**Coding visuo-spatial information in a vibrotactile belt: Perceived egocentric direction from patterns of vibration**

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How might we design more useful assistive devices for individuals with impaired vision? Although traditional tools such as the long cane are simple and effective for short-range guidance (2-3 steps), there are few practical aids for mid-range navigation and collision avoidance over intermediate distances. We are investigating vibrotactile belts as a potential sensory substitution interface, and are currently comparing alternative methods of encoding visuo-spatial information in patterns of vibration. In the present experiment, we tested perceived egocentric direction from single-tactor and distributed (Gaussian) patterns of vibration. Participants (N=16) wore a vibrotactile belt containing 16 pager motors spaced 22.5˚ apart, with an Arduino controller. Eight directions at 45-degree intervals were stimulated for 2 seconds at a fixed intensity (225 Hz), and participants indicated the perceived direction of vibration by clicking on a circle surrounding an icon of a person on a computer screen. Three vibration patterns were compared: (a) a single motor, (b) 3 adjacent motors in a narrow Gaussian distribution (spanning 45˚), (c) 3 or (d) 5 motors in a wide Gaussian distribution (spanning 90˚). Each stimulus was repeated ten times, randomized within each vibration block. The results show that the mean reported direction was linear and highly accurate (mean constant error = 0.35°). The mean variable error depended on direction, with the smallest within-subject SD in the anterior and posterior directions (mean SD = 6.22°) and the largest in the lateral directions (mean SD = 13.77°) (see also Cholewiak & Schwab, 2004). Furthermore, responses were unaffected by the vibration pattern. We conclude that single-tactor vibrations are sufficient to specify egocentric direction quite accurately, simplifying the encoding and reducing the controller computation. Next, we plan to evaluate different encoding strategies to guide walking to a series of spatial targets.

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