

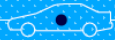


A Multi-Level Approach for the Validation of a Tractor Semi-trailer Ride and Handling MSC.Adams Model

Stefano Cassara

Senior Engineering Analyst

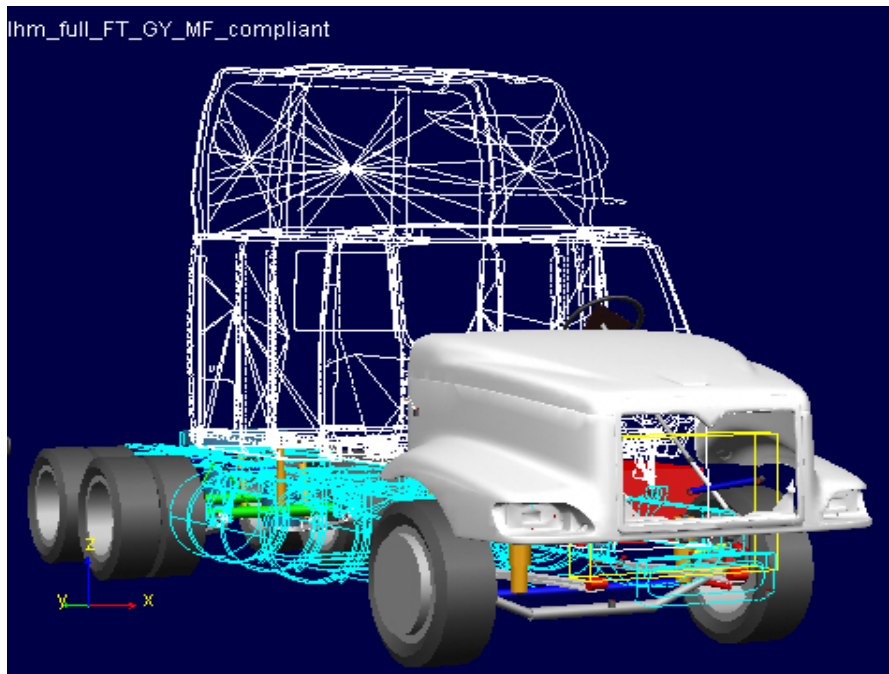
International Truck and Engine

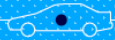


Full-Vehicle A/Car Model



- Improve modeling methods and correlation techniques
- Early development

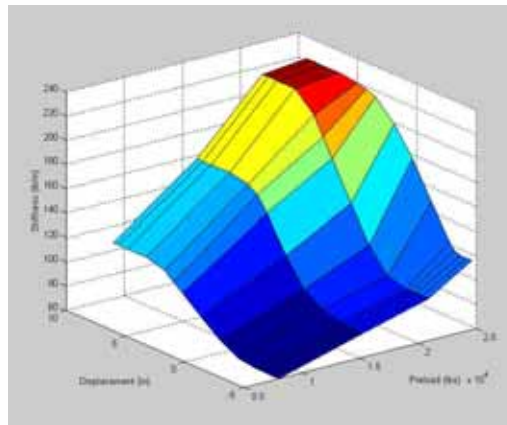


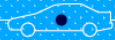


Traditional Correlation Method



1. Components (Mass Properties, Geometry)
2. Force Elements (Rubber Mounts, Shocks, Air Springs)
3. Suspension (Quasi-static)
4. Full Vehicle





Full-Vehicle Correlation Strategy



- Gather key acceleration measurements on control route
- Extract time- and frequency-domain statistical measures
- Adjust parameters



