



The impact of autostereoscopic screens on assessing depth perception

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3D is depth, dynamic and up to date.

Wang *et al.* (1), describe a new way to quantify near depth perception using a rapidly alternating shutter 1,920×1,080 pixel LCD screen to render spectacle-free autostereo. They use directional back light technology and describe the optics and characteristics of their system which quantifies levels of stereopsis from a coarse level of 680 seconds of arc to their finer level of 170 seconds of arc. Their system utilizes a random dots with static and dynamic presentation such that the perceived elevated object appears to move right and left; the degree of elevation does not change dynamically, however, in this study, the alternating shutter autostereo test is compared to a conventional device (random dot on computer with anaglyph goggles instead of shutter) with 8 of ten correct at each level needed to progress to finer stereo and 3 minutes for the new device compared to 5 minutes for conventional. Almost all subjects achieved 170 seconds of arc when most would have usually scored 40 seconds on a polarized static stereo test [compared in prior conventional validation (2) but not compared in this study]. Normal subjects and patients with intermittent exotropia were studied.

Binocular images can be presented to the eyes in different ways. Conventional, static options for measuring include anaglyph red-blue goggles and orthogonal polarized film with goggles—the latter used in the Titmus Fly and Randot test booklets which can characterize quality of stereopsis from 40 seconds of arc to 800 seconds of arc in 8 steps. Virtual reality (VR) headsets present synchronous

static or dynamic binocular images including stereopsis (3). The Frisby stereotest can be used on younger children and does not require goggles (<http://frisbystereotest.co.uk>). Two other binocular options are autostereoscopic screens with half the pixels projected to the right eye and half to the left either through lenticular or barrier method. The Nintendo 3DS game console (Japan) utilized an autostereoscopic parallax barrier screen (4) and was the platform for PDI Check (Anchorage, AK, USA) game, a dynamic forced-choice method of rapid determination of stereopsis without typical floor effect of other methods (5).

Binocular therapy for amblyopia over the last decade has undergone several randomized clinical trials with nearly 1,000 amblyopic patients initially with disappointing results due to poor screen delivery and boring content (6-8). As of 2022, binocularity is an increasingly important issue with respect to amblyopia relative to early assessment (9) and therapy now that dichoptic methods have finally shown promise to improve monocular visual acuity to a comparable degree as continued spectacles (3) and even compared to patching. Anaglyph goggles, particularly when combined with eye tracking (<https://nova-sight.com/curesight/>) has shown excellent short-term benefit for children with refractive and/or mixed mechanism amblyopia. Jost *et al.* (10), recently showed amblyopic visual acuity gains and stereopsis gains with dichoptic movie therapy on a Nintendo 3DS screen comparable to patching. Flicker glasses—somewhat similar to Wang's study, can provide amblyopia therapy with success similar to patching (11).

The high resolution of the shutter, autostereoscopic screen should allow for Wang and colleagues to re-program a presentation of even higher grades of stereo, perhaps in a quicker paradigm to make this a practical method for glasses-free screening and assessing stereo for patients with and without amblyopia.

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Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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