

Sim Test Investigation

Aims

The three aims of exercise will be to

1. Use the measured roll angle from a Sim test to determine the centre of gravity height H_{tot} of the Locost model you test.
2. Compare wheel load distribution obtained from the Sim with the wheel load distribution you obtain with your WT spreadsheet.
3. Investigate the effect of wedge on the handling characteristics of the car when cornering.

Aim 1

Find the Centre of Gravity Height

Data

T_f	Front track	m
T_s	Rear Spring track	m
L	Wheel base	m
M_{sf}	Front sprung mass	kg
M_{sr}	Rear sprung mass	kg
M_{usf}	Front total unsprung mass	kg
M_{usr}	Rear total unsprung mass	kg
h_f	Front RC height	mm
h_r	Rear RC Height	mm
K_{wr}	Rear wheel rate	N/m
K_{wf}	Front wheel rate	N/m
r	Rolling radius (also Hus)	m

Step 1 Calculate wheel rates

$$K_{wf} = \quad \quad \quad \text{N/m}$$

$$K_{wr} = \quad \quad \quad \text{N/m}$$

Step 2 Calculate roll stiffness

$$K_{\varphi f} = \frac{(T_f^2 \times K_{wf})}{2} \quad \text{Nm/rad}$$

$$K_{\varphi r} = \frac{(T_s^2 \times K_{wr})}{2} \quad \text{Nm/rad}$$

$$K_{\varphi \text{tot}} = K_{\varphi f} + K_{\varphi r}$$

Finding the Sim H_{tot}

Step 3

Find the roll angle ϕ that the Sim generates at a known lateral acceleration a_y

Step 4

Find the H_{sra} that the Sim model will have used to arrive at this roll angle

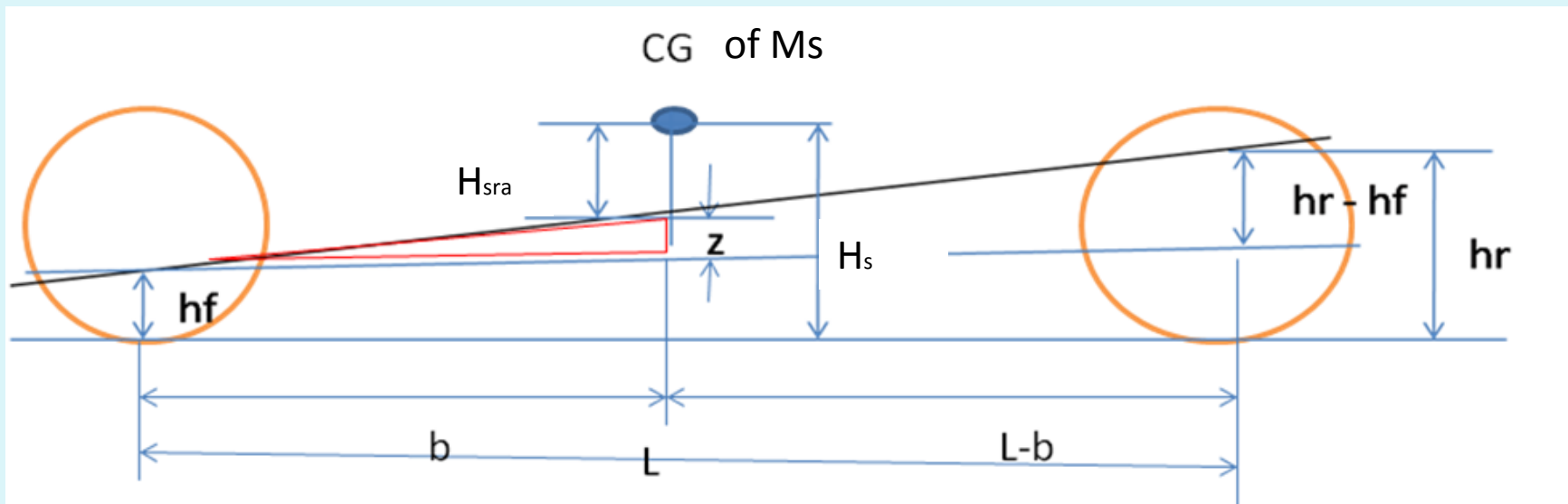
Finding H_{sra}

$$\phi = \text{Mot} / K_{\phi t}$$

$$\phi = \frac{M_s * a_y * H_{sra}}{K_{\phi t}}$$

$$H_{sra} = \frac{\phi * K_{\phi t}}{a_y * M_s}$$

Step 5 Find the H_s the Height of CG of the sprung mass above ground



Find b

Take moments to find dimension b, the distance of CG of sprung mass from front axle

$$M_s * b = L * M_r$$

$$b = \frac{L * M_r}{M_s}$$

Find Z

Z is the height of the roll axis above the front roll centre height at the position of the CG of the sprung mass

By similar triangles :

$$\frac{hr-hf}{L} = \frac{Z}{b}$$

$$Z = b \left(\frac{hr-hf}{L} \right)$$

Find Hs

L

H_s is the height of CG of the sprung mass above ground

$$H_s = H_{sra} + z + h_f$$

Step 6 Find the overall CG height H_{tot}

To find the CG Height of the total mass above the ground, take moments about a horizontal axis :

$$H_{\text{tot}} \times M_{\text{tot}} = (M_{\text{us}} \times H_{\text{us}}) + (M_{\text{s}} \times H_{\text{s}})$$

$$H_{\text{tot}} = \frac{(M_{\text{us}} \times H_{\text{us}}) + (M_{\text{s}} \times H_{\text{s}})}{M_{\text{tot}}}$$

Aim 2

Compare calculated and simulated wheel loads

1. From the steering pad data generated by the Sim select a period of steady state running.
2. Note the lateral acceleration, roll angle and the four wheel loads
3. Using the Sim generated lateral acceleration in your WT spreadsheet calculate the roll angle and the four wheel loads
4. Compare the two results and suggest reasons for any differences

Aim 3

Investigate the effect of wedge on car handling behaviour

Wedge is found from Corner Weight Scale readings.

$$\text{Wedge} = \frac{\text{FR} + \text{RL}}{\text{Total}}$$

If turning right a high wedge will reduce front load split and increase rear load split. Front grip goes up; rear grip goes down = reduced understeer

Adjusting wedge

In real life, increasing wedge would be achieved by winding FR and/or RL spring pans up and winding FL and/or RR spring pans down.

Reducing wedge would be achieved by doing the opposite

What will happen when:

Turning left with high wedge?

Turning right with low wedge ?

Turning left with low wedge ?

Setups

You will each be able to 'drive' on two runs on the Sim round Pembrey. On one, the setup will be significantly lower than 50% and on the other significantly higher than 50%.

Driver feedback

Describe the way the Sim model behaves when turning left and right for each run

Which run do you think was with high wedge and which with low wedge?