

# Mecanum wheel motion principle

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## Mecanum wheel motion principle

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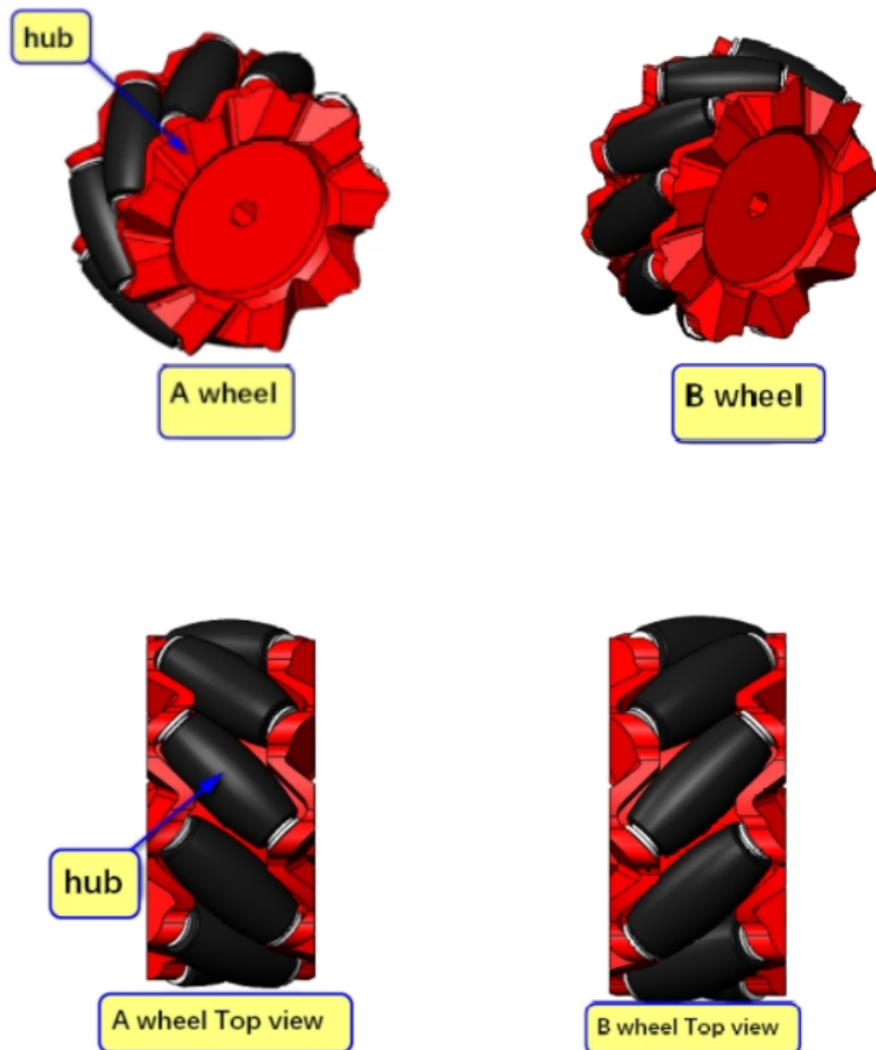
- Notes

Mecanum Wheel is a specially designed wheel, which is mostly used in scientific research, teaching, robot competition and other scenes. Its movement mode is very cool, including forward movement, lateral movement, oblique movement, rotation and their combination.

## Structure of Mecanum Wheel

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The Mecanum Wheel (hereinafter referred to as Mecanum Wheel) is composed of a hub and a roller around the hub. The roller is a small driven roller without power. The angle between the axis of the Mecanum Wheel roller and the axis of the hub is 45 degrees, and there are two types of A and B wheels that are mirror images of each other, or they are called left-handed wheels and right-handed wheels.



## Motion State Analysis

### Mecanum Wheel Analysis

Take the front of the car as the positive direction, and agree that the direction of the wheel when moving forward is the forward rotation of the motor, and the direction of the wheel when moving backward is the reverse rotation of the motor.

