Trajectories

Input

- Joystick commands: `cmd_hst_pt, cmd_crd_pt`

Output

- Torques: `u_hst, u_crd`
- Positions: `y_hst, y_crd`

Currently we have:

- `n_tra` different trajectories of size `n_sim`
- `n_tra = 9; n_sim = 1000`
- each of them is a matrix of size `(n_sim, n_tra)`

Objective Function

Parameters that are optimized:

`hst_inertia_engine, inertia_yy, hst_friction, crd_mass`

$$\min_{p \in \mathbb{R}^4} f(p) = \frac{1}{n_{\text{tra}}} \cdot \left(\alpha_1 \cdot \| \overline{U}_{\text{hst}} - U_{\text{hst}}(p) \|_{\text{F}}^2 + \dots \right)$$

$$\text{s. t.} \quad p_i \geq 0$$

where

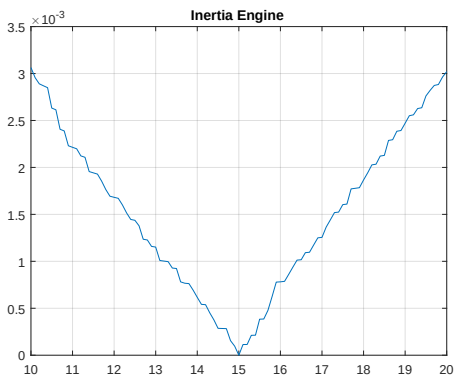
$$\alpha_1 = \frac{1}{\| \overline{U}_{\text{hst}} \|_{\text{F}}^2} \qquad \| \overline{U}_{i,j} \|_{\text{F}}^2 = \sum_{j=1}^{n_{\text{tra}}} \sum_{i=1}^{n_{\text{sim}}} |\overline{U}_{i,j}|^2$$

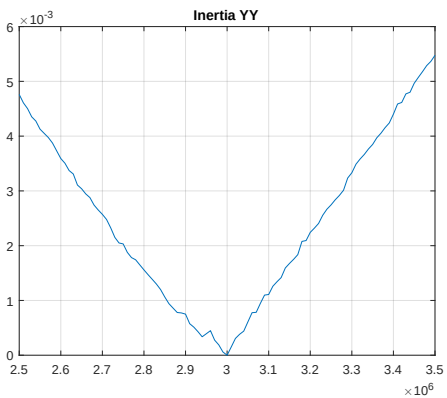
$\| \cdot \|_{\text{F}}$ is the Frobenius norm

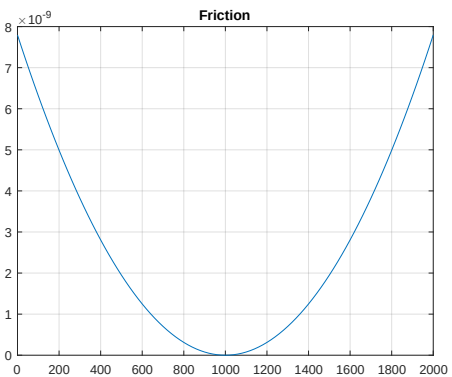
Influence of the Parameters

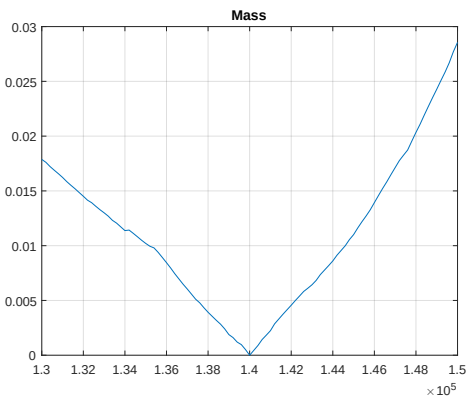
10% deviation of parameter . . . cause in the objective function:

`hst_inertia_engine`	$1 \cdot 10^{-3}$	linear
`inertia_yy`	$3.3 \cdot 10^{-3}$	linear
`hst_friction`	$7.8 \cdot 10^{-11}$	quadratic
`crd_mass`	$52 \cdot 10^{-3}$	linear









Solvers

Conditions:

- Starting values: $X \sim \mathrm{N}(\bar{x}, \bar{x}/2)$, where $\bar{x}$ is the given value
- Smarm Size: 10
- Function Tolerance: 10^{-9}
- Time Limit: 15 min
- Max Iterations: ∞

	penalty	evaluations	time
Particle Swarm	10^{-13}	2500	3 min
Pattern Search	10^{-3}	6000	8 min
Genetic Algorithm	10^{-2}	7500	10 min (time limit)
Simulated Annealing	10^{-1}	3000	4 min