4

PRODUCT DEVELOPMENT CONFERENCE



Revised Correlation Strategy



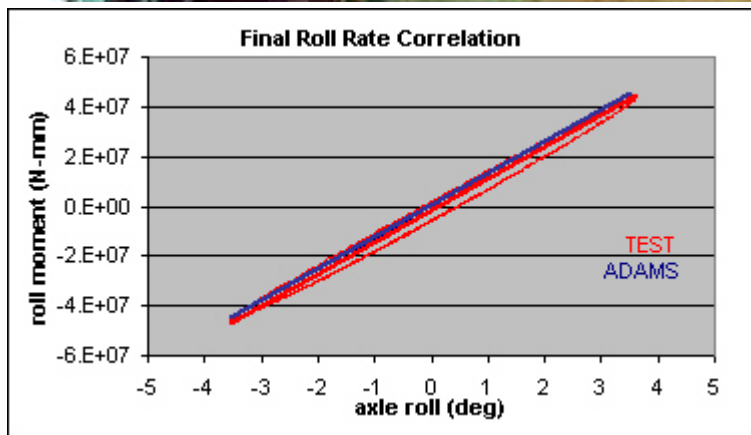
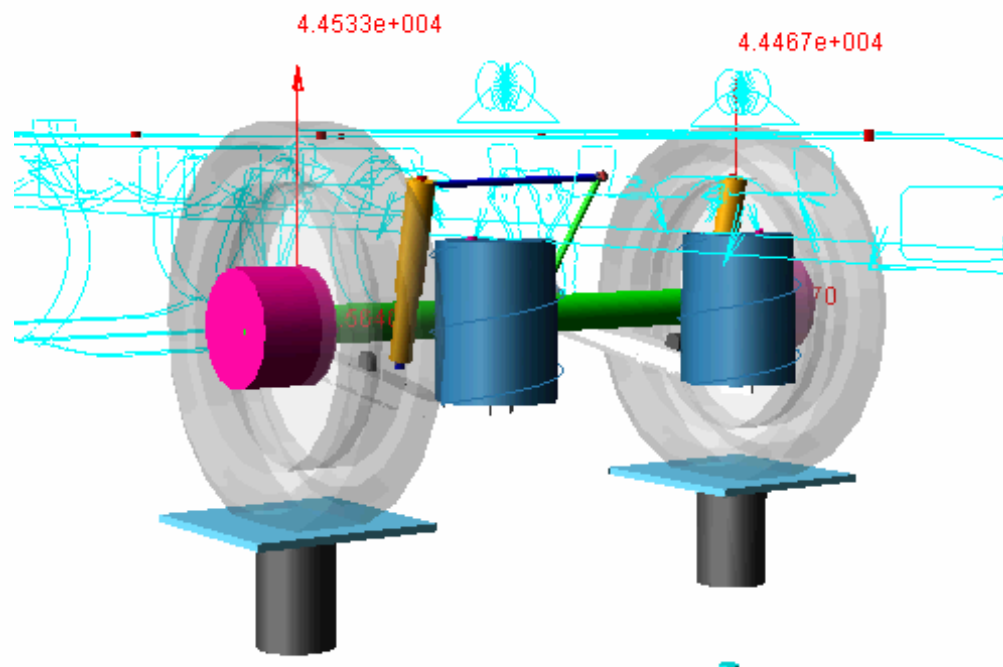
1. Component Data (Mass Properties, Geometry)
2. Force Elements (Rubber Mounts, Shocks, Air Springs)
3. Major Subsystems
 - Cab
 - Powertrain
 - Suspensions
 - Steering
4. Full Vehicle
 - Ride Evaluation
 - Tilt Table
 - Handling Maneuvers



UMTRI Suspension Characterization



UMTRI_IL_test_roll_angle Time= 1.0000 Equilibrium Frame=01





Subsystem Modal Analyses



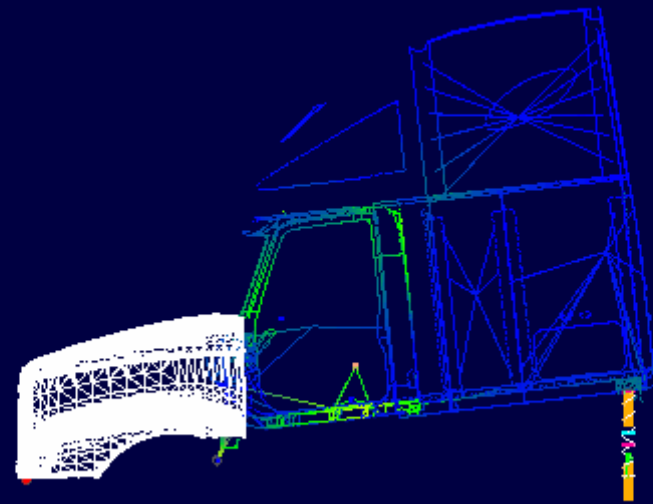
This control is not active

Container may be in Design Mode for sizing and position

To activate the control, use the container's Toolbox Tool

exit Design Mode

EIGEN_1 Mode=41 Frequency= 1.1122 (Hz)

