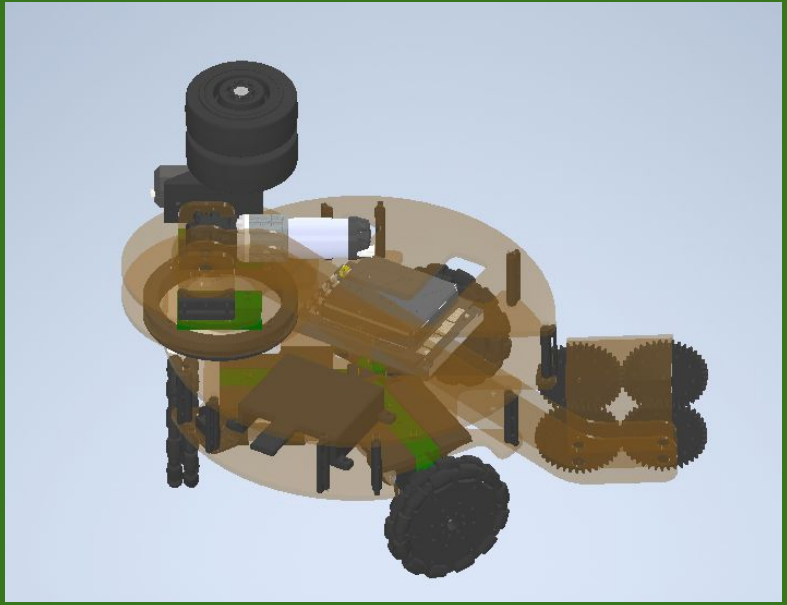
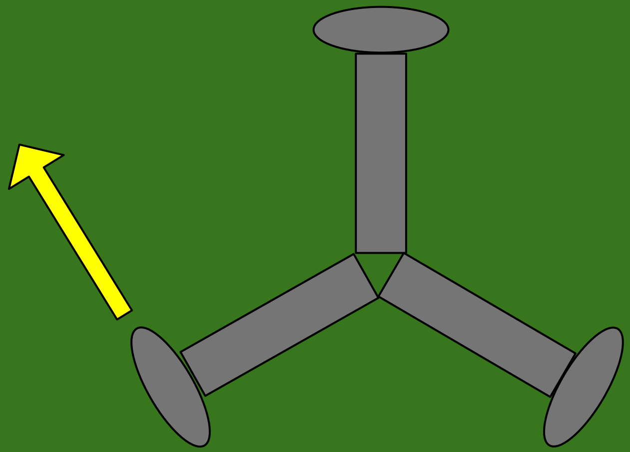
Kiwi Drivetrain Tutorial