The rollers on the outer periphery of the McReel are in contact with the ground. When the McReel rotates around the hub shaft, the rollers will generate friction with the ground. We can decompose the ground friction along the direction perpendicular to and parallel to the roller axis. Among them, the component perpendicular to the roller axis belongs to rolling friction, which causes the roller to rotate and is an invalid motion; The component parallel to the roller axis belongs to static friction, which causes the roller to move relative to the ground, thereby driving the entire McReel to move along the roller axis.

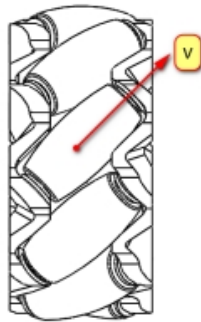
### Wheel A

The actual direction of movement needs to be determined based on the part where the wheel contacts the ground

Forward: The actual movement is diagonally to the right front

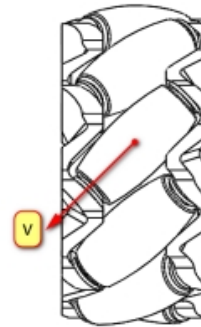
Backward: The actual movement is diagonally to the left rear

Forward



Force analysis diagram of A wheel bottom surface

back



Force analysis diagram of A wheel bottom surface

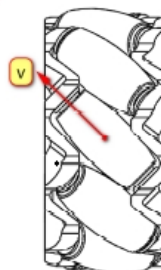
## Wheel B

The actual direction of movement needs to be determined based on the part where the wheel contacts the ground

Forward: The actual movement is diagonally to the left front

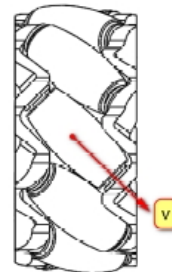
Backward: The actual movement is diagonally to the right rear