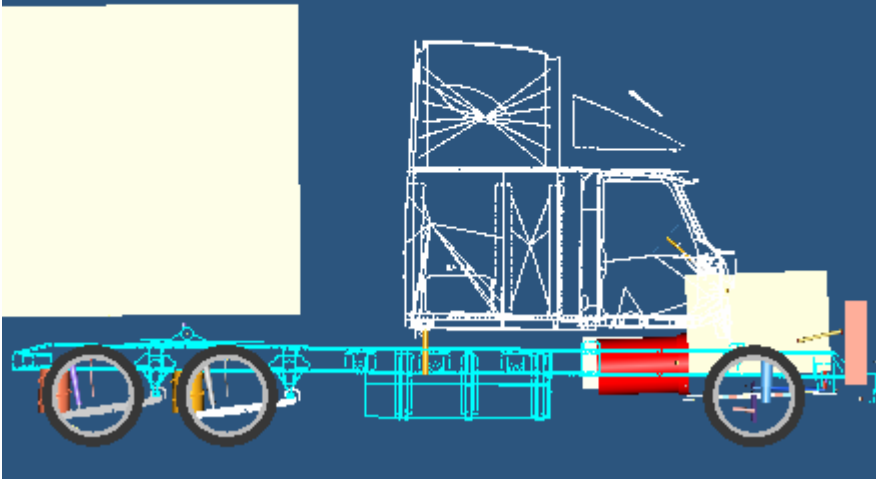




Full-Vehicle Modal Analysis



Mode 29 Freq = 5.645530 Hz, Damp = 7.450420 %



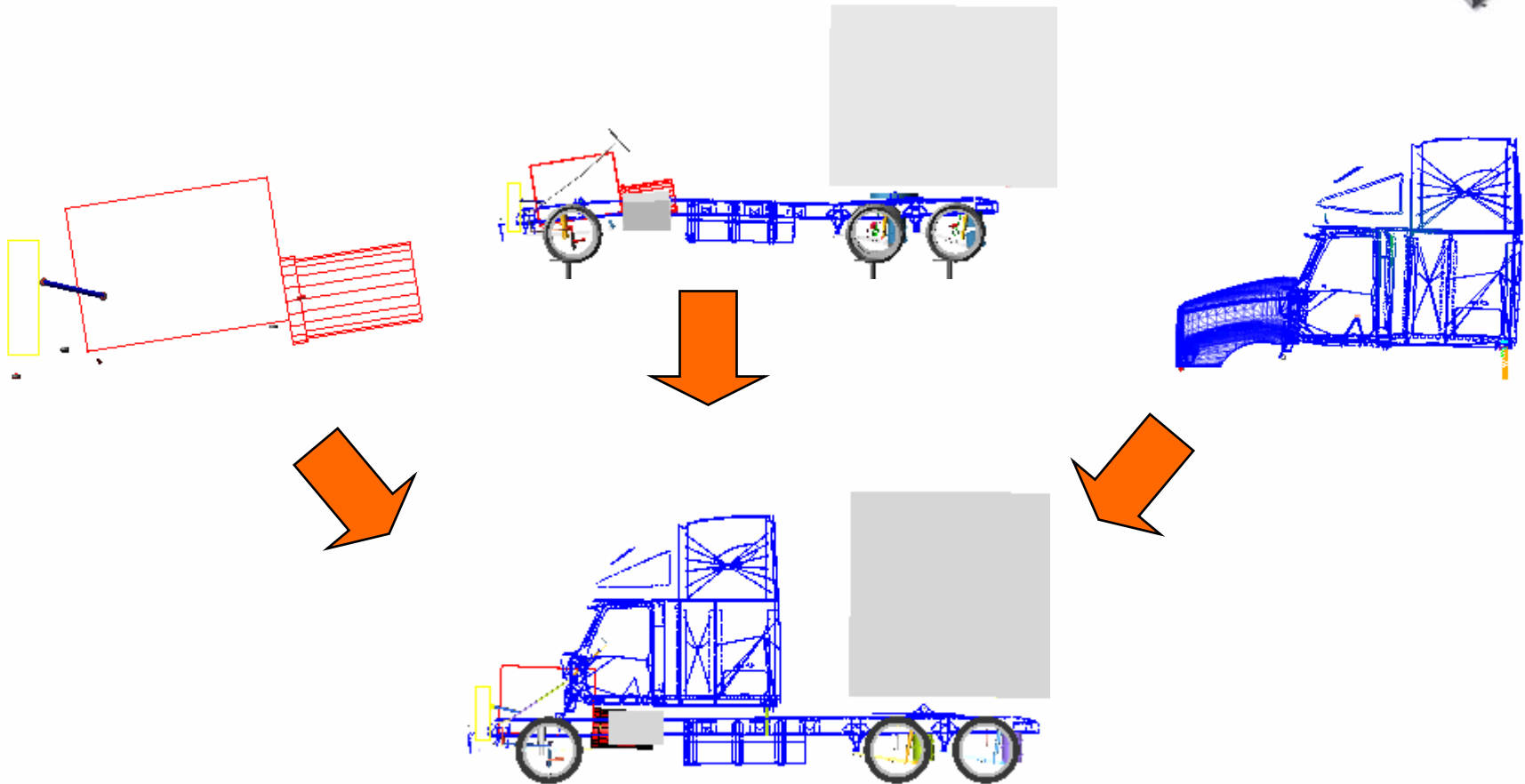
This control is not active

Container may be in Design Mode for sizing and position
To activate the control, use the container's Toolbox Tool

