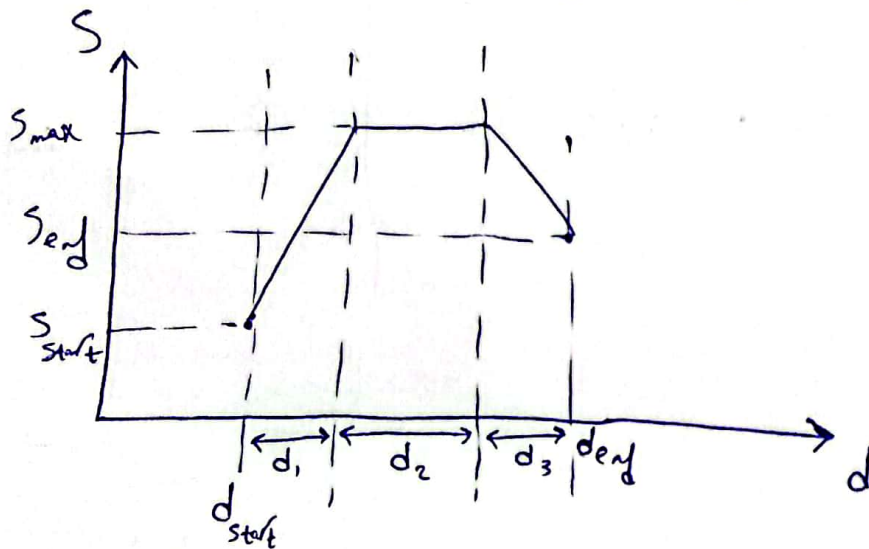# CNC

when to accelerate, keep speed, and decelerate?

* Assuming the stepper is to make distance d_{total} starting with a speed S_{start}, to a speed S_{end} with an acceleration magnitude of a_+, and a deceleration magnitude of a_-.

* From Newton's : $S_2^2 = S_1^2 + 2ad$

ⓐ d_1 : $S_{max}^2 = S_{start}^2 + 2a_+d_1$

$$\Rightarrow d_1 = \frac{S_{max}^2 - S_{start}^2}{2a_+}$$

edge case 👇

∴ d_1 is invalid only when : $S_{start} > S_{max}$

$\Rightarrow$ make d_1 zero
change S_{max} to S_{start}.

@ d_3 : $S_{end}^2 = S_{max}^2 - 2a_- d_3$

$\Rightarrow d_3 = \dfrac{S_{max}^2 - S_{end}^2}{2d_-}$

Edge Case $\Rightarrow d_3$ is invalid only when $S_{end} > S_{max}$

$\Rightarrow$ make d_3 zero
Change S_{max} to S_{end}

@ d_2 : $d_2 = d_{total} - (d_1 + d_3)$

Edge Case $\Rightarrow d_2$ is invalid only when : $d_1 + d_3 > d_{total}$

$\Rightarrow \therefore S_{max}$ is less than what it is

$\Rightarrow$ make d_2 zero

, recalculate $S_{max} \Rightarrow$ also $d_1 \& d_3)$ as follows:

$$d_{total} = \dfrac{S_{max}^2 - S_{start}^2}{2a_+} + \dfrac{S_{max}^2 - S_{end}^2}{2a_-}$$

$$\Rightarrow S_{max}^2 = \dfrac{d_t + \dfrac{S_{start}^2}{2a_+} + \dfrac{S_{end}^2}{2a_-}}{\dfrac{1}{2a_+} + \dfrac{1}{2a_-}}$$

which could never be negative $\Rightarrow S_{max}$ is real always.

and the system would look like:

and $d_1 \& d_3$ could never be negative