers
- Sinusoidal eye motion (0.01 or 0.05 cycles/frame)
- Created from sets of still images with known gaze

Data Processing (using test videos)

- Verified correct identification and tracking of eyes
- Graphed first-order moment vs. frame for each video
  - Identified frequency visually and with Fast Fourier Transform (FFT)

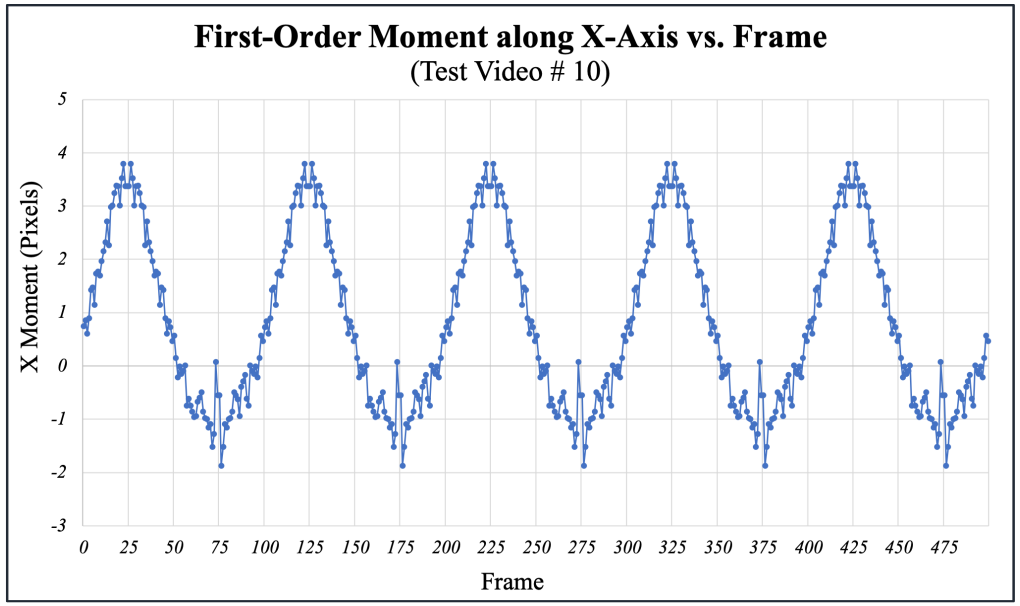


Area containing both eyes (automatically identified and tracked) at 2 different times in a "pseudo-nystagmus" test video

Results & Conclusions

Results

- Eye region found and tracked in every video
- Periodicity, frequency identified in 14 of 16 videos
- Average processing rate: 39 frames per second



Conclusions

- Reliability and Speed
  - Moment calculations: effective in detecting periodic motion
    - Acceptable signal-to-noise ratio
  - Processing rate: promising of real-time application
- Next steps
  - Phase-locked loop to autonomously find frequency and phase
  - Real-time user testing
  - Combination with FingerSight, another assistive device for visual impairments