Motion tracking of iris features for eye tracking

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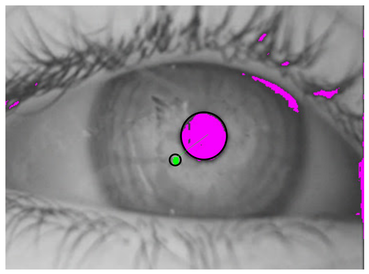
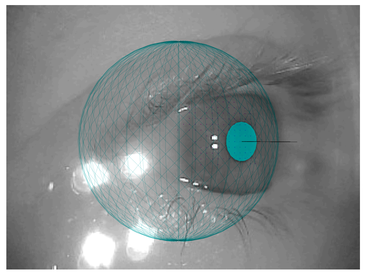
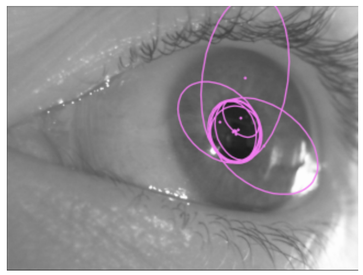
Overview

- Current video-based eye trackers have **low signal-to-noise ratio (SNR)**
- Reliance on only **pupil or pupil & corneal reflection (CR)** in current methods result in **high variance**


(Swirski et al., 2013)




(Topal et al., 2017)

- Pelz & Witzner Hansen (2017) proposed a new method to **extract velocity signals** by tracking a large number of iris features.
- We update that method, and demonstrate that **microsaccades as small as 0.2°** can be reliably detected.
- Estimating the velocity based on the motion distribution of a large number of iris features over time can **improve the precision and accuracy of eye trackers.**

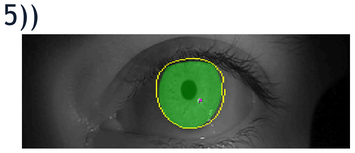
Method

1.**1080p96** captured with modified DMC-GH4 (RGB-IR)

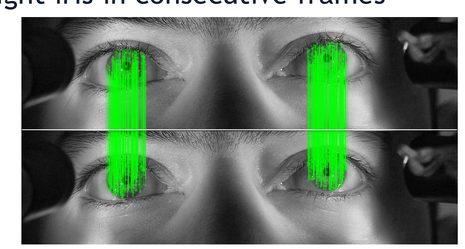
2.Head stabilized with **chin rest**

3.**Image-based approach** for head-motion stabilization (by tracking skin features)

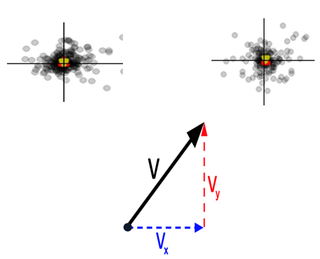
4. Iris segmentation with **trained CNN** (U-Net based architecture (Ronneberger et al., 2015))



5.**Match features** from respective Left & Right iris in consecutive frames

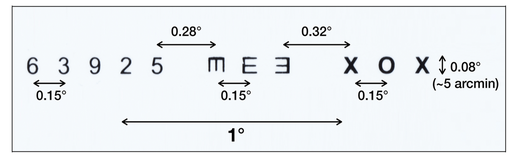


6.Velocity determined from **distribution of matches**



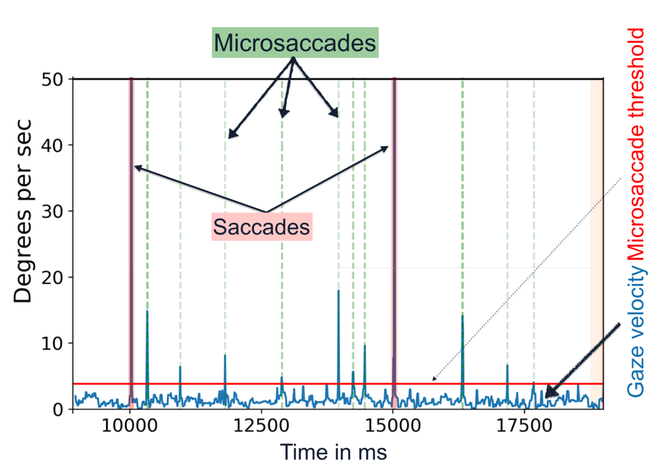
Experimental Design

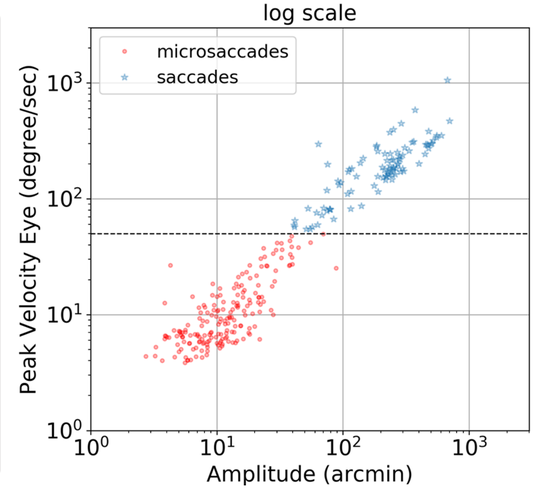
- Task 1: Fixate each target point (Shelchkova et al., 2018)
- Task 2: (Video stimuli) Track the motion of a car and marble in a cup ‘shell game’ (Kurzhals et al., 2014)



Results

- Detection of microsaccades over **0.2° with high certainty** (100% accuracy)
- Both saccades and microsaccades fall on the **main sequence** with a slope of 47 s^{-1}
- Median microsaccade rate 1.0/s
- Head motion stabilization reduced **false alarms**
- Iris Segmentation Results: Intersection over Union value of 87%





Future Work

- Compensate for the drift in the position
- Measure torsional and smooth pursuit eye movements

References

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