Fillet radius for gear racks
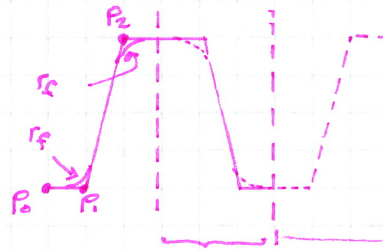
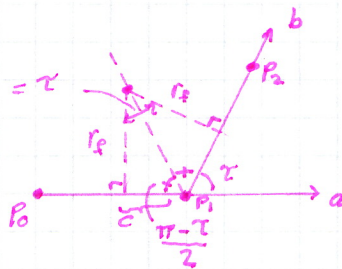

Known points: P_0, P_1, P_2
" radius: r_f

remaining geometry generated by sequential translations by the pitch length.

This part generated by mirroring the polyline from $P_0 \to P_2$

The distance $\|P_1 - P_0\|$ determines the maximum value for r_f

$$a = \frac{P_1 - P_0}{\|P_1 - P_0\|} \quad , \quad b = \frac{P_2 - P_1}{\|P_2 - P_1\|}$$

$$\tau = \cos^{-1}(a \bullet b)$$
$$\|a\| = \|b\| = 1$$

$$\tan\left(\frac{\pi - \tau}{2}\right) = \frac{r_f}{c} \iff c = r_f \tan\left(\frac{\tau}{2}\right)$$

Let $\quad c = \|P_1 - P_0\|$

$$\boxed{r_{f,max} = \frac{c}{\tan\left(\frac{\tau}{2}\right)} = \frac{\|P_1 - P_0\|}{\tan\left(\frac{\tau}{2}\right)}}$$