

Ackermann, Robust Control

Exercise 9

The characteristic polynomial of the linearized single-track model for car steering is $p(s) = a_0 + a_1s + s^2$ with the parameter-dependent coefficients

$$a_0 = \frac{\mu}{m\ell_R\ell_{DP}} \left[\frac{\mu c_F c_R \ell^2}{mv^2} + c_R \ell_R - c_F \ell_F \right],$$
$$a_1 = \frac{\mu}{mv} \left[c_R + c_F + \frac{c_R \ell_R^2 + c_F \ell_F^2}{\ell_R \ell_{DP}} \right].$$

The city bus Daimler-Benz O 305 has the following single-track model parameters

$$\ell_F = 3.67[\text{m}]$$

$$\ell_R = 1.93[\text{m}]$$

$$c_F = 198000[\text{N/rad}]$$

$$c_R = 470000[\text{N/rad}]$$

$$\ell_{DP} = 5.62[\text{m}]$$

The velocity varies in a range $v \in [3 ; 20][\text{m/s}]$,

The mass varies in a range $m \in [9950 ; 16000][\text{kg}]$,

The friction coefficient varies in a range $\mu \in [0.5 ; 1]$.

Calculate and plot the root set in the s -plane. Do the extremal root locations arise from the vertices or edges of the parameter box?