

Electro-mechanical device for vergence step stimuli presentation

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Problem

Vergence is the simultaneous movement of both eyes in opposite directions to obtain or maintain single binocular vision. The eyes rotate inwards – converge (convergence) – or outwards – diverge (divergence) (Figure 1).

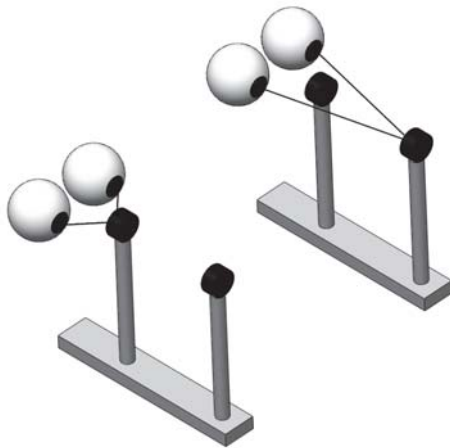


Figure 1. Vergence movements: the eyes converge to look at nearer stimulus and diverge to look on the more distant stimulus.

To test vergence under natural viewing condition – in free space, the stimuli must be perfectly aligned along person's midline and placed along the side of view. It creates problem for close stimuli (the distance between stimuli can be even 5 cm to produce +1 degree difference in convergence response) – targets obscure each other (Figure 2).

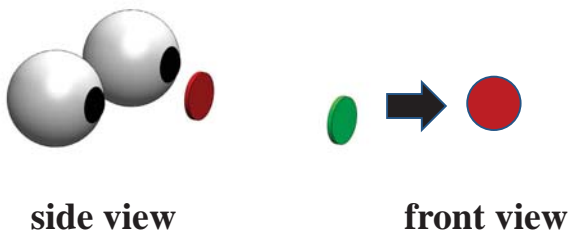


Figure 2. Schematic illustration of stimuli position – side view and front view – from the persons point of view.

Conclusions

We successfully demonstrated the first step in solving the problem for vergence evaluation in free space environment for small distances between stimuli. We continue to work on technical problems in order to gain more convincing results.

Solution

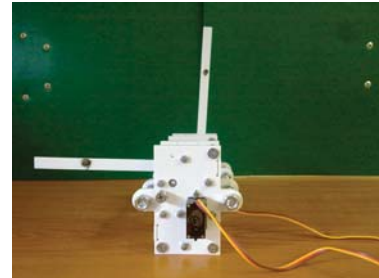


Figure 3. Device allowing automatic changing of viewing targets.

To avoid using targets obscuring each other, we propose electro-mechanical device which is designed to present one stimuli at the time (Figure 3). Our first design were able to lift or cast stimuli by 90 degrees at 300-400 ms. By redesigning gear trains and choosing more powerful servo motors, we achieved 131.4 ± 9.4 ms for lifting and casting test stimuli by 90 degrees. Currently developed device is equipped with second gear train which may change target position twice as fast. Each device module is equipped with control mechanism which may allow to operate two modules at the same time (Figure 4). Using new stimuli presentation device, we successfully stimulated vergence response (Figure 5).

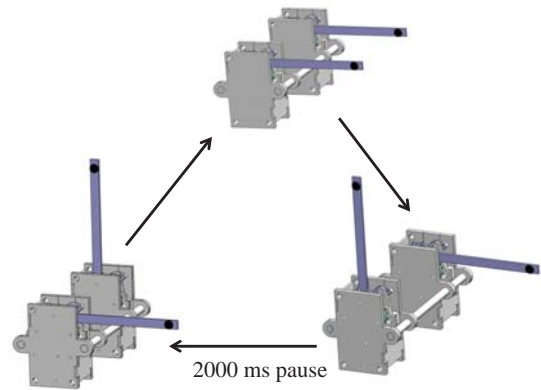


Figure 4. Schematic illustration of two module operation.

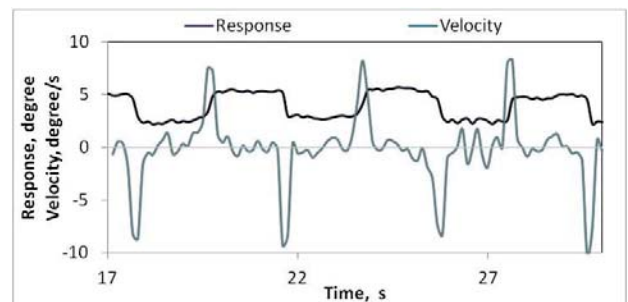


Figure 5. The first results of vergence response using new device (obtained with iViewX Hi-Speed (SMI, Germany) eye tracking system). Black line – vergence response in time, blue line – vergence velocity profile.