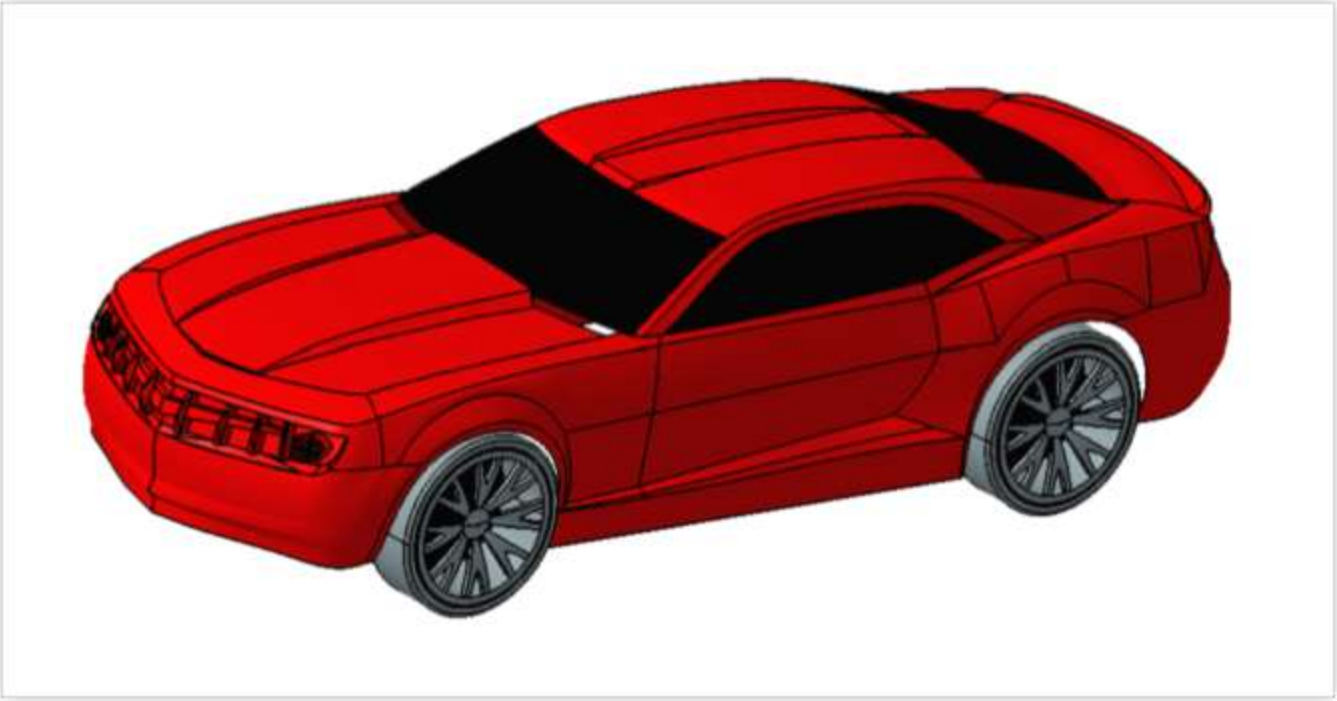
Drive Train Simulation
Multi Body Dynamics



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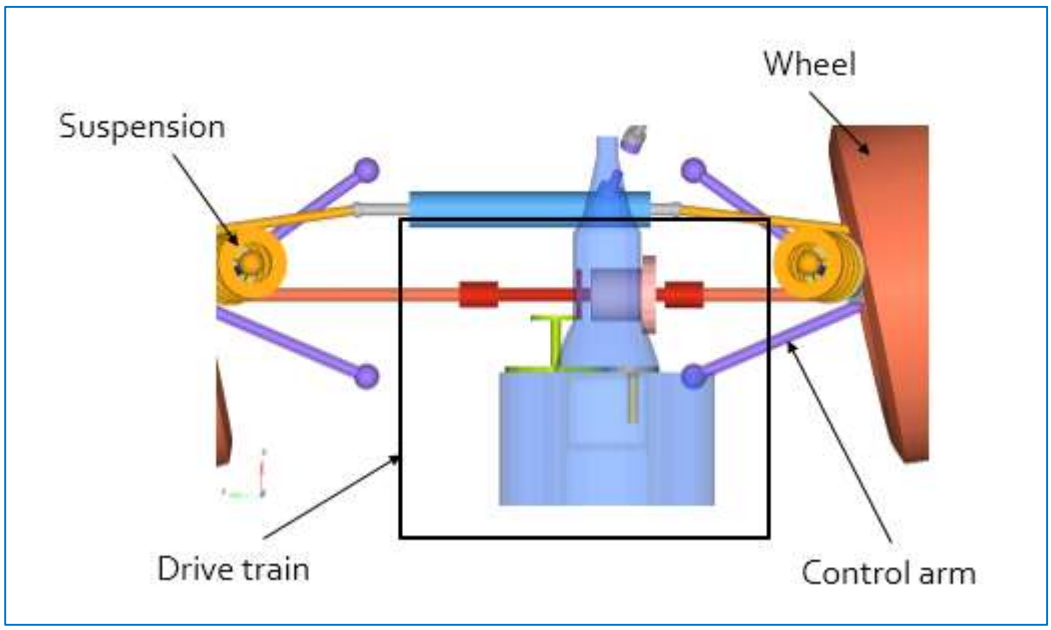
1.0 **Introduction**

