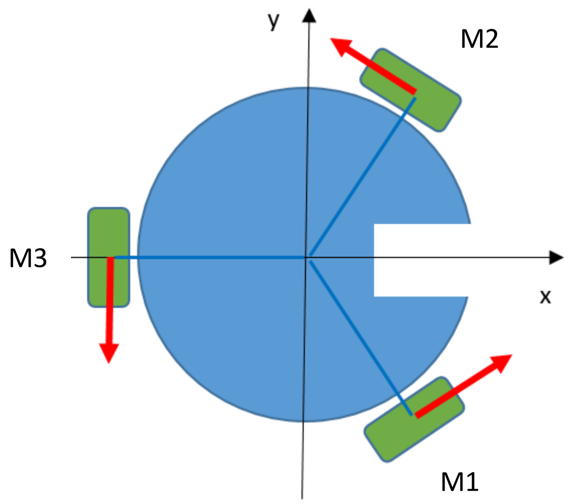
KINETIC MODEL

For simplicity, the thrower is pointing on positive x axis direction.



The motors turn counterclockwise, so the velocity of each one points as shown in the diagram (red arrows).

The motors (and so the wheels) are separated 120° from each other forming an equilateral triangle.

Decomposing each force in their horizontal (x) and vertical (y) components, can be calculated:

$$F_{1x} = F_1 \cdot \cos\frac{\pi}{6} \quad ; \quad F_{1y} = F_1 \cdot \sin\frac{\pi}{6}$$

$$F_{2x} = F_2 \cdot \cos\frac{5\pi}{6} \quad ; \quad F_{2y} = F_2 \cdot \sin\frac{5\pi}{6}$$

$$F_{3x} = 0 \;\; ; \;\; F_{3y} = -F_3$$

And putting that into:

$$a_x = \sum_i F_{ix} \quad ; \quad a_y = \sum_i F_{iy} \quad ; \quad \omega = \sum F$$

In matrix is shown as:

$$\begin{bmatrix} a_x \\ a_y \\ \omega \end{bmatrix} = \begin{bmatrix} \frac{\sqrt{3}}{2} & -\frac{\sqrt{3}}{2} & 0 \\ \frac{1}{2} & \frac{1}{2} & -1 \\ 1 & 1 & 1 \end{bmatrix} \cdot \begin{bmatrix} F_1 \\ F_2 \\ F_3 \end{bmatrix}$$

And finally inverting it:

$$\begin{bmatrix} F_1 \\ F_2 \\ F_3 \end{bmatrix} = \begin{bmatrix} \frac{\sqrt{3}}{3} & \frac{1}{3} & \frac{1}{3} \\ -\frac{\sqrt{3}}{3} & \frac{1}{3} & \frac{1}{3} \\ 0 & -\frac{2}{3} & \frac{1}{3} \end{bmatrix} \cdot \begin{bmatrix} a_x \\ a_y \\ \omega \end{bmatrix}$$

To obtain the forces to be applied to the motors depending on the movement that the robot has to perform.