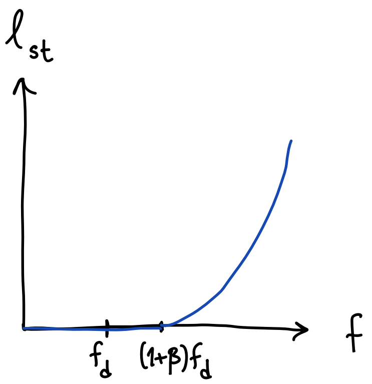
$$\dot{x}_d T_d = 2\ell_1 \sin(\alpha) \quad \text{so} \quad T_d = \frac{2\ell_1 \sin(\alpha)}{\dot{x}_d}, \quad f_d = \frac{1}{T_d}$$

Penalize deviations on f_d only if it is exceeded greater than some specified factor $(1+\beta)$, $\beta > 0$, i.e.,



$$\ell_{st}(f) = \begin{cases} 0 & \text{if } f < (1+\beta)f_d, \\ \gamma\left(f - (1+\beta)f_d\right)^2 & \text{if } f \geq (1+\beta)f_d. \end{cases}$$

or linearly as,

$$= \begin{cases} 0 & \text{if } f < (1+\beta)f_d, \\ \gamma\left(f - (1+\beta)f_d\right) & \text{if } f \geq (1+\beta)f_d. \end{cases}$$

$f = \frac{1}{T}$, where T : time between consecutive heelstrikes of a particular traj.

We could approximate T from a given trajectory as

$$T \approx \frac{2\ell_1 \sin(\alpha)}{\bar{\dot{x}}}, \quad \text{where} \quad \bar{\dot{x}} = \frac{1}{T}\int_0^T |\dot{x}(t)|\,dt,$$

where T is as defined before.