

MECH 4420 Lab Day and Final Project
Combining Experimental Data, Simulation, and Design.
(Preliminary Requirements)

Formal Presentations due during dead day or Final Exam Period. Exact time - TBA

To be performed in teams. The team should schedule a time to meet with me before going to the track to discuss what experiments you will be taking and what aspects of vehicle dynamics you will be concentrating on. The team should also see me before presentations to seek advice and approval of the presentation.

Only, printouts of the presentation need to be turned in – but these presentation slides should be fully self-contained (equations, derivations, results, etc.).

I. Experiments

Pick some of the following experiments to perform at the track. You may think of other experiments as well – this is just a list of suggestions.

1) Coast Down Experiment

Log deceleration, velocity, position and time (AP22)

Have someone log time vs. speed data for verification

2) Quarter Mile Experiment

Log $\frac{1}{4}$ mile acceleration, velocity, position and time (AP22)

Have someone log time vs. speed data for verification

Have someone estimate pitch

3) Steer Angle vs. Yaw Rate

Run around the track. Roughly Measure your steer angle input for various speeds

Have someone record Speed.

Log Lateral Acceleration (AP22)

4) Braking and/or Acceleration

Have someone estimate pitch

Log deceleration, position and velocity (AP22)

Have someone log total braking time

5) Transient Handling

Perform Lane Change Maneuvers

Sinusoidal Steering Inputs

Have someone log time, frequency, etc.

II. Data analysis and Simulation

From experimental data estimate:

- Pitch rate (K_θ) of the vehicle in deg/g under acceleration and braking
- Drag coefficient and rolling resistance for you vehicle
- The understeer characteristics of you vehicle
- Delivered Power
- Engine Inertia
- Drive Train loss factors (one constant and one proportional to engine speed)

Compare experimental data with simulation results

III. Design

We have developed lots of simulation tools over the semester. Taking experimental data and simulation data now allows the ability to perform design. Take some aspect of the vehicle and modify the design. Show you are confident that your new design will work (compare simulation and experimental with existing design then show how the car would perform with the new design using the simulation tools!).

IV. Other Possible things to look at or model

- (1) Look at the effect of roll steer on the transient handling model we have developed.
- (2) Investigate active suspension techniques on a quarter-car and half-car model of the suspension.
- (3) Examine suspension kinematics in more detail than we have, developing models for roll camber and roll steer effects (using a CAD package, for instance).
- (4) Examine what four wheel steering can do and what algorithms might work for such a system.
- (5) Design an ABS control system and simulate
- (6) Design a traction or stability control system and simulate
- (7) Design an automated lanekeeping system and simulate
- (8) Analyze data from a Mercedes E-class and determine vehicle understeer gradient and tire cornering stiffnesses.
- (9) Accident Reconstruction
- (10) More detailed handling analysis and design, including camber effects and transients