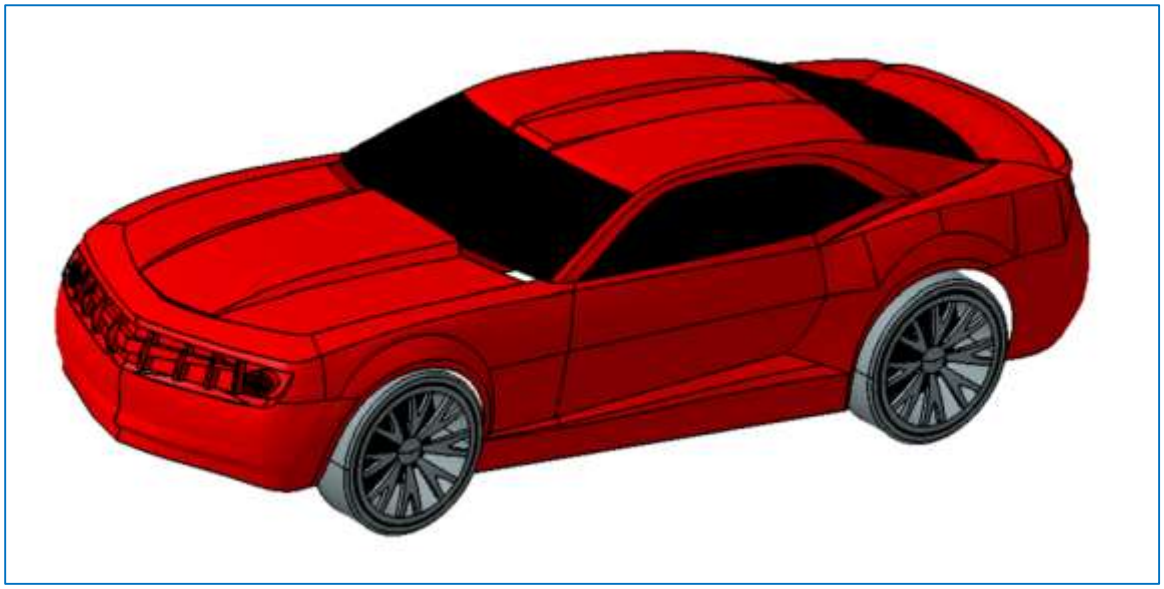
Objective of the study is to simulate multi body dynamics of Drive train and Steering systems of a passenger car. Drive train, Steering system and Suspension system are modeled in Altair Motion Solver. Motion is simulated on Drive train and steering systems and inferences are drawn.



2.0 **Modeling**

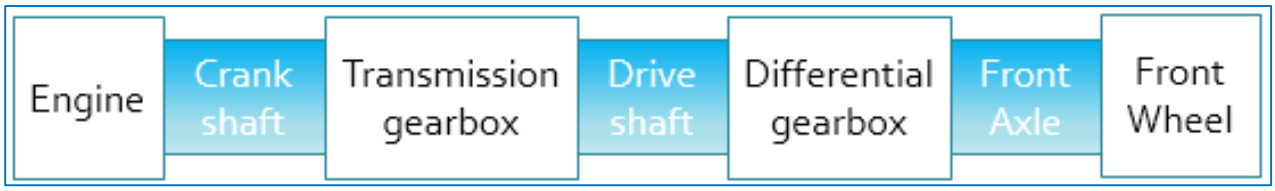
2.1 Car Body

Car body of a sports coupe is modeled (Surface model of the outer car body) using NX 8.5 3.



