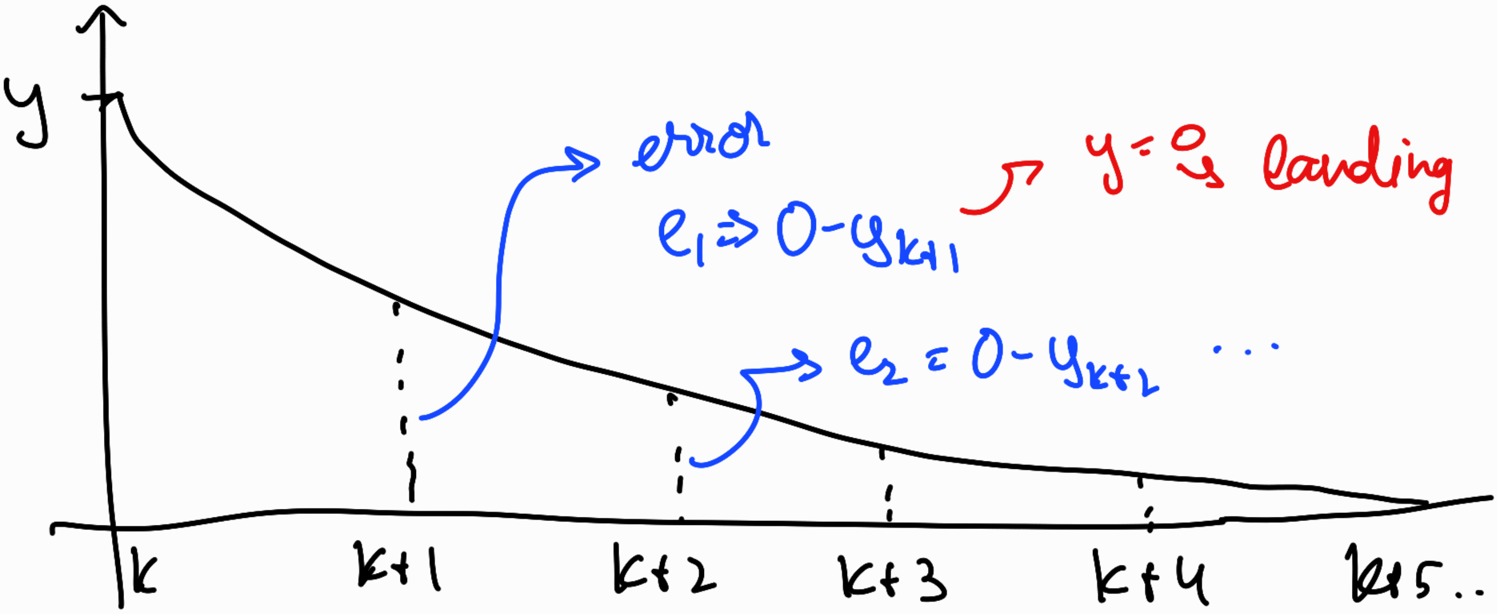
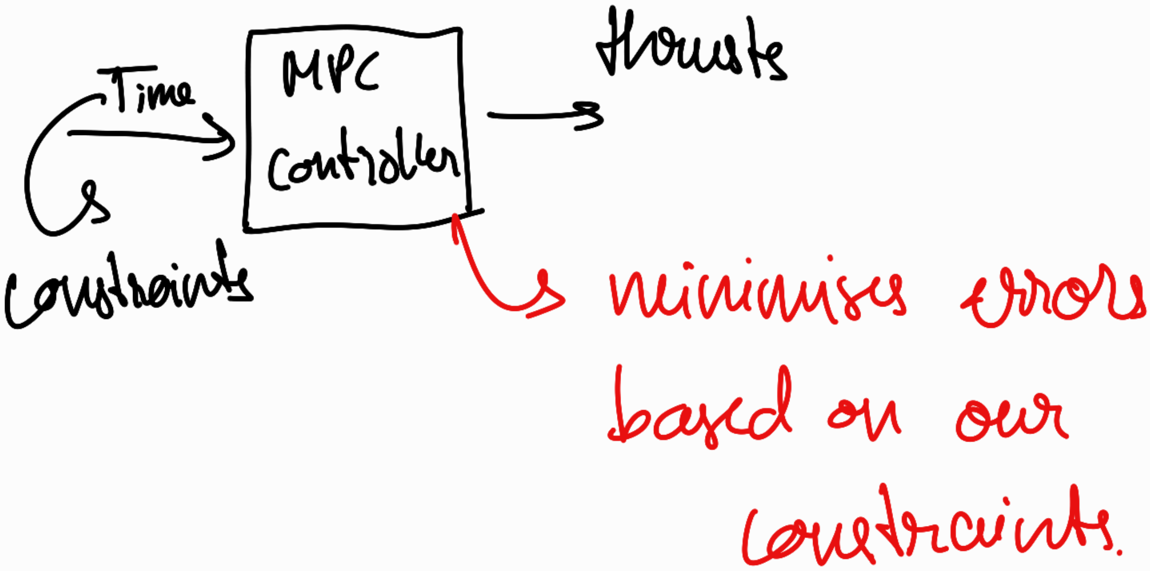




MPC → Minimises cost function.

