

ME 106/227
Spring 2002
Assignment #3 - Vehicle Suspension Parameters
Due Tuesday, April 23

This assignment can be performed in teams of up to three or four people if you would like. Turn in one report that lists the names of all team members. It shouldn't be that much work, but does involve crawling around under cars where second opinions about what is what can be very useful.

Purpose of Assignment #3

In this assignment, you will relate the discussion of linkage and steering kinematics to the characteristics of several real cars, including the vehicle you drove in the lab. Each team should choose one car to model and follow through the steps outlined below to produce a parameter set. Taking measurements from real cars can be tricky – if you need help, send email to me or the TAs and we will set a time to head out with you and look at your vehicle.

Problem 1 – Suspension Parameters

Pick a car or truck (other than our test vehicle) and parameterize the front and rear suspensions by answering the following questions. Identify what vehicle you are using for your parameters and be prepared to discuss your results in class on Tuesday.

- (1) Suspension type. What type of front suspension does the car have? Rear suspension? Why do you think these types were chosen for this particular car?
- (2) Suspension kinematics. Draw (to scale) a front view of the suspension kinematics for both the front and rear suspensions. Include all link points, the vehicle centerline, the tire, the linkage's instantaneous center in this configuration (as you measure it, at rest) and the roll center. How high is the roll center off of the ground? What does this tell you about scrub? Where is the instantaneous center of the suspension? What do you predict happens with camber change?
- (3) Steering kinematics. Locate the ball joints where the tie rod connects to the wheel body and the inboard elements of the steering system (the rack, for instance) on a scale front view of the suspension. Is it a front steer or rear steer arrangement? Do these two ball joint points lie along the line to the instantaneous center? If not, is this an understeer or oversteer effect? Explain. In this front view, locate the kingpin axis, the kingpin inclination angle and the scrub radius. In a side view, draw the caster angle, kingpin offset and mechanical trail. What are the quantitative values of the caster angle, kingpin inclination angle, scrub radius and mechanical trail?
- (4) Roll stiffness. Estimate the spring rate and spacing of the front and rear springs. If you have a stabilizer bar, estimate the additional stiffness due to this element. Do you see a bump stop on the suspension? If so, about how much compression can the spring or suspension handle before you hit the bump stop?

Problem 2 – Suspension Kinematics of the Double Wishbone

In class on Thursday, we will hand out a diagram showing the approximate suspension geometry of the Mercedes used in the lab. Using the MATLAB scripts on the web, look at the characteristics of the roll center of this suspension by going through the following steps:

- (1) Develop a subroutine that calculates the roll center of the suspension from some combination of the values calculated by the function wishbone.m. There is more than one way to do this since you are given much more information than needed. Keep in mind that you must handle cases where the links are parallel and the instantaneous center lies on the ground. We will give you test cases in class on Thursday for which to calculate the roll center using your code.
- (2) Put in the geometry for the Mercedes and calculate the roll center. If we assume the vehicle rolls about the roll center 5 degrees in either direction, calculate a combination of car body height and roll about the center of the car body that corresponds to this roll about the roll center.
- (3) For this range of parameters, calculate the roll center location as a function of roll angle and plot graphs of the roll center height versus roll angle and the right and left camber angles versus roll angle.