exit Design Mode



Subsystem Interaction





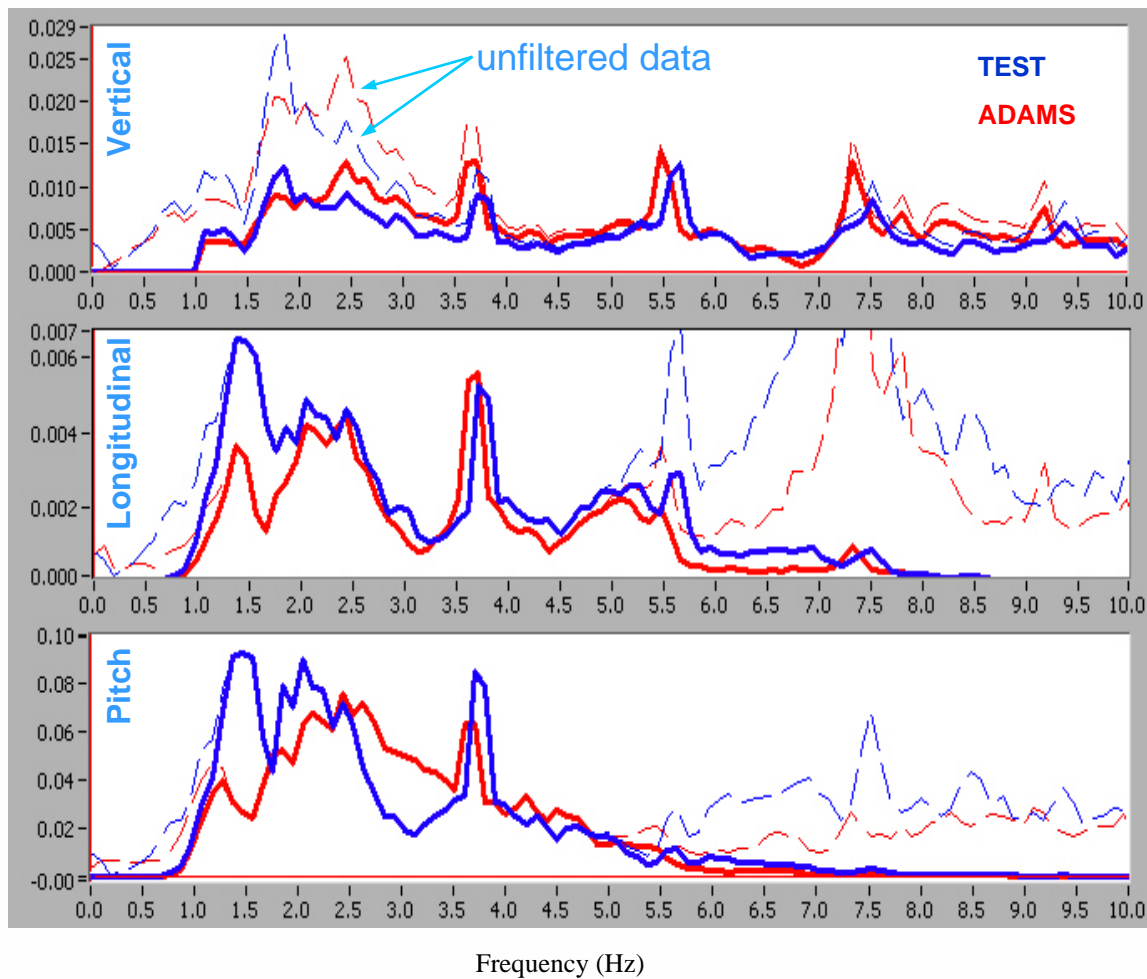
Modal Map



Freq	Vehicle	Chassis (No Cab)	Cab
0.7	cab pitch		
1.1			cab pitch
1.4	cab roll IP chassis roll		
3.2		chassis roll	cab roll
4.8	cab roll OP chassis roll		
7.5	frm beam OP cab pitch		
7.7		frm beam	



Ride Quality Correlation



Ride Quality Index

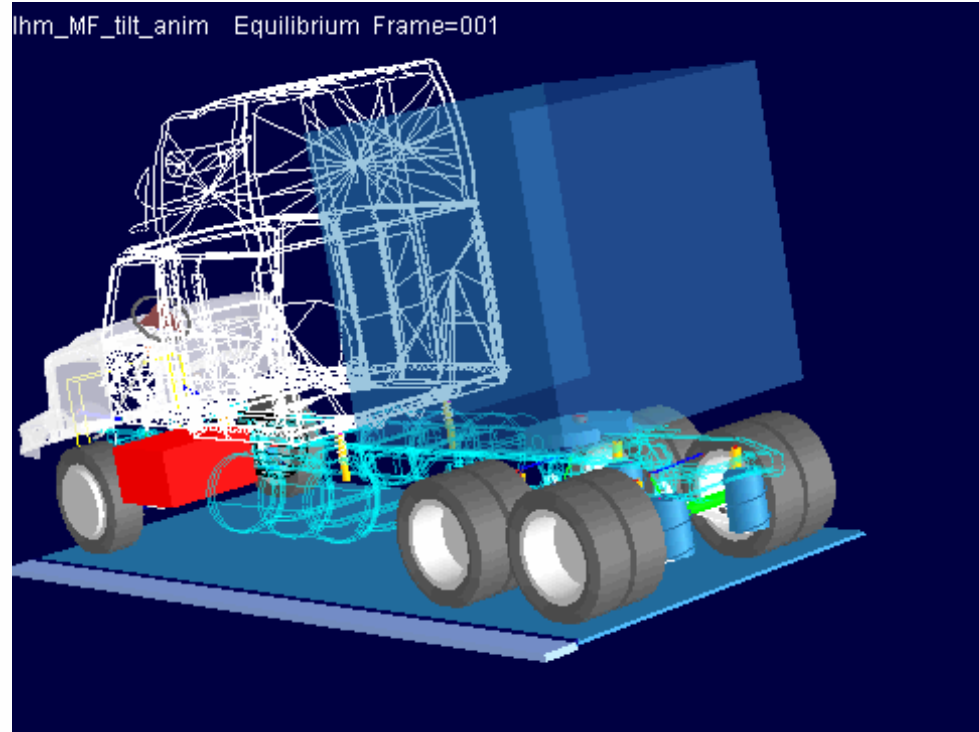
$$RQI = \frac{RQN}{RQN_{TV}}$$



	TEST	ADAMS	%DIFF
Vertical	1.10	1.13	2
Long	0.97	0.73	-25
Pitch	1.06	0.95	-10
Total	1.10	1.15	5