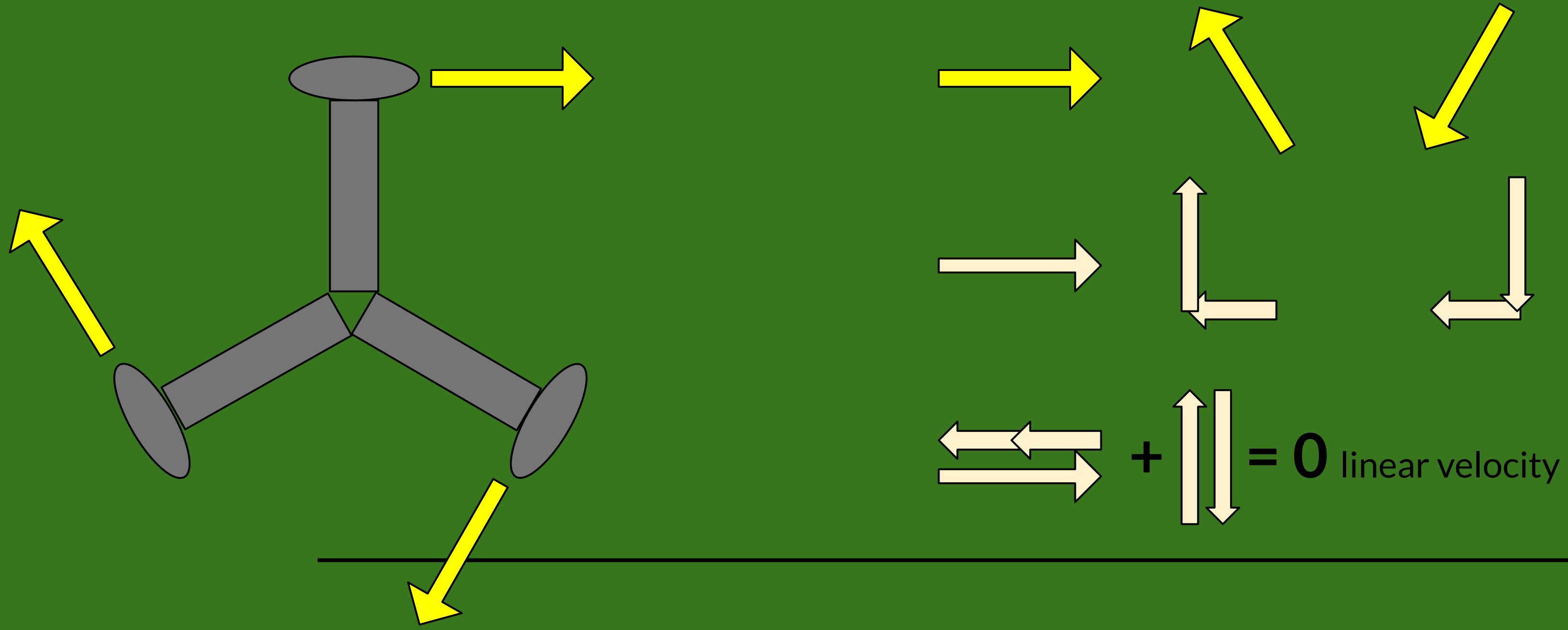
Electric Mayhem 12736

Fundamentally, a robot can drive straight, spin, or do both.

When a wheel spins on the Kiwi drivetrain, it produces a force on the edge of the robot. Since it isn't pushing on the center of the robot, it creates torque. This means that driving one wheel makes the robot move in linearly and spin. By spinning multiple wheels at specific speeds, we can get more controlled movement.



To spin, the robot needs angular velocity and no linear velocity. This is accomplished by setting all the wheels to the same speed. The torque produced by each wheel will add together to make the robot spin, and the linear components of the forces they produce will cancel out.

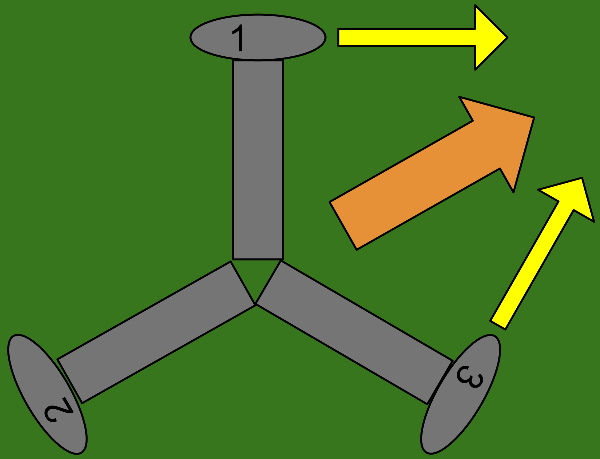


To drive straight, the robot needs linear velocity and no linear velocity. Now, the torques must add to zero. If the robot is ideal, the speed of the wheels is proportional to the force they produce and thus the torque, so the speeds must add to zero. We need a set of three functions that add to zero and that map an angle, the direction we want to drive, to a speed for each wheel. This sounds like a job for trigonometry.

x = wheel speed, θ = intended drive direction (degrees)
$x_1 = \cos(\theta + 0)$, $x_2 = \cos(\theta + 120)$, $x_3 = \cos(\theta + 240)$

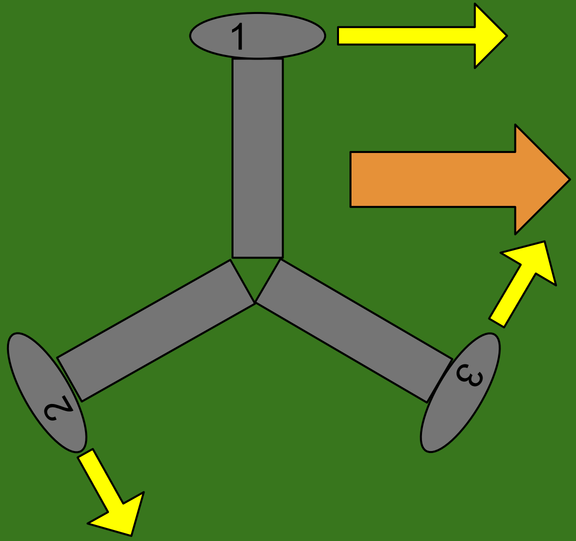
The angle added in each function may change based on your wheel orientation and what you consider the front of your robot, but they will always be offset by 120 degrees.

Some examples of the linear movement:



$\theta = 30$

$x_1 = 0.87$, $x_2 = -0.87$, $x_3 = 0$



$\theta = 0$

$x_1 = 1$, $x_2 = -0.5$, $x_3 = -0.5$

To spin and drive straight at the same time, we have to allot some of the wheels' power to spinning and some of the power to driving straight.

a = the proportion of power to be allotted to spinning [0, 1]

$x_1 = a + (1-a)\cos(\theta + 0)$, $x_2 = a + (1-a)\cos(\theta + 120)$, $x_3 = a + (1-a)\cos(\theta + 240)$

Spinning all the wheels at least at a certain speed, a, makes the robot spin. Each wheel's speed is increased by the same trigonometric functions used for driving straight. This makes the robot drive in a straight line while spinning.

To control the robot, we need to tell what numbers to plug into those functions. Our team did it this way:

θ = joystick angle
a = amount trigger is pushed / amount joystick is pushed

The left trigger makes the robot spin counter clockwise, and the right trigger makes it spin clockwise. For example, if the trigger and joystick are both pushed all the way, the robot will use 50% of the wheels' power to spin, and 50% to drive straight.