

# P.V.Giridharan

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## Title: Vehicle Dynamics Project Portfolio

Vehicle dynamics (CAE Multibody Simulation) projects and related research activities performed at Jaguar Land Rover (UK), Daimler India Commercial Vehicles India, Honda (Japan), Tata Motors, TVS, ARAI.

Objective	<b>Steady-State Handling Behaviour of Passenger Vehicle and Sensitivity Study</b>
Abstract	Evaluate the vehicle concerning behaviour, responsive of the vehicle to driver inputs using steady-state test methods: Constant radius, Constant Steering wheel angle, constant speed with discrete turn radii and constant speed with discrete steering wheel angles. Initially correlated the multibody dynamics model and then carried sensitivity studies for various vehicle parameters: Axle loads, Cornering stiffness, Vehicle CoG Distance from front axle, Vehicle CoG height, Antiroll Bar Stiffness
Measurable Parameters	Under Steer Gradient, Steering Wheel Angle vs Lateral Acceleration, Chassis Body Yaw Angle vs Lateral Acceleration, Body Roll Angle vs Lateral Acceleration, Turning Circle Radius, Tire Slip Angles, Tire Lateral Cornering Force
Tools Used	MSC Adams, MATLAB/Simulink
Objective	<b>Optimization of Vehicle Handling Performance using Torque Vectoring Differential</b>
Abstract	Using active driveline system – torque vectoring differential evaluate vehicle handling performance for steady-state and transient conditions, compare with open differential - passive/conventional driveline results to show performance improvement index. Keeping initial results of active driveline results as baseline, optimize the active driveline controls – torque shift for driving inputs and terrains to improve the directional stability.
Measurable Parameters	Drive wheel torque, Steering Wheel Angle, Chassis Lateral Acceleration, Driver Seat Acceleration(X,Y,Z), Body Roll angle, Chassis Yaw Angle, Wheel Linear and Rotational Velocities, Tire Slip Angles, Tire Lateral Cornering Force
Tools Used	MSC Adams, SIMPACK, MATLAB/Simulink
Objective	<b>Optimisation of vehicle traction control (TCS) for icy surface</b>
Abstract	Due to network delay (up to 300ms) in traction control system, there will unnecessary wheel slipping shoot up and loss of vehicle control momentarily till TCS get fully activated. Developed a control system (plant model with 50ms delay) to resolve the momentarily loss of control of vehicle. Using Test data of failed response, developed and implemented a wheel speed vs tire slip curve, which acts as a limiter to cut off the throttle and smooth handover to TCS. For this activity used co-simulation – SIMPACK Virtual Full vehicle MBS model and SIMULINK Vehicle control system.
Measurable Parameters	Individual Wheel speed Linear & Rotational, Vehicle Speed, Engine Torque, Throttle Position, Engine RPM
Tools Used	SIMPACK, MATLAB/Simulink
Objective	<b>Optimization of Vehicle Ride and Comfort – Passive and Active suspension system</b>
Abstract	Objective assessment, correlation and optimization of ride performance index of vehicle using multi-body simulation. Evaluated the ride for various terrains smooth road, rough road, durability track, low frequency 0 to 20hz and high-frequency oscillation <20 Hz. Used flexible chassis model to incorporate the chassis flexibility and stiffness. Optimized/Tuned the damper curve nonlinear characteristics in terms of jounce and rebound 3D Road surfaces were modelled using OpenCRG and F-Tire used as tire model.
Measurable Parameters	Vehicle acceleration (RMS) at discrete location at chassis, Suspension travel, Seat acceleration (RMS) Chassis displacement, steering wheel acceleration, vehicle Pitch, roll and yaw angle, Jerk ( $m/s^3$ ), Suspension damper velocities
Tools Used	MSC Adams, Hypermesh
Objective	<b>Design and Optimization of Double Wishbone Suspension and Multi-Link Suspension</b>
Abstract	Design and optimize the suspension hardpoints, design, performance, durability and correlate with testing. This involved K & C testing, to determine the optimum response - bump steer, roll steer, brake steer, ride rate, kinematic roll centre, roll stiffness, anti-dive & squat angles, Vehicle CoG height, caster, camber, toe angles evaluation, longitudinal and lateral compliance, Aligning torque and understand the effects of mount stiffness, friction/hysteresis.
Measurable Parameters	Bump steer (Toe in/Toe out angle vs jounce/rebound travel), roll steer, brake steer, wheel vertical loads, camber, caster, kingpin inclination, steering torque, steering angle, pitch, roll, yaw.
Tools Used	MSC Adams, Motion View

