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Basic Comparison of Chrono::Vehicle and ADAMS/Car

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Abstract

As part of the validation work for Chrono::Vehicle, a short single vehicle comparison study was executed between similar Chrono::Vehicle and ADAMS/Car automotive vehicle models. These models were compared in straight-line acceleration tests, a fixed speed constant radius turn test, and a double lane change test. The simulation results for the two models are in relatively close agreement, especially considering that the models are not intended to be completely identical.

Keywords: Comparison, Project Chrono, Chrono::Vehicle, ADAMS, ADAMS/Car

Contents

1 Introduction

Chrono::Vehicle is a template based modeling toolkit for CHRONO::Engine[1] designed to expedite the creation and simulation of full vehicle multi-body dynamics models. Although the fundamental components that the Chrono::Vehicle model is composed of have already been validated [2] [3], no full vehicle comparisons have been conducted to date. Therefore, this report details an initial basic comparison between similar full vehicle dynamics models in Chrono::Vehicle and ADAMS/Car.

For this initial comparison, a simplified model of the 2012 ADAMS/Car demo model was created in Chrono::Vehicle. The ADAMS/Car model was left unchanged except that the tires were exchanged for the Fiala tires used in the previous tire model validation work[3], the aerodynamic drag was reduced to zero, and the differential was changed to an "open" design instead of a limited slip design in order to simplify the comparison. The vehicle hard points and approximate mass properties were then replicated in the Chrono::Vehicle model. Where possible, ADAMS bodies were combined in the Chrono::Vehicle model in order to keep the Chrono::Vehicle model simple so that it could also serve as a general demonstration model within Chrono::Vehicle.

Three types of comparison maneuvers were conducted for this report. The first was a simple straight-line acceleration test in a fixed gear. The second was a slow speed constant radius cornering test, where the same speed was maintained through turns of various constant radii. The third was an ISO double lane change run at a single speed.

2 Straight-line Acceleration

For the straight-line acceleration test, the vehicles were started at 30kph and then full throttle was applied through the end of the simulated test without shifting gears. This test was executed in both 3rd and 4th gears. Since the initial settling conditions of the two models were slightly different, the simulation results were aligned at the time where each vehicle reached 40 kph. The driveline models and their associated rotational inertia are different between the two vehicles and this differences could potentially account for some of the acceleration variance between the two models.