forward



Force analysis diagram of B wheel bottom surface

back

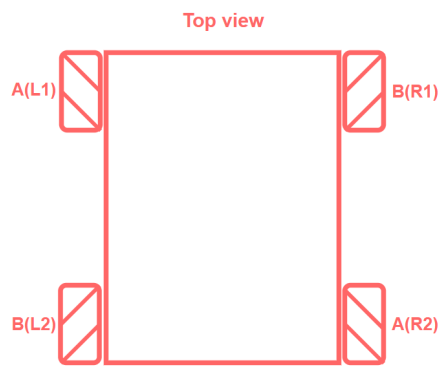


Force analysis diagram of B wheel bottom surface

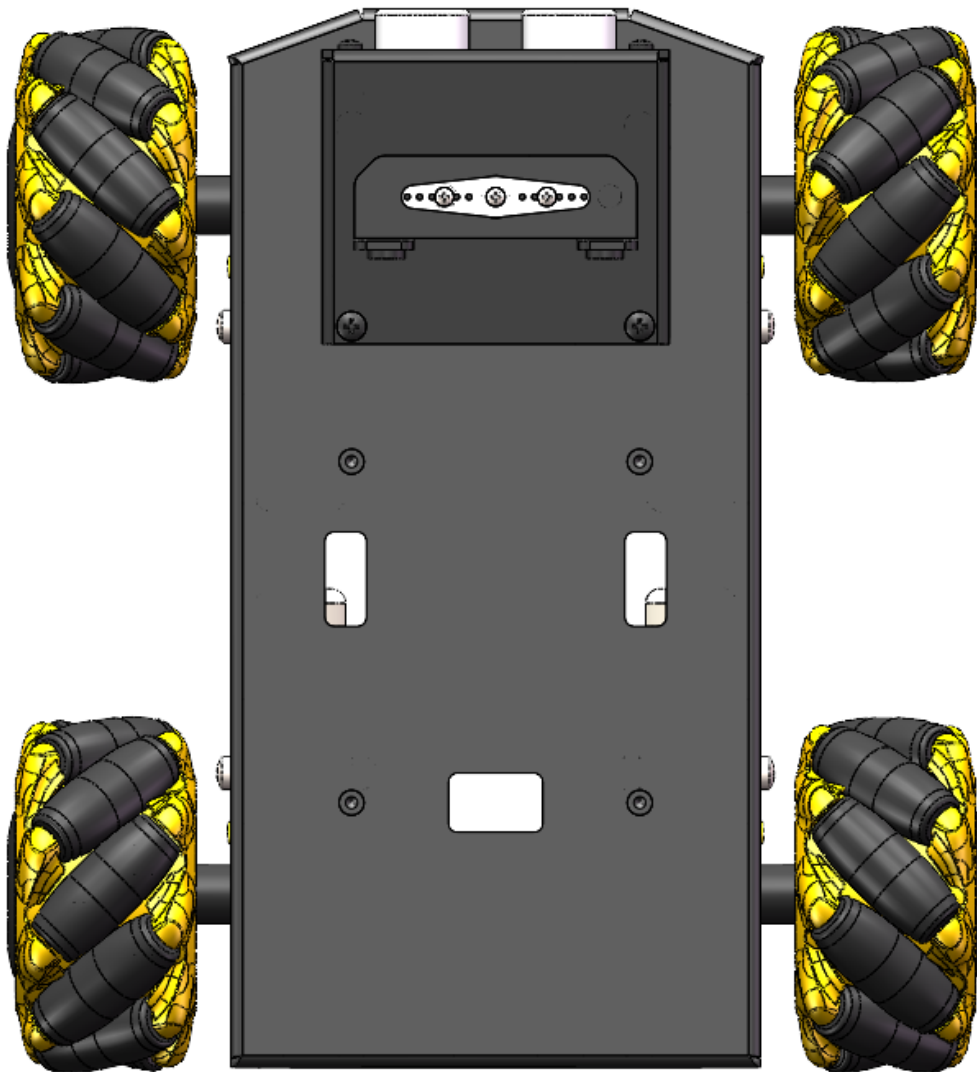
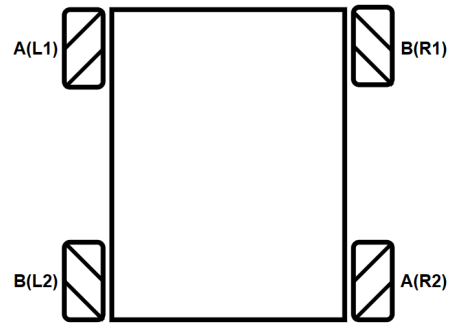
## Analysis of the movement state of the car

The actual wheel distribution of our car is ABBA type. The actual installation can refer to the top view in the picture for installation. The stick shape of the wheel in the top view is "X-shaped".

To conduct motion analysis, you need to refer to the contact part between the Mecanum wheel and the ground!



The part of the mecanum wheel in contact with the ground



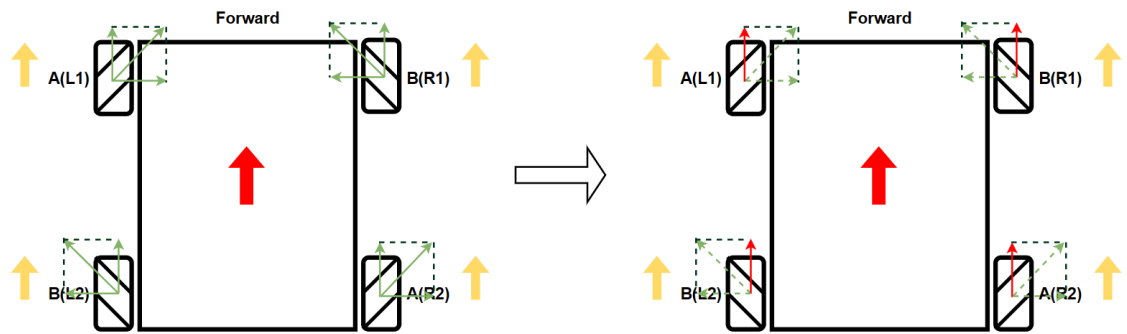
## Motion decomposition

The following figure demonstrates the speed decomposition of the car's forward state.

