

Exercise

Velocity Profile

Task 1. The following values are given for the calculation of a velocity profile:

	Initial state	Final state
Position	$\vec{p}_i = \begin{pmatrix} -520mm \\ 215mm \\ -30mm \end{pmatrix}$	$\vec{p}_f = \begin{pmatrix} 580mm \\ 575mm \\ 340mm \end{pmatrix}$
Velocity	$v_i = 1400 \frac{mm}{s}$	$v_f = 0 \frac{mm}{s}$
Acceleration	$a_i = 0 \frac{mm}{s^2}$	$a_f = 0 \frac{mm}{s^2}$

- The maximum velocity is $v_{max} = 1800 \frac{mm}{s}$
 - The maximum acceleration is $a_{max} = 3000 \frac{mm}{s^2}$
 - For the polynomials of the velocity functions of the individual phases shall apply:
 - $v_a(t) \sim t^3$ in the acceleration phase
 - $v_p(t) = constant$ in the plateau phase
 - $v_d(t) \sim t^3$ in the deceleration phase
- a) Sketch the velocity profile, and the acceleration and acceleration change profiles derived from it.
- b) Calculate the distance s_{total} of the movement and express it as a formula (depending on the velocities within the individual phases of the movement).
- c) Calculate the velocity functions for a minimum duration of motion:
 - in the acceleration phase $v_a(t)$
 - in the plateau phase $v_p(t)$
 - in the deceleration phase $v_d(t)$
- d) Calculate the duration of:
 - the acceleration phase t_a
 - the deceleration phase t_d
 - the plateau phase t_p
- Note: The duration of the plateau phase depends on the duration of the acceleration and deceleration phases.
- e) Specify the total velocity function.

Task 2. Adjust the velocity profile of a given axis for a Synchro PTP motion:

- The maximum acceleration is $a_{max} = 100 \frac{rad}{s^2}$
 - The duration of the movement is $t_{total} = 0.5s$
 - The angle to be traversed is $\phi_{total} = 3rad$
 - The initial and final velocity are $\omega_i = \omega_f = 0 \frac{rad}{s}$
 - For the polynomials of the velocity functions of the individual phases shall apply:
 - $\omega_a(t) \sim t^3$ in the acceleration phase
 - $\omega_p(t) = constant$ in the plateau phase
 - $\omega_d(t) \sim t^3$ in the deceleration phase
- a) Calculate the polynomial coefficients of the velocity function in the acceleration phase (as a function of the maximum velocity to be determined ω_{max}).
- b) Calculate the duration of the acceleration phase (as a function of ω_{max}).
- c) Calculate the angle traversed in the acceleration phase (as a function of ω_{max}).
- d) Calculate the duration of the plateau phase (as a function of ω_{max}).
- e) Calculate the maximum velocity of the movement ω_{max} .