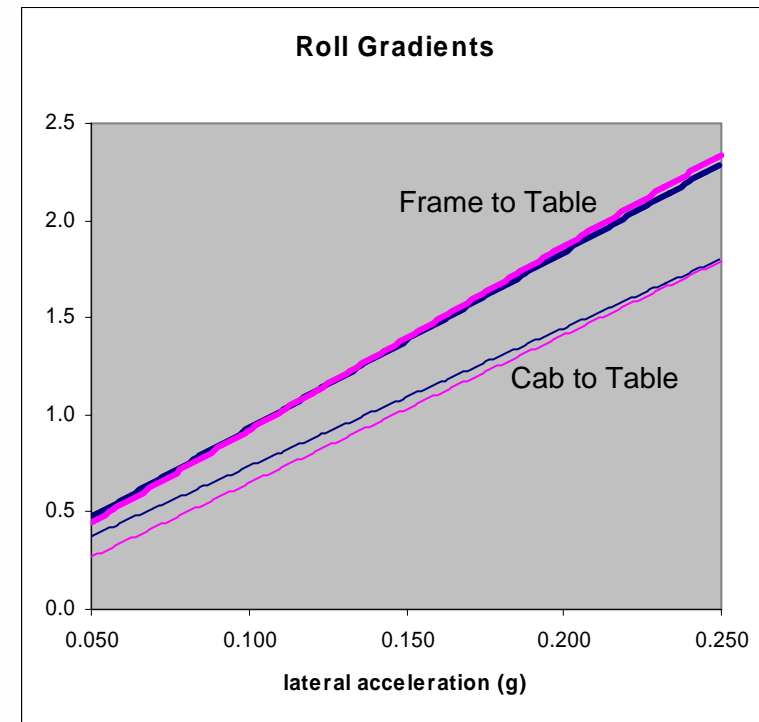
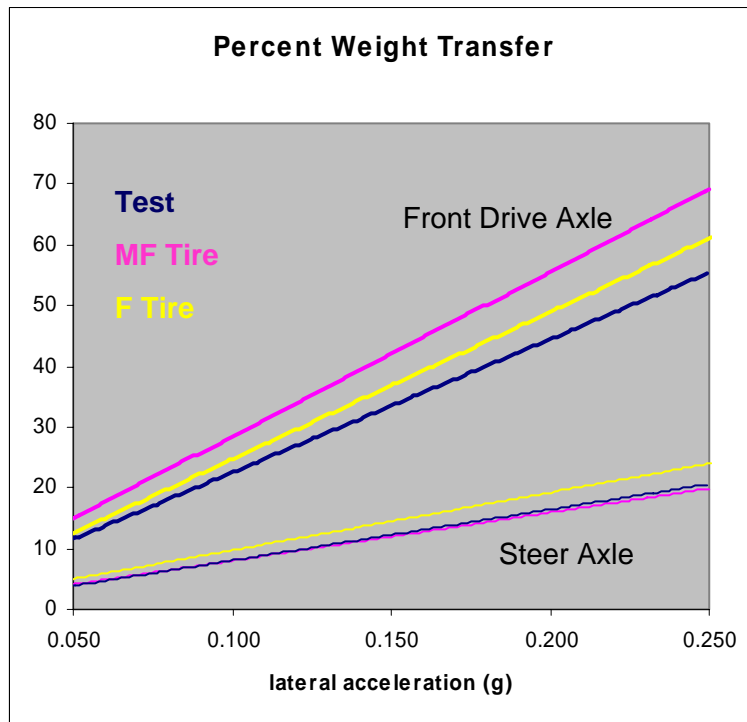


Tilt Table Testing



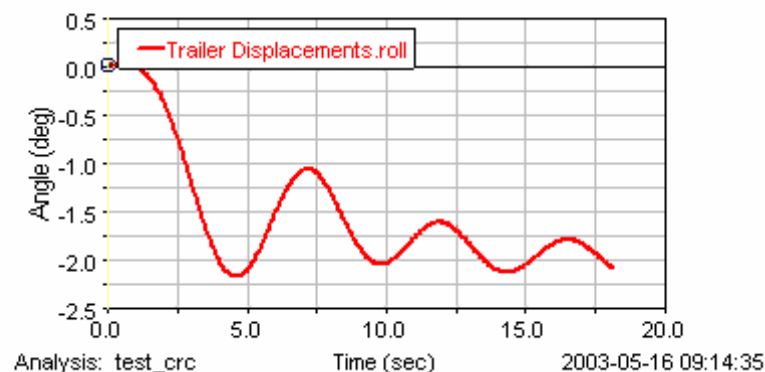
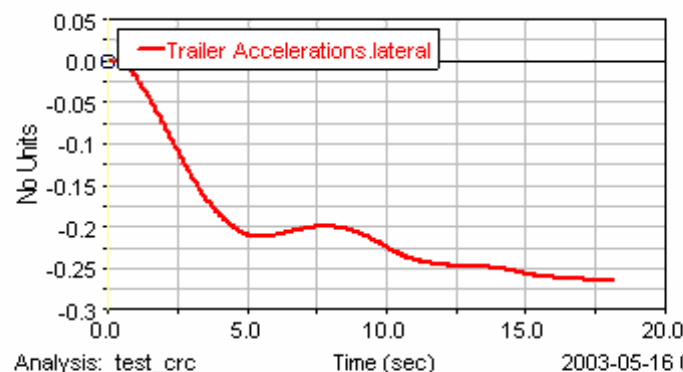