Yellow arrow: motor rotation direction (upward means forward - motor forward rotation, downward means backward - motor reverse rotation)

Red arrow: actual movement direction of the car

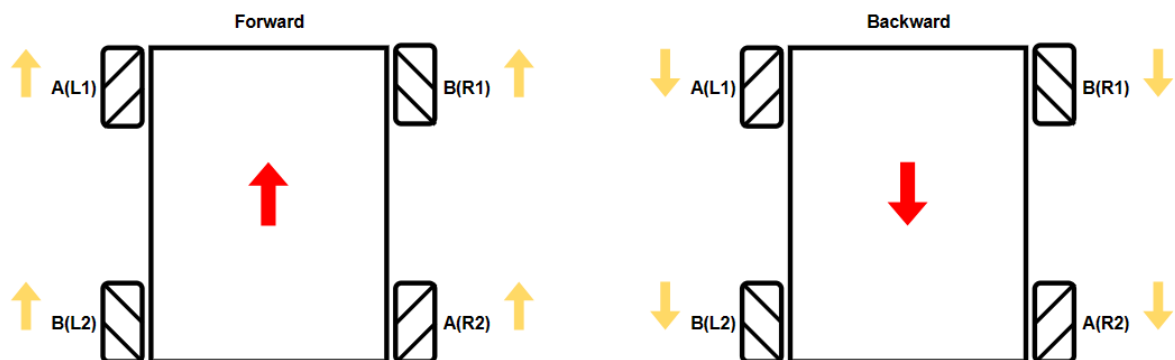
Green arrow: speed decomposition direction (where the dotted arrow is the speed component after offset, and the red arrow is the actual speed component)



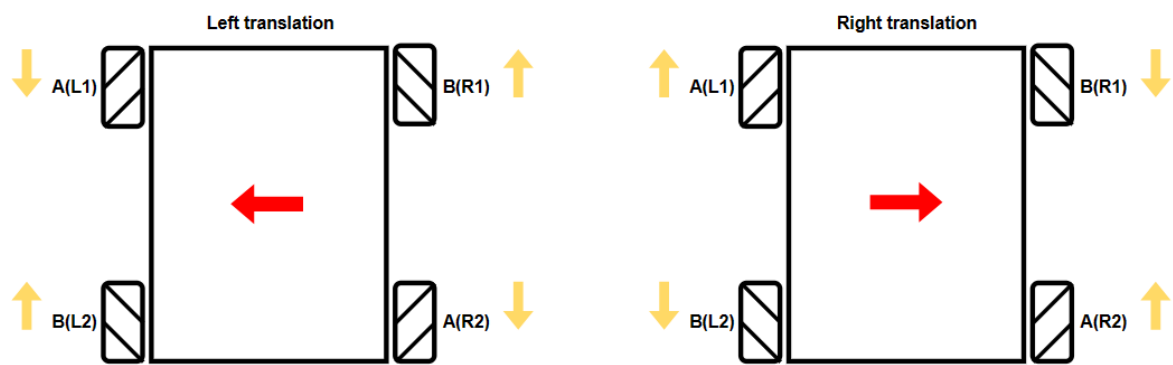
The movement state in the table is analyzed when the speeds of the four motors are consistent and the ground is flat: + represents forward rotation, - represents reverse rotation, and 0 represents no speed.