Objective	<b>Research: Concept Feasibility Study of 5 axles Rigid truck</b>
Abstract	New vehicle concept 32-ton capacity– 5 axles rigid truck (2 front axle – twin steering axles, 2 Rear rigid tandem axles and extreme rear self-steering pusher axle. Evaluate the vehicle performance, handling and ride assessment for the new concept vehicle in the Indian commercial vehicle market
Measurable Parameters	Turning circle diameter, Steering effort, steering wheel angle vs lateral acceleration, Tire slip – individual tires – to estimate the tire wear, Tire lateral forces
Tools Used	MSC Adams, Motion View
Objective	<b>Evaluate the Sloshing dynamics (Fluid) of Tanker Truck</b>
Abstract	Assess the influence of fluid sloshing (partial filled) on rollover stability, directional stability (yaw instability), and straight-line braking performance. Initially started with a simple pendulum model (combined longitudinal and lateral) to capture the fluid dynamics using test data and then moved to co-simulation with CFD software.
Measurable Parameters	Chassis Roll angle, Pitch Angle, Yaw angle, Steering Wheel angle, Suspension travel, Seat acceleration, Vehicle lateral acceleration, roll stiffness, pitch stiffness, vehicle wheel load transfer
Tools Used	MSC Adams, Motion View
Objective	<b>Determination of Rollover stability of LCV/HCV – Tipper Truck based on IRTE guidelines</b>
Abstract	Developed a virtual prototype of the tipper vehicle to determine the vehicle rollover stability in ramp and banking conditions based on IRTE guidelines for various vehicle configurations
Measurable Parameters	Individual Wheel loads (Vertical, Longitudinal and Lateral), Tipper body (Roll and pitch angle), Vehicle Roll and Pitch angle, Vehicle CoG Displacement, Chassis twist angle. Zero Vertical Wheel load determine the wheel lift out points the max roll stability angle.
Tools Used	MSC Adams, Motion View
Objective	<b>Predict the Directional Stability of the Semi-Trailer Truck (Articulated Vehicle)</b>
Abstract	Modelled a tractor/semi-truck with trailer (with full suspension subsystems) connected using the fifth wheel. The project aim is to understand the directional stability of the vehicle under various conditions such as weight distribution, wet roads, emergency braking, and lane change scenarios also harsh conditions such as jackknifing. This evaluation includes an open loop and closed driver models. Validated the model and process by correlating with test and later this validated process used across other capacity vehicles.
Measurable Parameters	Turning circle diameter, Steering effort, steering wheel angle vs lateral acceleration, Tire slip – individual tires – to estimate the tire wear, Tire lateral forces
Tools Used	MSC Adams, Motion View
Objective	<b>Design and optimisation of anti-roll bar design for passenger car</b>
Abstract	Developed an antiroll bar design (weight to performance ratio) to meet the required body roll targets and optimized the design further for durability (strength, stress, strain), forces transfer to mounts, natural frequency. This involved evaluation of hollow bar/solid bar, design the bar arm curvature based on packaging and evaluated for steady-state and transient conditions.
Measurable Parameters	Body Roll, Strength - Stress, Strain, Bracket forces, Steering Wheel Angle vs Lateral Acceleration, Body Roll vs Lateral Acceleration
Tools Used	MSC Adams, Motion View, Hypermesh
Objective	<b>Predict Steering Component Forces of Single and Twin steer Light Duty and Heavy Duty Commercial vehicles</b>
Abstract	To evaluate the strength and life of steering components(Knuckle, Steer Arm, Tie Rod, Drag Link, Pitman arm) of the vehicle, developed a multibody dynamics parametric model to predict and extract the maximum loads of each component in its local coordinates to evaluate the fatigue life, buckling of rod. This involved evaluation for various abuse conditions such as frontal kerb strike, side kerb strike etc.
Measurable Parameters	Components forces, Stress, Strain
Tools Used	MSC Adams, Motion View, Hypermesh