Horizon period → number of samples we estimate.

→ lets say,

weights errors

$$j = w_1 \cdot e_{k+1}^2 + w_2 \cdot e_{k+2}^2 + w_3 \cdot e_{k+3}^2 + w_4 \cdot e_{k+4}^2 + w_5 \cdot e_{k+5}^2$$

cost function

$$\boxed{\begin{aligned} \text{error} &= 0 - y_t = -y \\ e^2 &= y^2 \end{aligned}}$$

→ MPC → minimises CF.

$\therefore$ j_{min} = combination of values

depended on.

$$\begin{bmatrix} e_{k+1} & (T_k) \\ e_{k+2} & (T_{k+1}) \\ e_{k+3} & (T_{k+2}) \\ e_{k+4} & (T_{k+3}) \\ e_{k+5} & (T_{k+4}) \end{bmatrix} \rightarrow$$ most optimum value.

$\rightarrow$ T_k influences the next error.

$$J_{min} = w_1 \cdot e_{k+1}^2 + w_2 \cdot e_{k+2}^2 + w_3 \cdot e_{k+3}^2 + w_4 \cdot e_{k+4}^2 + w_5 \cdot e_{k+5}^2$$

$$+$$

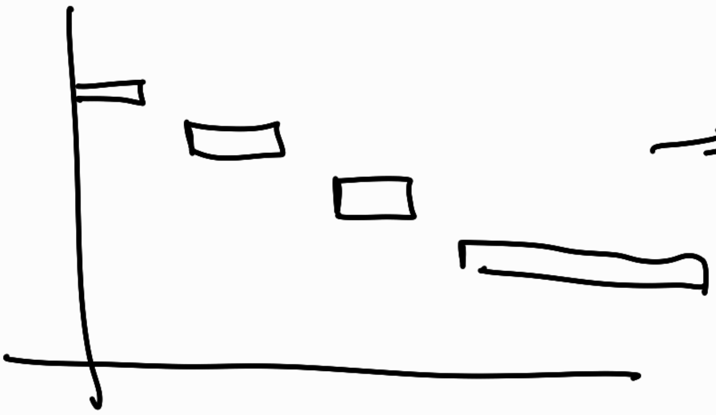
$$w_6 T_k^2 + w_7 T_{k+1}^2 + w_8 T_{k+2}^2 + w_9 T_{k+3}^2 + w_{10} T_{k+4}^2$$

$\hookrightarrow$ now J_{min} also influences the thrust used and tries to minimise the thrust.

$\hookrightarrow$ since error is also dependent on thrust

→ Thrust is inversely related to the errors. More thrust less error.

→



→ smoothens out the graph

$\rightarrow$ we also need to minimise Noise.
$\hookrightarrow N$

Now new cost function,

$$J_{min} = w_1 \cdot e_{k+1}^2 + w_2 \cdot e_{k+2}^2 + w_3 \cdot e_{k+3}^2$$
$$+ w_4 \cdot e_{k+4}^2 + w_5 \cdot e_{k+5}^2$$

$$+$$

$$w_6 T_k^2 + w_7 T_{k+1}^2 + w_8 T_{k+2}^2$$
$$+ w_9 T_{k+3}^2 + w_{10} T_{k+4}^2$$

$$+$$

T_k influences N_{k+1}

$$w_{11} N_{k+1}^2 + w_{12} N_{k+2}^2 + w_{13} N_{k+3}^2$$
$$+ w_{14} N_{k+4}^2 + w_{15} N_{k+5}^2$$

$$J_{min} = w_1 \cdot e_{k+1}^2 + w_2 \cdot e_{k+2} + w_3 \cdot e_{k+3}^2$$
$$+ w_4 \cdot e_{k+4}^2 + w_5 \cdot e_{k+5}^2$$

we assign less weight to this and max to w_5.

max weight so max minimisation takes place here.

⇒ We try to minimise e_{k+5} first, because of which $e_{k+1}, e_{k+2}, e_{k+3} \dots$ all get automatically minimised.

↳ not by a lot but less.