2.2 Drive Train system

Block diagram of the Drive train arrangement connecting various components:

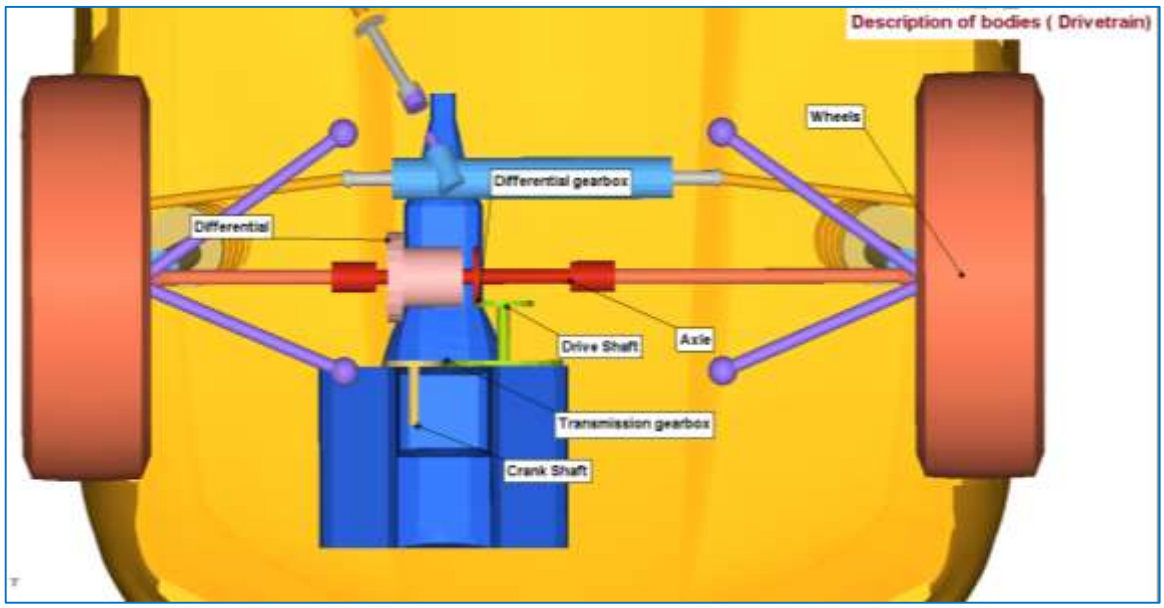


Drive train arrangement consists of:

- Engine (block)
- Crank shaft
- Transmission gearbox
  - Spur gear drive: 1:2 gear ratio
- Out shaft
- Differential gearbox

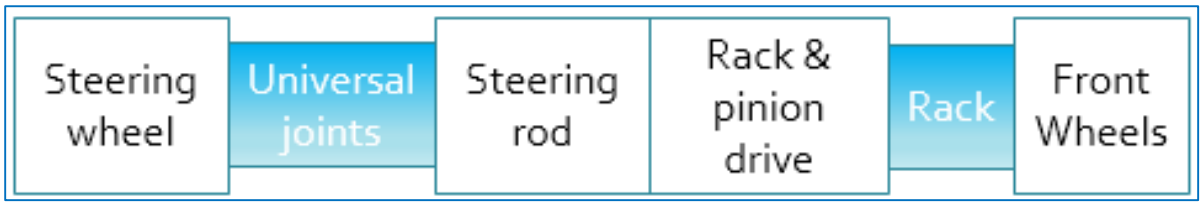
- Bevel gear drive – 1:1 ratio, to transmit drive perpendicular to the axle.

- Front Wheels



2.3 Steering system

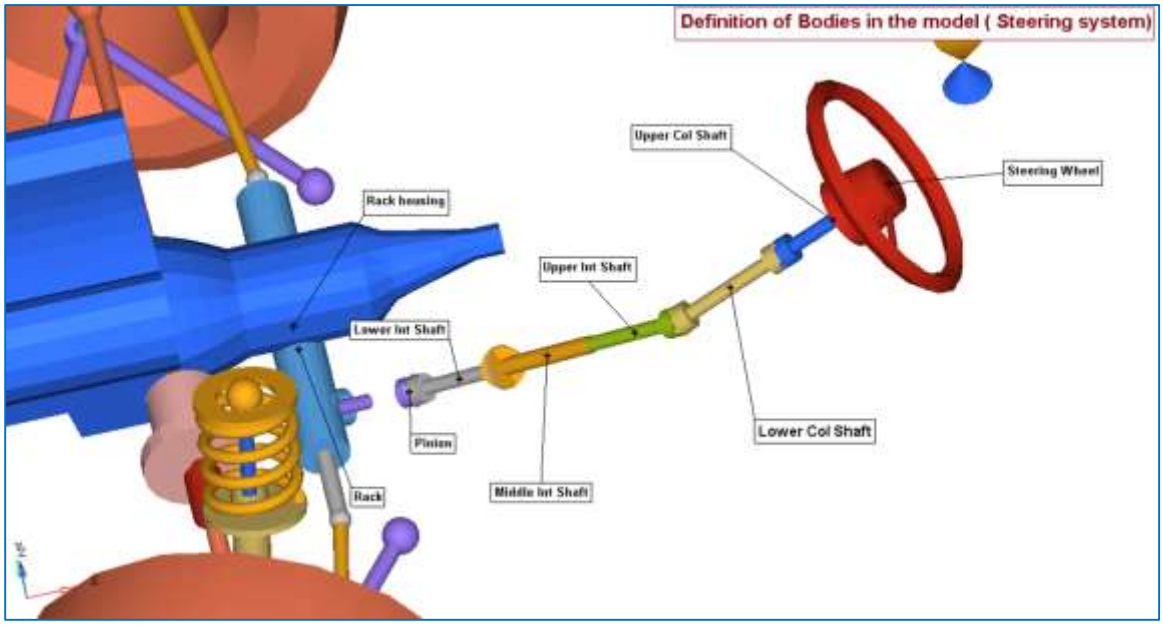
Block diagram of the steering system:



