Code Brainstorming and Equations

Steering Forces   -> Using a current steering force calculator as reference

Calculate required Self aligning torque -> Steering Output torque must be greater
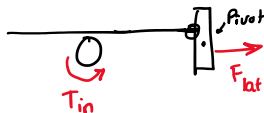
Input
   pnomatic trail
   Mechanical trail
   Scrub radius
   Torque Arm
   Normal force on tires
   Max aligning torque
   Friction Coefficient
   Lat force

Input best steering torque

Calculates required pin gear diameter

Going to require more insight

We now need to find the necessary diameter and ratio to meet this self aligning torque

We want a force per hand lower than 20lb
  -> The program can loop through

Compared to the Spreadsheet, I'm adding a gear selection matrix that will allow comparisons between different gear ratios, all in one spot

Calculating Tyre Load and Self aligning torque

$$T_{SA} = x_{TA} \cdot F_{Lat} + T_{SA}$$

$$x_{TA} = \sqrt{r_S^2 + (T_P + T_M)^2} \Rightarrow \text{Torque Arm: Given by geometry}$$

$$F_{Lat} = F_N \cdot \mu_S \Rightarrow \text{Lateral force on tyres}$$

$r_S \Rightarrow$ Scrub Radius, defined by suspension geometry

$T_P \; \& \; T_M \Rightarrow$ pnumatic and mechanical trail, defined by geometry and tyre data

$F_N \; \& \; \mu_S \Rightarrow$ Found based on previous running data

$T_{SA} \Rightarrow$ Self aligning torque, Known from tyre data

With this, we can calculate the self aligning torque present on the steering system

Calculating the steering torque output, based on a known input force

$$T_{S_o} = F_R \cdot L_{SA} \Rightarrow T_{S_o} - \text{Steering torque output} - \text{Calc}$$
                      F_R - Force on the linear rack - Calc
                      L_{SA} - Steering arm Length (Given)

$$F_R = T_{Si} / (P_G/2) \quad T_{Si} - \text{Steering Torque Input} - \text{Calc}$$
                          D_G - Diameter of the gear - Variable
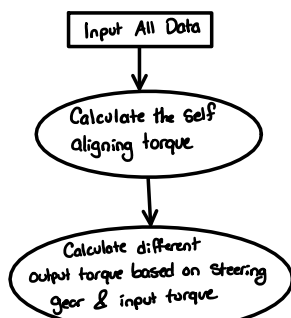
$$T_{Si} = R_\omega \cdot F_i$$
          F_i - Input force (Both hands) - Given
          R_ω - Radius of steering wheel - Given

Flow Chart:

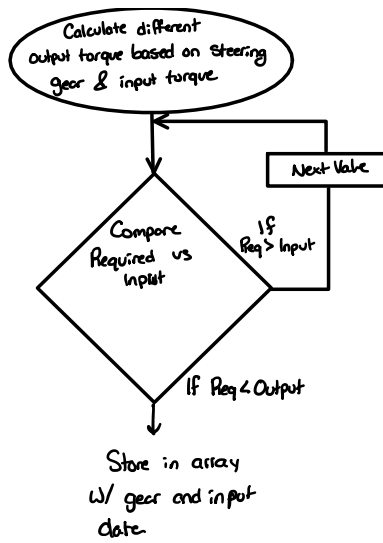 Steering Force Calculations

Pseudo Code:

Store Data:

$$F_{Lat} = F_N \cdot \mu_S$$
$$x_{TA} = \sqrt{r_S^2 + (T_P + T_M)^2}$$

$$T_{SA} = x_{TA} \cdot F_{Lat} + T_{SA}$$

Load Spreadsheet data containing   ->   Data
Steering force and gear data   Force Diameter Teeth

Calculate different output torque based on steering gear & input torque

Next Value

Compare Required vs Input

If Req > Input

If Req < Output

Store in array w/ gear and input date

Load spreadsheet data containing steering force and gear data $\rightarrow$

Force Diameter Teeth

Calculate forces and store in new array

Create empty array

$\text{for } F \text{ in } 1: \text{size}(\text{data}(-))$

$\quad \text{for } D \text{ in } 1: \text{size}(\text{data}(-1))$

$T_{Si} = R_u \cdot F_i$

$F_R = T_{Si} / (D_G / 2)$

$T_{So} = F_R \cdot L_{SA}$

data.append (T_{So}) ← Whatever the syntax is Matlab is easier for arrays