

# Consideration of Pitch Attitude of Personal Mobility Vehicles (PMVs) During Tilted Cornering

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The appropriate pitch attitude of personal mobility vehicles (PMVs) during cornering has not yet been clarified. To support experimental studies from the perspective of occupant perception, this paper presents a hypothetical consideration focusing on the relationship with human perception, with the aim of defining quantitative experimental conditions and providing a foundation for subject-based experiments and an ergonomic approach.

First, the vertical displacement of the forward gaze point from a driver's perspective in passenger cars was compared with the typical nose-down posture observed during cornering in production vehicles. A hypothetical relationship between the two was then examined. Four-wheel passenger cars exhibit a slight roll during cornering, resulting in a nose-down attitude. Consequently, from the driver's viewpoint, the direction of travel shifts slightly downward during a turn. Quantitative analysis indicates that the downward displacement of the forward gaze point approximately corresponds to the typical nose-down posture of the vehicle.

As shown in Fig. 1, for a PMV with two front wheels and one rear wheel that tilts significantly inward during cornering, the occupant's forward gaze point shifts considerably upward during a turn, similar to a motorcycle. Fig. 2 shows the variation of the upward shift angle ( $-\alpha$ ) with respect to the turning radius  $R$  and the forward gaze duration  $s$ . However, it was found that directly applying the relationship observed in passenger cars—where the downward gaze shift corresponds to a nose-down posture—is not feasible for PMVs.

Based on these considerations, the initial conditions for quantitative experiments were defined as shown in Table 1. Furthermore, it is suggested that reproducing the cornering behavior of an inward-tilting PMV (Fig. 3) may be feasible using only a VR headset, without the need for a motion-based driving simulator.

Building on these preliminary findings, future work will proceed to experimental studies based on participants' subjective perception to determine the appropriate pitch attitude for PMVs during cornering.

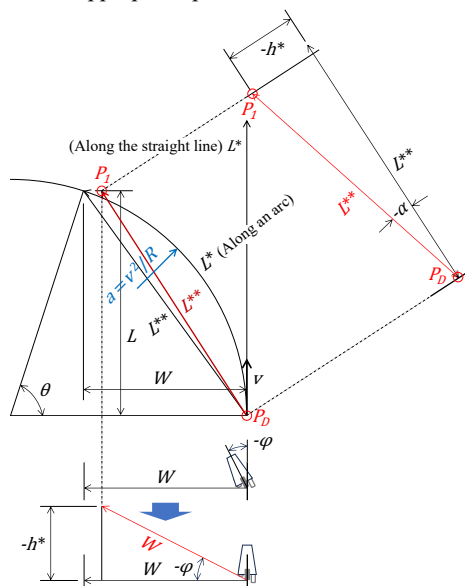


Fig. 1 Upward movement angle of the forward gaze point of a PMV

Table 1 Initial Values of Experimental Condition

item	unit	min. - reference value - max.
Turning radius ( $R$ )	m	25 - <b>50</b> - 100
Time to gaze point ( $s$ )	s	1.0 - <b>2.0</b> - 4.0
Lateral acceleration ( $a$ )	m/s <sup>2</sup>	4.9

note; Red numbers indicate reference values

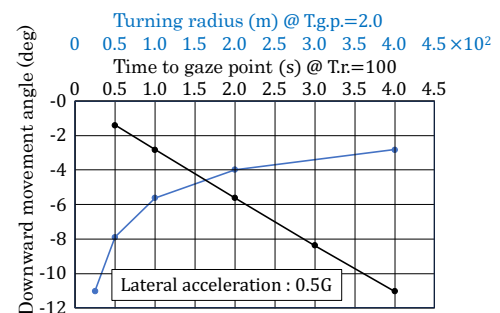


Fig. 2 Variations in the upward movement angle of a PMV

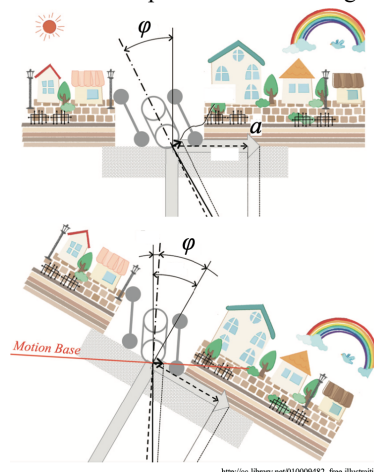


Fig. 3 Comparison DS motion of PMV with real world