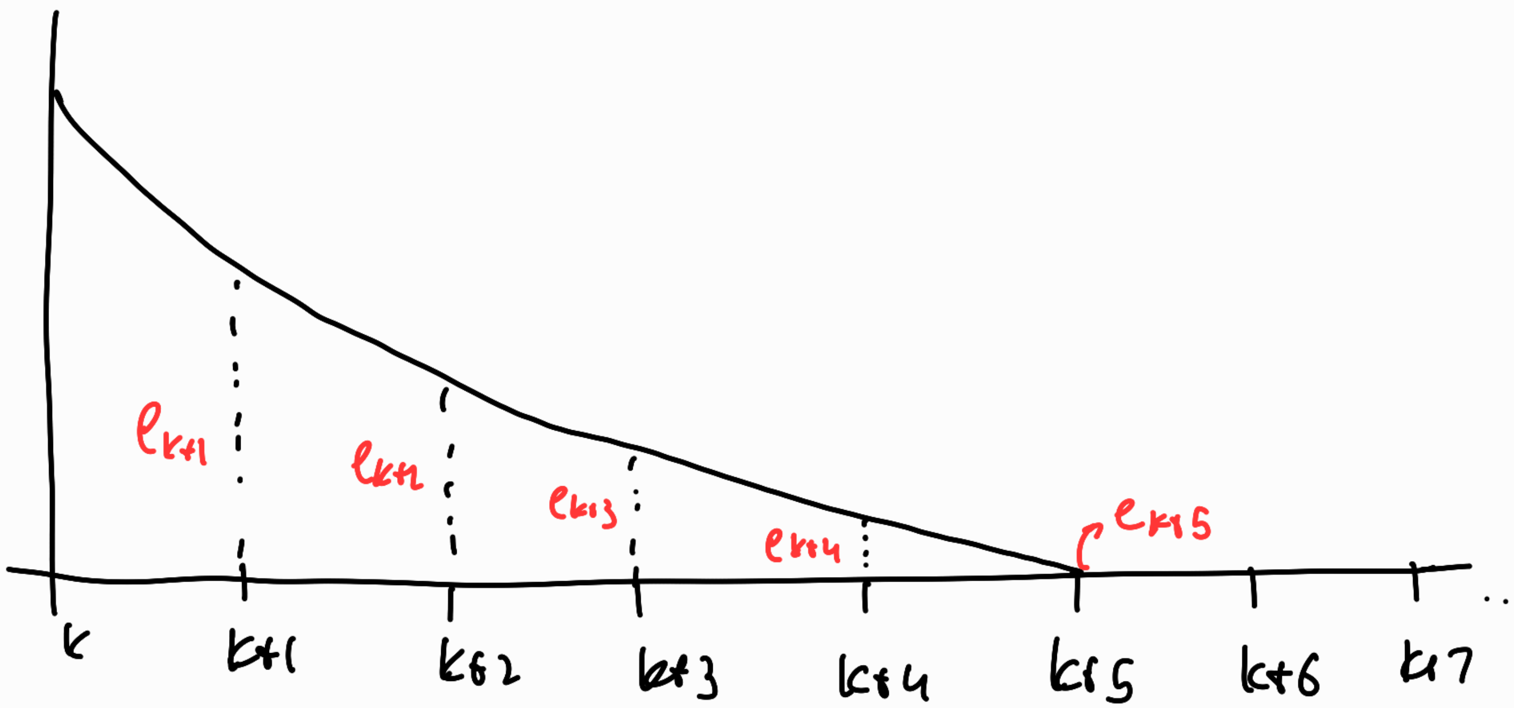
$$J_{min} = \overset{10}{w_1} \cdot e_{k+1}^2 + \overset{10}{w_2} \cdot e_{k+2} + \overset{10}{w_3} \cdot e_{k+3}^2$$
$$+ \overset{10}{w_4} \cdot e_{k+4}^2 + \overset{10}{w_5} \cdot e_{k+5}^2$$

$$+$$

$$\overset{100}{w_6} T_k^2 + \overset{100}{w_7} T_{k+1}^2 + \overset{100}{w_8} T_{k+2}^2$$
$$+ \underset{100}{w_9} T_{k+3}^2 + \underset{100}{w_{10}} T_{k+4}^2$$

→ we can give huge weights to the thrusts, this in turn leads to the cost function minimising the thrusts.

Horizon Period :-

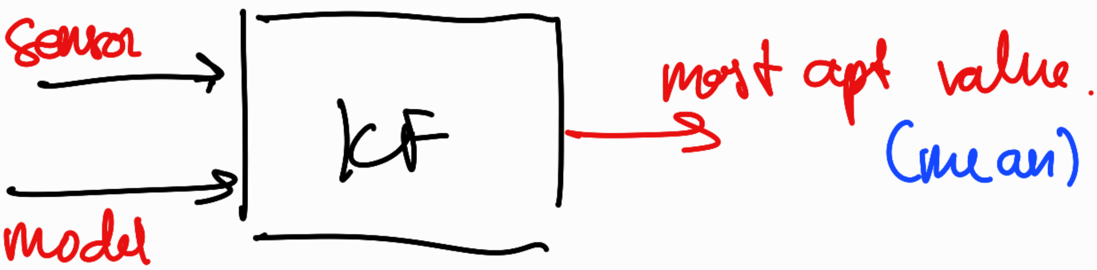


→ small horizon period → gives faster results but throws a trade off with less precision.

→ We can then get value for τ_{k+1} by shifting everything one step ahead and taking only the first value.

$$j_{min}\left(e_{k+2}, e_{k+3}, e_{k+4}, e_{k+5}, e_{k+6}, \tau_{k+1}, \tau_{k+2} \ldots\right)$$

Kalman Filter



→ Real position and sensor can give different values, Kalman filter gives the more appropriate values mathematically.

→ By giving a mean between them which is closer to the real value.