Reduction in Ackerman Error in Steering System

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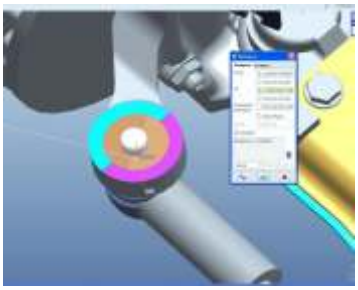
Keywords: Ackerman Error, Linkages, Steering System

Abstract:

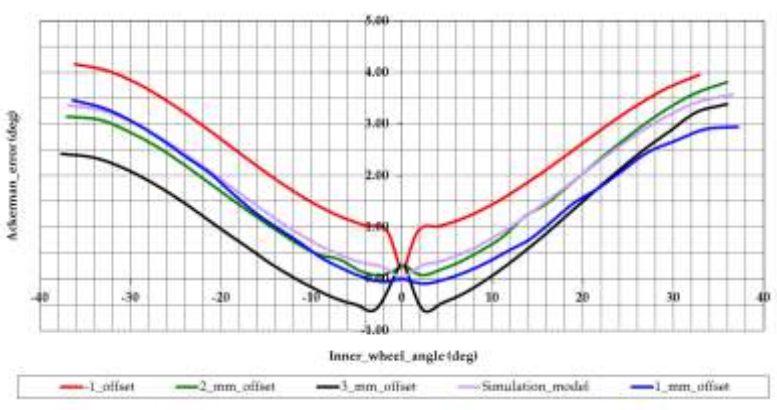
Direction control is one of the main requirements for road vehicles. This requirement is satisfied by utilizing steering system on a vehicle. One of the prime considerations during design of a steering system is, to minimize tire scrub during cornering. However, to achieve minimum tire scrubbing, wheel shall have pure rolling action without lateral sliding. This requirement can be met at only one angle of turning in existing mechanisms. The effect of which is seen as tire wear and higher lateral forces on steering and suspension components. The actual trials have shown 38% and 30% improvement in tire life during test with pure rolling action. Hence, Ackerman error is a focus point for steering, suspension and tire design and selection.

Hence, the scope of this project was decided to achieve reduction in Ackerman error in steering system with minimum modifications as the vehicle under consideration is already in production. However, during prior literature search it was learned that the length of the linkages needs to be changed to reduce Ackerman error. To change the length, a bush with an eccentric hole was employed in the steering arm of knuckle which can change the effective linkage length during rotation of tire. To confirm the concept, a virtual model of existing mechanism of the vehicle was made in Pro-e and validated with actual vehicle Ackerman error data. Further, the modifications were carried out in same model to achieve modified mechanism and same trials as earlier were carried out.

It was observed that with change in the eccentricity of hole of the bush hole, the Ackerman error changes during turning of the vehicle. Various trials were carried out with combinations of eccentricity value and direction in which eccentricity is employed. Finally based on the trials, it was concluded that with 3 mm eccentricity towards inner side of wheel appreciable amount of reduction in Ackerman error can be achieved. The reduction in Ackerman error at lock is 0.25° on right and 1.2° on left side over existing mechanism.



Modified mechanism



Ackerman error graph at various offset values with modified mechanism