Mecanum Drivetrain
How a Mecanum drivetrain works in an in depth explanation.

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Preface

The kinematics of a Mecanum drive train can be derived using a set of equations. Let us consider a robot with a Mecanum drive train that has four wheels. The wheels are labeled W_1, W_2, W_3, and W_4, as shown in Figure 1.1.

Chapter 1

Kinematics

The kinematics of a Mecanum drive train can be derived using a set of equations. Let us consider a robot with a Mecanum drive train that has four wheels. The wheels are labeled W_1, W_2, W_3, and W_4, as shown in Figure 1.1.

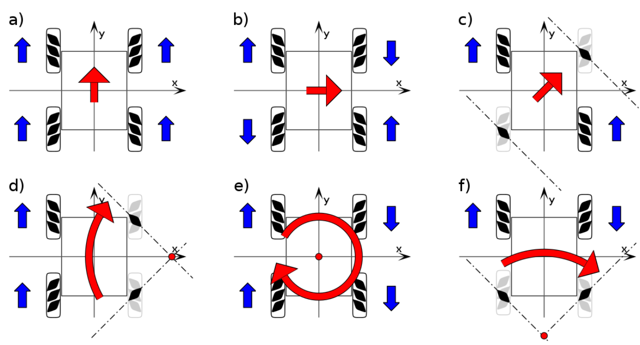

Figure 1.1: Mecanum drive train with four wheels.

The motion of the robot can be described using the following equations:

$$\begin{bmatrix} v_x \ v_y \ \omega \end{bmatrix} = \begin{bmatrix} \frac{1}{r} & \frac{1}{r} & \frac{1}{r} & \frac{1}{r} - \frac{1}{r} & \frac{1}{r} & \frac{1}{r} & -\frac{1}{r} - \frac{d}{r} & \frac{d}{r} & -\frac{d}{r} & \frac{d}{r} \end{bmatrix} \begin{bmatrix} \omega_1 \ \omega_2 \ \omega_3 \ \omega_4 \end{bmatrix} \tag{1.1}$$

where v_x and v_y are the robot's linear velocity components in the x and y directions, respectively, ω is the robot's angular velocity, r is the radius of the wheels, d is the distance between the wheels, and ω_1, ω_2, ω_3, and ω_4 are the angular velocities of the wheels.

Equation 1.1 can be used to calculate the angular velocities of the wheels needed to achieve a desired motion. For example, if we want the robot to move forward with a linear velocity of $v_x = 0.5$ m/s and no angular velocity, we can set $v_y = \omega = 0$ and solve for the wheel velocities:

$$\begin{bmatrix} 0.5 \ 0 \ 0 \end{bmatrix} = \begin{bmatrix} \frac{1}{r} & \frac{1}{r} & \frac{1}{r} & \frac{1}{r} - \frac{1}{r} & \frac{1}{r} & \frac{1}{r} & -\frac{1}{r} - \frac{d}{r} & \frac{d}{r} & -\frac{d}{r} & \frac{d}{r} \end{bmatrix} \begin{bmatrix} \omega_1 \ \omega_2 \ \omega_3 \ \omega_4 \end{bmatrix}$$

Solving for ω_1, ω_2, ω_3, and ω_4 gives:

$$\begin{bmatrix}\omega_1 & \omega_2 & \omega_3 & \omega_4\end{bmatrix}\begin{bmatrix}0.25 & -0.25 & -0.25 & 0.25\ 0.25 & 0.25 & 0.25 & 0.25\ 0 & 0 & 0 & 0\end{bmatrix}\begin{bmatrix}0.5\ 0\ 0\end{bmatrix}\begin{bmatrix}0.125\ 0.125\ 0\ 0.125\end{bmatrix}$$

This means that we need to set the angular velocities of the wheels as follows:

$\omega_1 = 0.125$ rad/s $\omega_2 = 0.125$ rad/s $\omega_3 = 0$ rad/s $\omega_4 = 0.125$ rad/s

This will cause the robot to move forward at a linear velocity of 0.5 m/s.

Chapter 2

Conclusion

In conclusion, the kinematics of a Mecanum drive train can be described using a set of equations, as shown in Equation 1.1. These equations can be used to calculate the angular velocities of the wheels needed to achieve a desired motion. Mecanum drive trains are widely used in robotics due to their ability to provide omnidirectional motion without changing the orientation of the robot.