Postural Goal of Unconstrained Head Movement Strategies

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Since the primary function of visually guided head movements is to carry the eyes for target localization, preprogramming the entire head movement kinematics would be unrealistic, particularly when the target is beyond the instant visual field. Hence it is suggested that unconstrained head movements require an on-the-fly type of control strategies, which may be based on both cognitive and sensori-motor processes. In the present study, head movements were measured from subjects performing visual gazing movements to horizontally distributed targets at the eye level. The first component of the head movement, labeled as “initially intended head movement (IIHM)”, was reconstructed based on the assumption and observation that the IIHM has the characteristics of time-optimal movements (bell-shaped velocity profiles). The reconstructed movement component indicated that the amplitude of the IIHMs reaches an asymptote value of 20.3° on average, even though the targets were presented at eccentricities of up to 120° azimuth. Following the IIHM component, corrective movements are made until the head is stabilized in a final posture corresponding to 72% of target eccentricity. The corrective movements are unnecessary since the eyes are estimated to be already on the target when head corrections occur. Furthermore, although the number of corrective movements increases with target eccentricity, the overall kinematics of corrective movements shows a large variability, which indicates that the final head posture can be achieved through a number of kinematic variations that are loosely programmed using an on-the-fly strategy. Hence the results support the hypothesis that achieving a desired posture is a goal of head movement control, which is expressed by a combination of an initial feed-forward and subsequent feedback corrections. It is hypothesized that the final eye and head orientation represent an optimal posture for the given task requirements and movement context.

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