Three-Dimensional Reach Kinematics of the Upper Extremity in a Dynamic Vehicle Environment

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This study analyzes three dimensional reach kinematics of the upper extremity of the seated operator exposed to vehicle whole body vibration. The goals of this study are to investigate vibration-induced changes in joint kinematics, and to identify the characteristics of upper body coordination in reaching movement phase. Earlier studies on reach performance in vibration environment have focused primarily on fingertip deviation from a desired trajectory without considering multi-body dynamics of the upper extremity (Rider and Chaffin, 2003, 2004). Most studies on reach kinematics modeling have described movements performed in static environment (Wang, 1999; Faraway, 2003; Lim et al, 2004). In contrast, this paper investigated the aspect of a multi-segmental model of the upper body in a dynamic environment in order to develop an active biodynamic model of the seated human. Thirteen subjects reached to five target locations distributed in the right hemisphere space. Joint kinematic characteristics of the right arm-hand system were calculated from reach motion data captured by an optical motion analysis system. The data showed that the reach movement patterns which characterize upper body coordination varied as functions of target location. Identification of movement patterns in terms of joint kinematics can be used to determine some principles of upper body links coordination in reaching movements. This analysis could also help identify aiming movement phases in vehicle vibration environment as well.

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