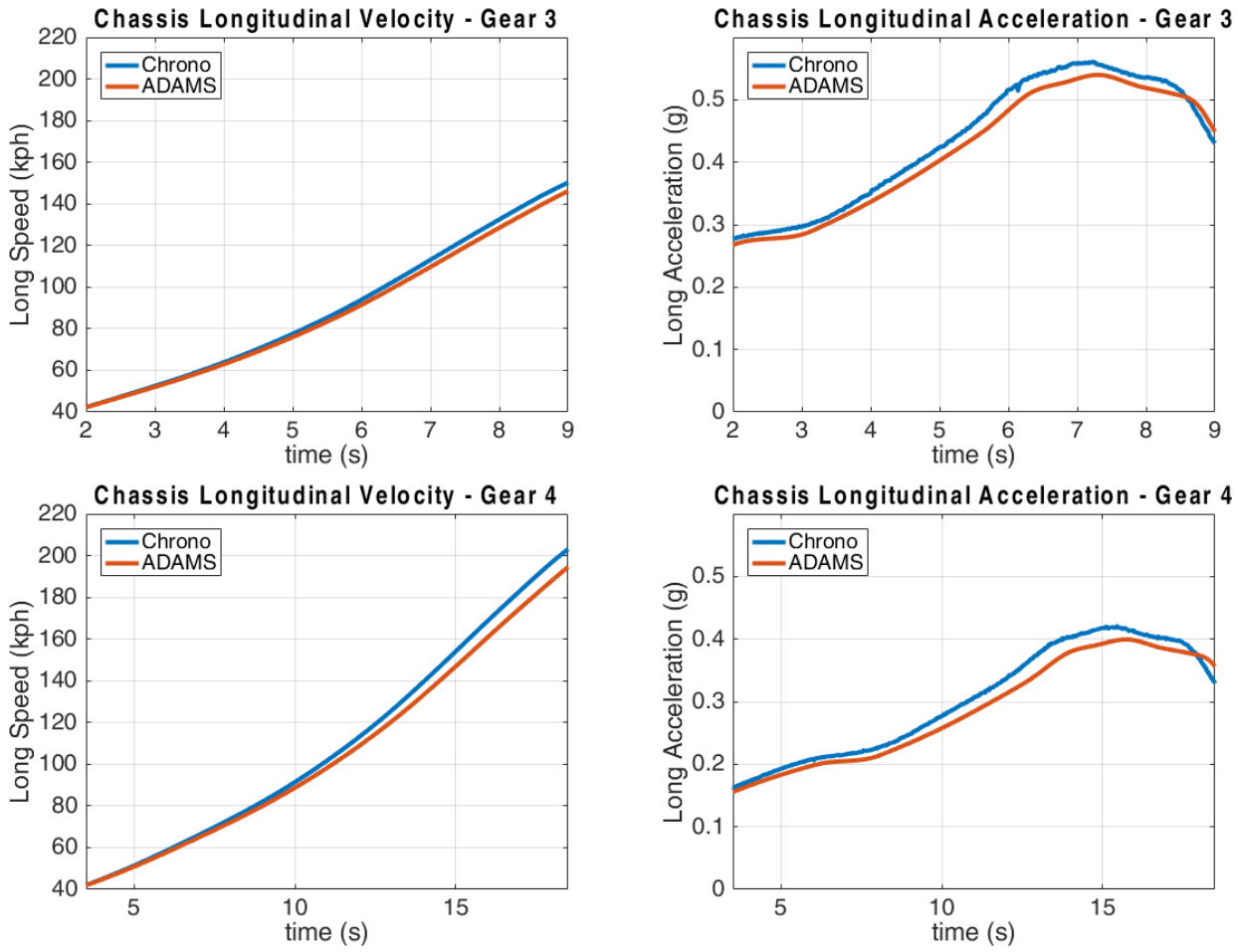

Figure 1: Straight-line acceleration test comparison between Chrono::Vehicle and MSC ADAMS/car in both 3rd and 4th gears

3 Constant Radius Cornering

For the constant radius cornering test, the vehicle was setup to run at a constant longitudinal speed of 2.5 m/s in first gear around various fixed radii turns. For each radius, the vehicle was allowed to reach a steady-state and then an average displacement of the steering rack was recorded. The displacements of the steering rack versus the turn radius or the lateral acceleration calculated for that turn radius are very close between the two models.

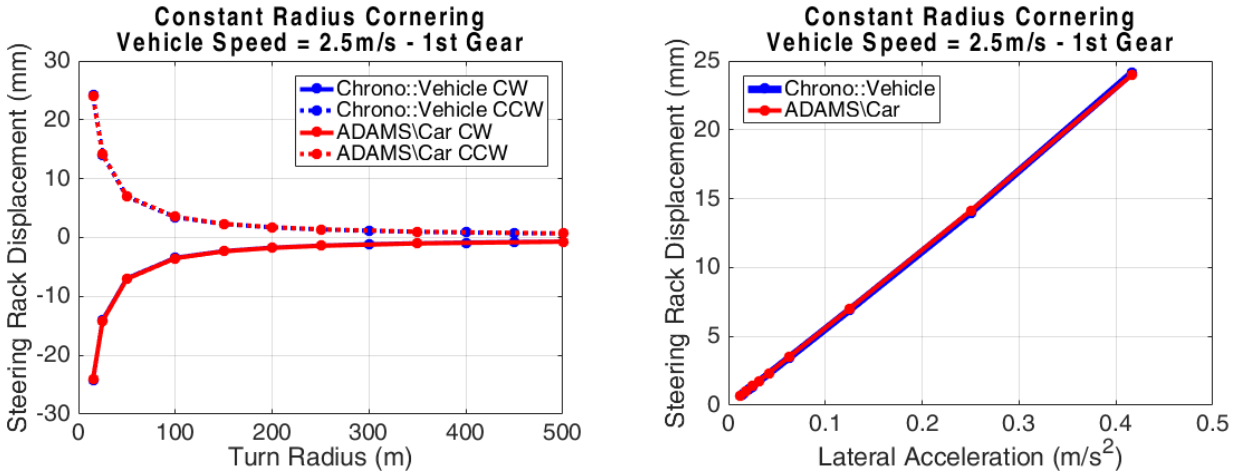

Figure 2: Constant radius cornering test comparison between Chrono::Vehicle and MSC ADAMS/car at 2.5 m/s in 1st gear

4 ISO Double Lane Change

For this test, both vehicles executed an ISO double lane change at 60 kph in 3rd gear. The lateral chassis positions for each vehicle are in close alignment for the two simulations, especially considering that the path and controllers used are slightly different between the two.

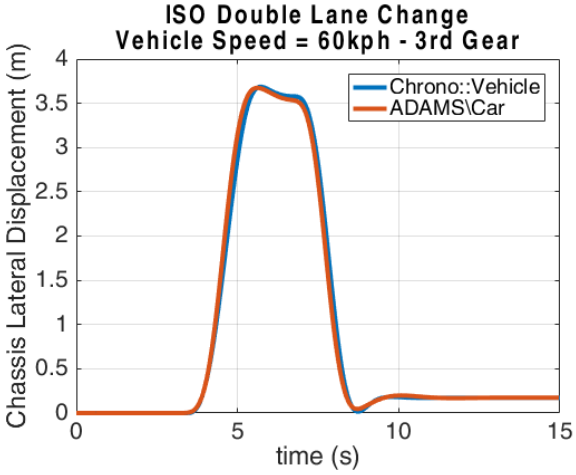

Figure 3: ISO double lane change test comparison between Chrono::Vehicle and MSC ADAMS/car at 60 kph in 3rd gear

5 Conclusion

Overall, the simulation test results between the two models are relatively close, especially considering that the models were not setup to be exact replicas of each other. If additional refinements to the Chrono::Vehicle model were made to bring it in closer alignment to the ADAMS/Car model, it is likely that even an closer agreement between the outputs of the two simulation models would be obtained.

References

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