

Homework #3
MEEM4450/5450
(40 Points due 2/18)

1. We defined longitudinal slip as $\sigma = \frac{\omega R - v}{v}$ an alternate definition is $\sigma^* = \frac{\omega R - v}{\omega R}$. Find a relationship between σ and σ^* .
2. Find the gear ratio (N_{tf}) that would give the maximum acceleration at 30 mph for a car with a wheel radius of 12.5 inches. Assume that traction is power limited and the open throttle power versus engine angular velocity is given by the equation below.

$$P = 0.07\omega + 1.3 \times 10^{-4}\omega^2 - 2.4 \times 10^{-7}\omega^3$$

$$P[\text{kw}], \omega[\text{rad/sec}], \omega_{\min}=1500 \text{ rpm}, \omega_{\max}=6000 \text{ rpm}$$

- b. Plot the tractive effort[N] vs velocity[m/s] for your chosen gear ratio on the same graph with P_{\max}/v versus velocity.
 - c. For your calculated gear ratio find the speed at which the tractive effort is maximum.
3. Calculate the time and distance it would take a car represented by the data given in the example problem on page 32 to accelerate from 50 mph to 60 mph in fourth gear. Assume the car is going up a 2% grade and use the rolling resistance equation (4-15) given on pages 117 of your text. Assume an inflation pressure of 30 psi.

Other Data:

Car weighs 2500 lbs

Air density is 0.00236 slugs/ft³

$C_d=0.32$

$A=20 \text{ ft}^2$