Tilt Table Correlation



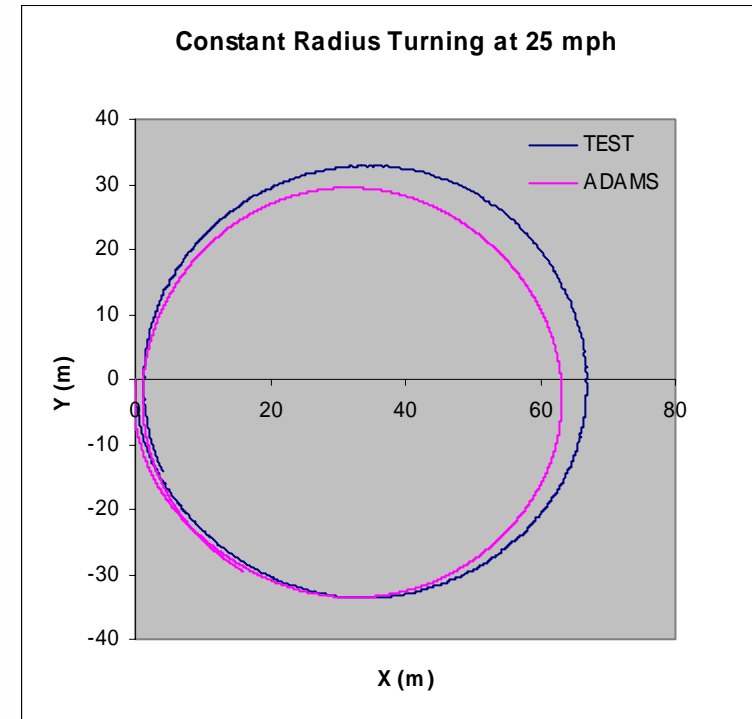
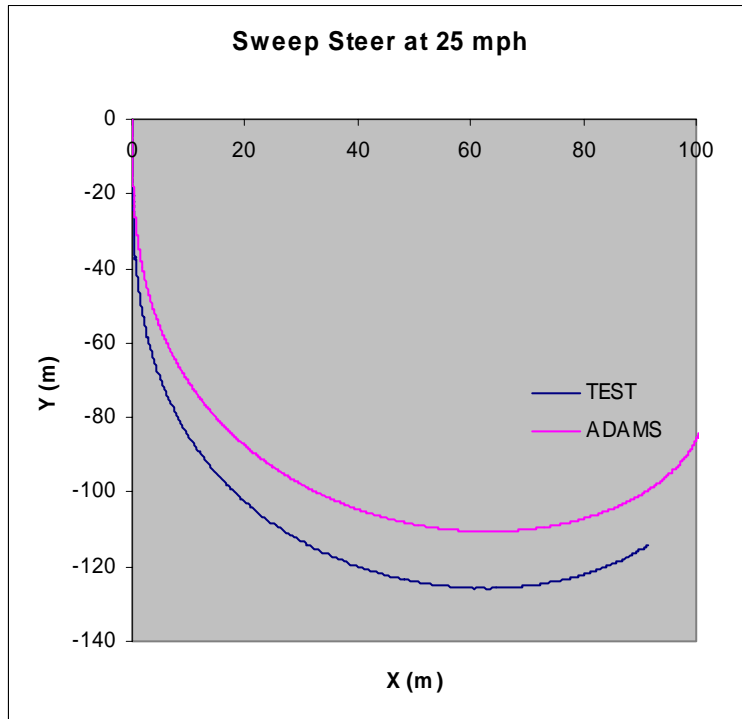