Steering arrangement consists of:

- Steering wheel
- Universal and Flexible couplings
- Steering rod
- Control arm

- Rack and pinion
- Front wheel



3.0 **Methodology**

Tools used in the present study:

NX 8.5: for 3D modeling (surface modeling) of outer car body.

Altair Motion solver: for multi body Simulation

1. Components of all systems explained earlier are modeled in Altair motion solver.
2. Mass and Inertia are assigned to components.

3.1 Drive train:

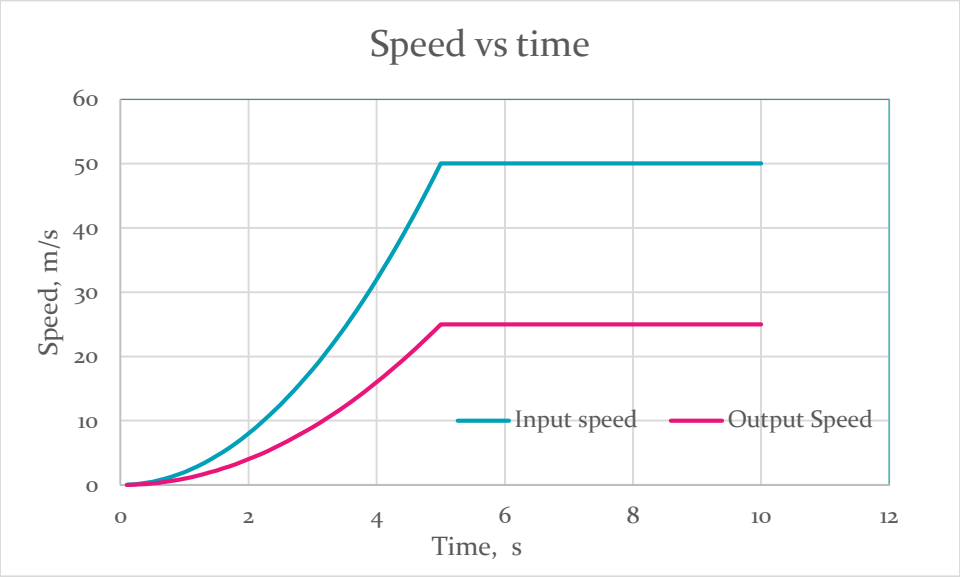
a. Speed and torque are given as input to the Crank shaft.
b. Ramp up time of 5 sec and total drive time of 10 seconds (including ramp up) is given to the simulation.
c. Transmission gear box, coupled to the input of the gear box has a ratio of 1:2.
d. Input speed is varied from 0 to 50 m/s at the crank shaft.
e. Corresponding out speed is achieved at the output of the gear box as 0 to 25 m/s in 5 seconds.
f. Using bevel gear box (differential) this speed is transferred to the axle, which in turn transmitted to the front wheels.

3.2 Steering system:

a. Components of the system are constrained sufficiently so that rotation of steering wheel inturn rotates the wheels sufficiently for proper steering control of the wheel.
b. Rotary motion of the steering rod is translated as linear motion at the wheel to turn by using rack and pinion arrangement. Rack pushes/pulls the wheel in /out for proper steering.

4.0 **Simulation output and observations**

a. Wheel rotation (see the attached video).
b. Steering control of the wheel (see the attached video).
c. speed vs. time at wheels



Belwo two simulation files (video files) are uploaded along with the report.

a. Simulation of drive model :- ***Drivetrain_new.avi***
b. Simulation of Steering model :- ***Steering_sys.avi***