

Fig. 1. Screenshot of the movie used in this study. A large number of balls at random positions and a green cross at the center position as the point-of-regard in the movie space. The direction of motion in the movie followed two patterns: depth direction (Z-direction) and side direction (X-direction), and the movies were 3-dimensional (3D) with binocular stereopsis.

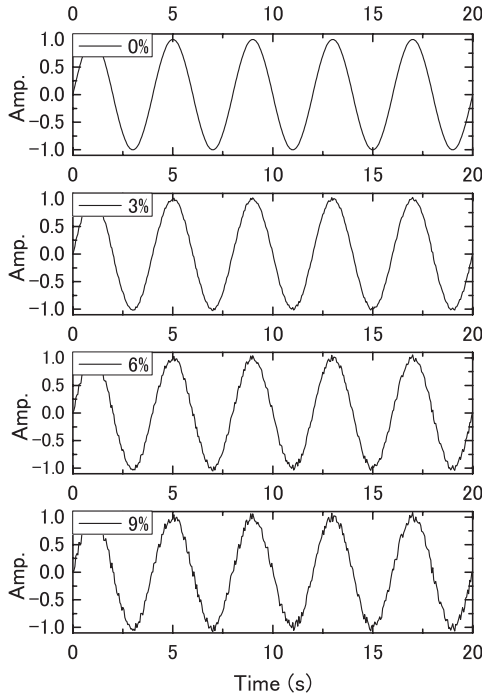


Fig. 2. Simulated motion added the unpredictable motion component in the movie. The amplitude of sine wave is standardized 1.

dom positions and a green cross at the center position as the point-of-regard.

The direction of motion in the movie followed two patterns: depth direction (Z-direction) and side direction (X-direction). The motion in the movies was sinusoidal at 0.25 Hz in each direction and was generated by moving camera-simulated ocular globes (the balls did not move directly). The reason for adaptation of this frequency was that this study followed some previous study, which had reported that motion components under the 0.5 Hz provided large effect such as motion sickness on human [12,13,14]. The amplitude of the sinusoidal motion was set to 150 as a software

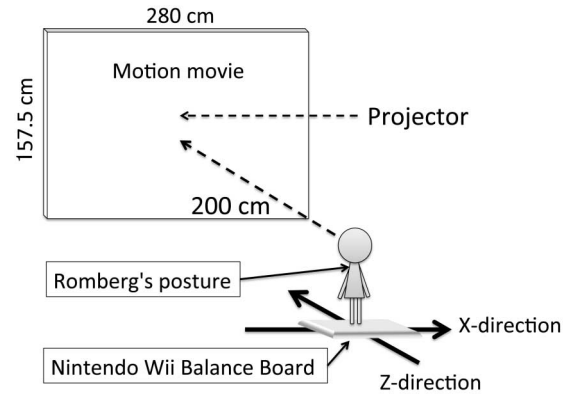


Fig. 3. The setup utilized in the study. The subject stood on a Wii Balance Board (Nintendo, Japan) in Romberg's posture. to measure body sway with a 2 m viewing distance to the screen.

setting in all directions. Moreover, we added the basic sinusoidal at 0.25 Hz to each uniform random number, which defined the maximum/minimum value as  $\pm 3\%$ ,  $\pm 6\%$ , and  $\pm 9\%$  of the amplitude of the sinusoidal motion for each direction of motion of the movie to create sinusoidal motion movies containing unpredictable components. The motion in the movie can be expressed as follows:

$$F(t) = A \sin(2\pi f t) + \epsilon, \quad (1)$$

where  $F(t)$  denotes the position value at time  $t$  (s),  $A$  represents the amplitude of the sinusoidal,  $f$  indicates the frequency of the sinusoidal, and  $\epsilon$  denotes the unpredictable component. Figure 2 shows simulated motion added the unpredictable motion component in the movie according to the above equation. For presentation, the movie was projected on a white wall 200 cm in front of a subject with a domestic version 2D/3D convertible projector (EH-TW5100, EPSON, Japan). The projected movie size was 157.5 cm (vertical)  $\times$  280 cm (horizontal), pixel size was 1,080 (vertical)  $\times$  1,920 (horizontal), and the viewing distance was 200 cm. Thus, the view angle was  $38^\circ$  (vertical)  $\times$   $70^\circ$  (horizontal).