Handling Maneuvers



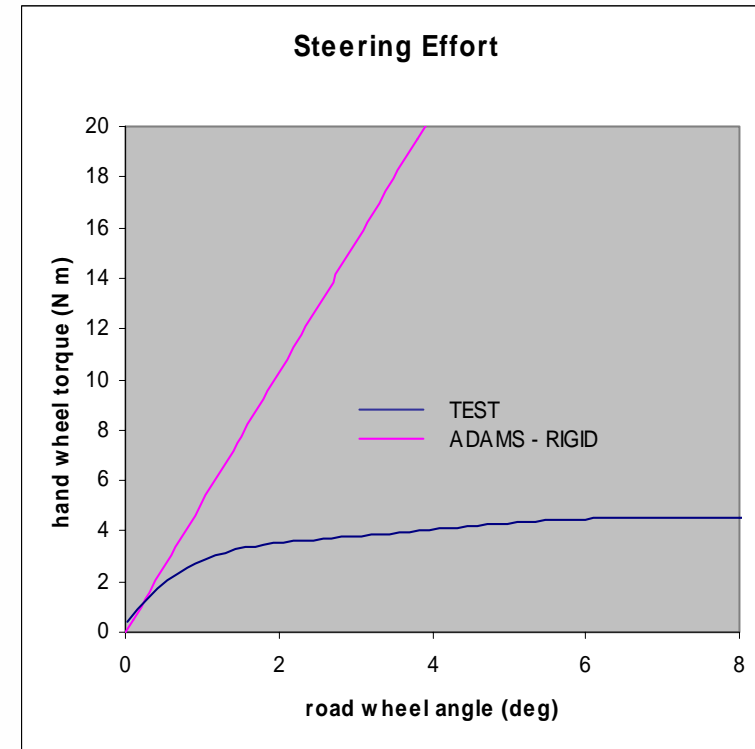
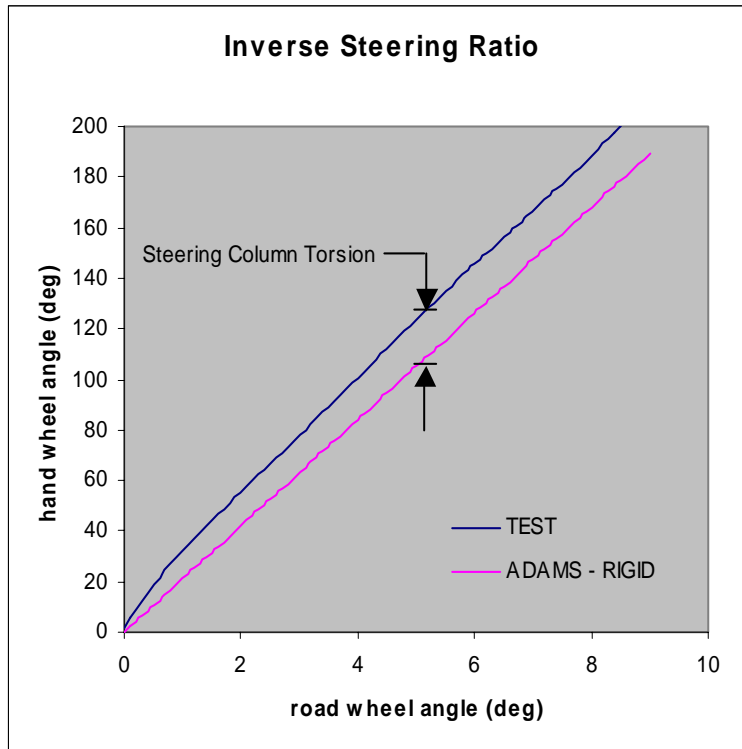


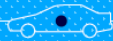
Handling Correlation - Initial



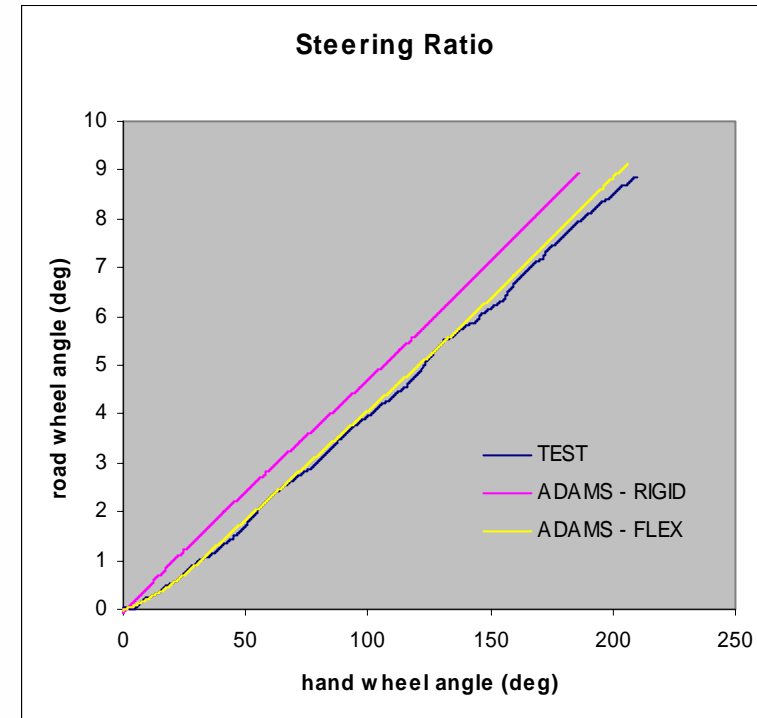
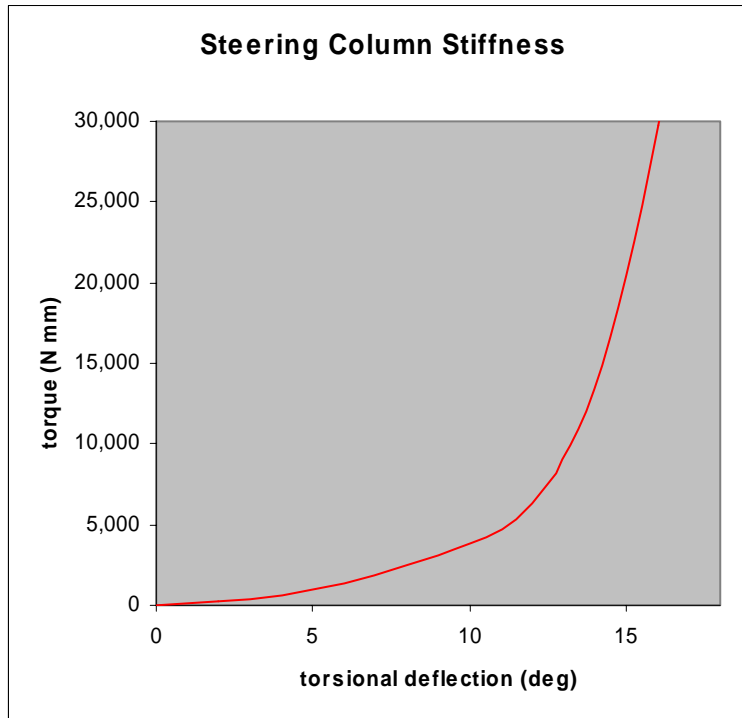


