winch diameter \[ r_{\text{cyl}} := 6\text{mm} \]

winch cog pitch diameter \[ r_{\text{wheel}} := \frac{130\text{mm}}{2} = 65\text{mm} \]

drive cog pitch diameter \[ r_{\text{cog}} := \frac{7.8\text{mm}}{2} = 3.9\text{mm} \]

angle per cog step \[ \text{ang}_{\text{cog}} := 1.8\text{deg} \]

wheel angle per cog step \[ \text{ang}_{\text{wheel}} := \text{ang}_{\text{cog}} \frac{r_{\text{cog}}}{r_{\text{wheel}}} = 0.108\text{deg} \]

cable displaced per cog step \[ \text{disp}_{\text{cyl}} := \pi \cdot 2 \cdot r_{\text{cyl}} \frac{\text{ang}_{\text{wheel}}}{360\text{deg}} = 11.31\mu\text{m} \]

number of steps per mm \[ \text{step}_{\text{mm}} := \frac{1\text{mm}}{\text{disp}_{\text{cyl}}} = 88.419413 \]

range of total displacement \[ \frac{28\text{deg}}{\text{ang}_{\text{wheel}} \cdot \text{step}_{\text{mm}}} = 2.9322 \]

Spring rate - non-stainless
0.3mm wire, 3mm OD, 40mm length, 13 total coils (11 active coils)

\[ k := 0.371 \frac{\text{N}}{\text{mm}} \]

PTFE coefficient friction \[ \mu := 0.1 \]

Contact angle \[ \phi := 90\text{deg} \]

\[ T_{\text{hold}} := 1\text{N} \]

\[ T_{\text{load}} := T_{\text{hold}} \mu \phi = 1.17\text{N} \]

difference in force can then be used to evaluate the stretch in the wire between pulling and releasing (backlash). In combination with the stiffness of the lever mechanism