Swerve Mathematics

November 28, 2021

Definitions:
Δt - **Time diference for swerve module displacement calculations**
$\Delta t \to 0$

v_x - **Desired velocity of chasiss in the X axis**
v_y - **Desired velocity of chasiss in the Y axis**
ω - **Desired angular velocity of chasis**
W - **Half the horizontal distance betwen the modules (see fig. 1)**
L - **Half the vertical distance betwen the modules (see fig. 1)**
Δy_i - **Total displacement of the general module in the Y axis**
Δx_i - **Total displacement of the general module in the X axis**
v_i - **Calculated linear velocity for general module**
θ_i - **Calculated angle location for general module**
α_i - **General angle disposition from** $(W, 0)$
$r = \sqrt{L^2 + W^2}$
$\alpha_0 = \arctan(\frac{L}{W})$
$\alpha_1 = \pi - \alpha_0$
$\alpha_2 = \pi + \alpha_0$
$\alpha_3 = -\alpha_0$

Holonomic movement:
$\underline{v} = (v_x \cdot \Delta t, v_y \cdot \Delta t)$
$\theta_i = \arctan(\frac{v_y}{v_x})$
$v_i = \sqrt{v_y^2 + v_x^2}$

Rotation Case:
$\Delta y_i = r \cdot \sin(\omega \cdot \Delta t + \alpha_i) - r \cdot \sin(\alpha_i)$
$\Delta x_i = r \cdot \cos(w \cdot \Delta t + \alpha_i) - r \cdot \cos(\alpha_i)$
$\theta_i = \arctan(\frac{\Delta y_i}{\Delta x_i})$
$v_i = \sqrt{\Delta x_i^2 + \Delta y_i^2}$

Combined Case:
$\Delta x_i = v_x \cdot \Delta t + r \cdot (\cos(\omega \cdot \Delta t + \alpha) - \cos(\alpha_i))$
$\Delta y_i = v_y \cdot \Delta t + r \cdot (\sin(\omega \cdot \Delta t + \alpha) - \sin(\alpha_i))$
$\theta_i = \arctan(\frac{\Delta y_i}{\Delta x_i})$
$v_i = \frac{\sqrt{\Delta x_i^2 + \Delta y_i^2}}{\Delta t}$

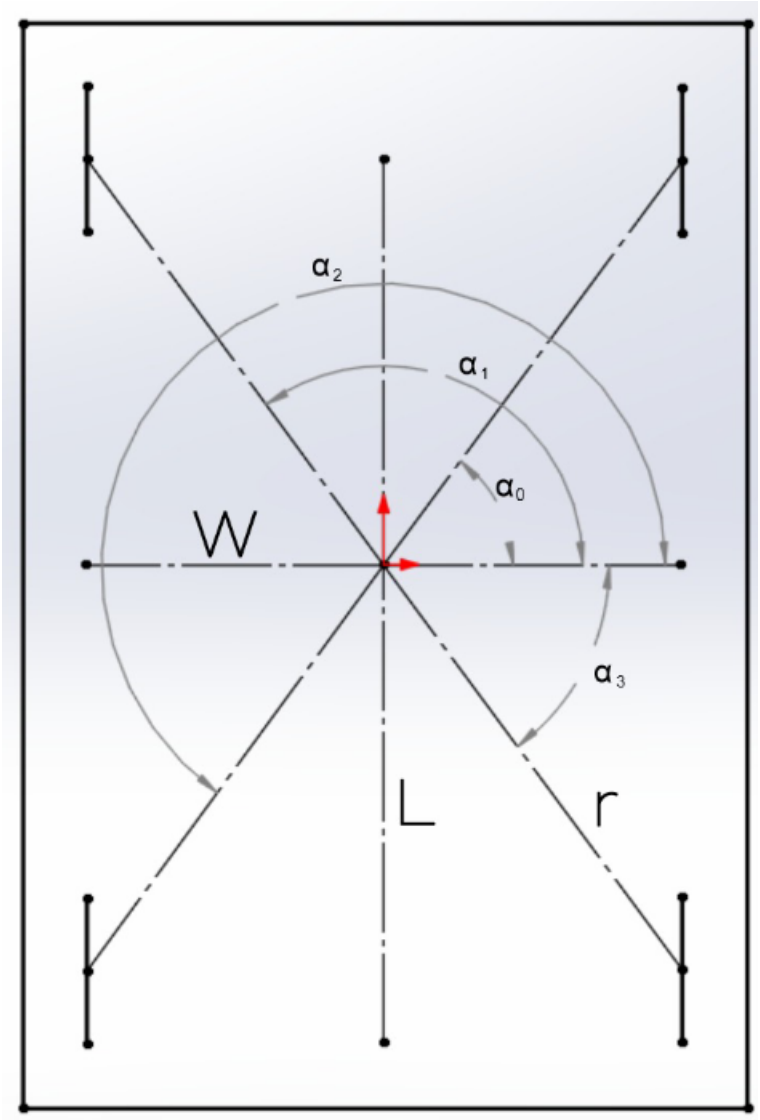

Figure 1: Swerve diagram