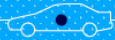
Steering System Correlation



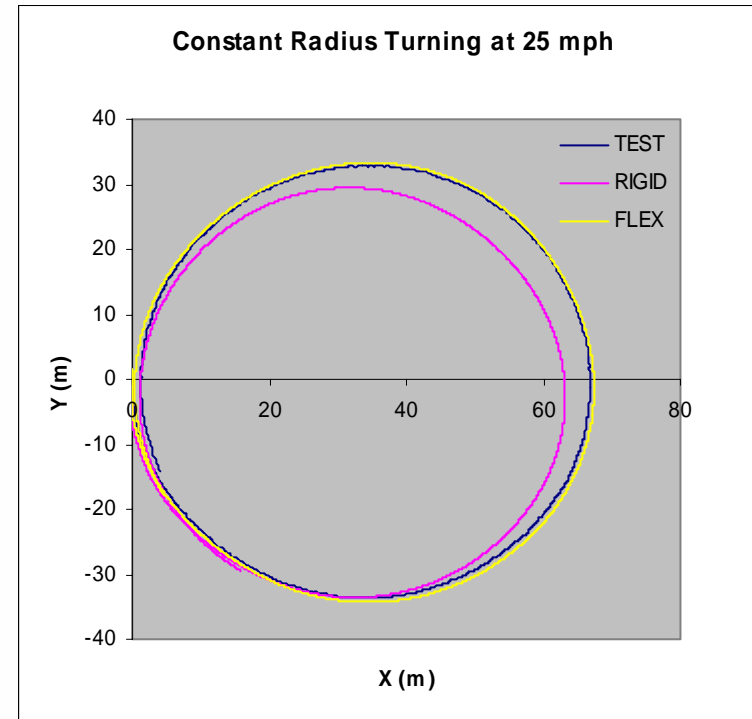
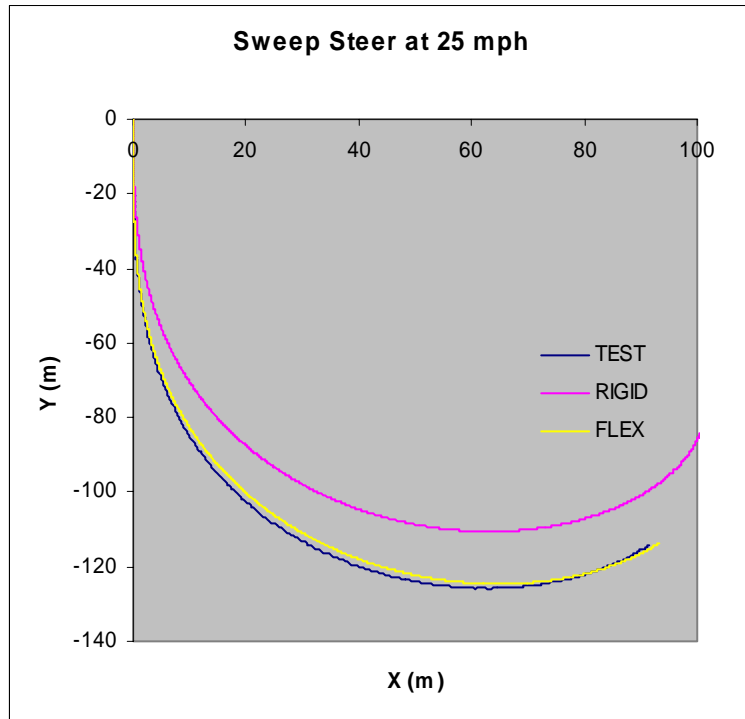


Steering System Correlation





Handling Correlation – Final





Advantages



- Fewer parameters, faster simulations
- Modeling weaknesses are easier to identify
- More meaningful correlation metrics
- Higher overall efficiency and effectiveness