Movement Status	L1	L2	R1	R2
Forward	+	+	+	+
Backward	-	-	-	-
Left Translation	-	+	+	-
Right Translation	+	-	-	+
Left Front	0	+	+	0
Left Rear	-	0	0	-
Right Front	+	0	0	+
Right Rear	0	-	-	0
Counterclockwise Rotation (Left Rotation)	-	-	+	+
Clockwise Rotation (Right Rotation)	+	+	-	-
Stop	0	0	0	0

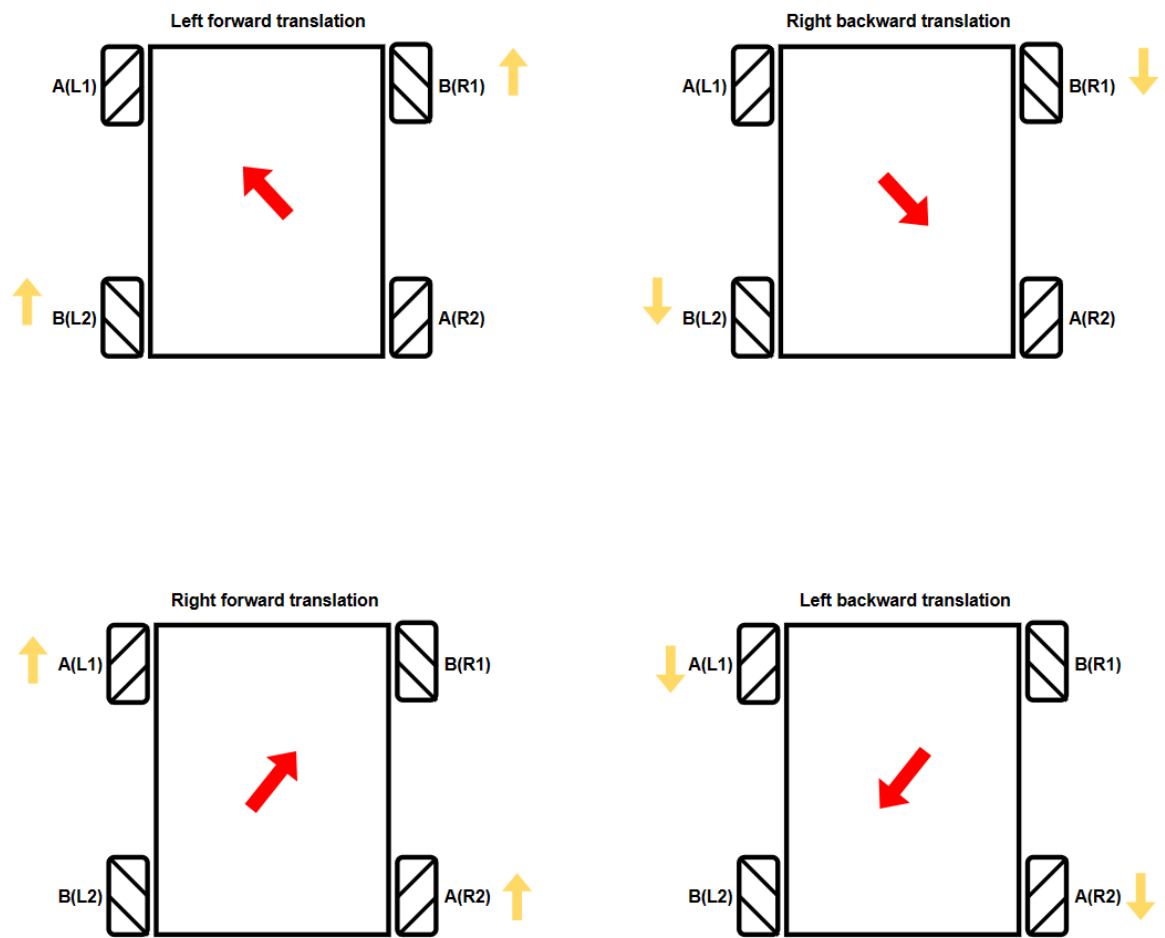
## Forward/Backward



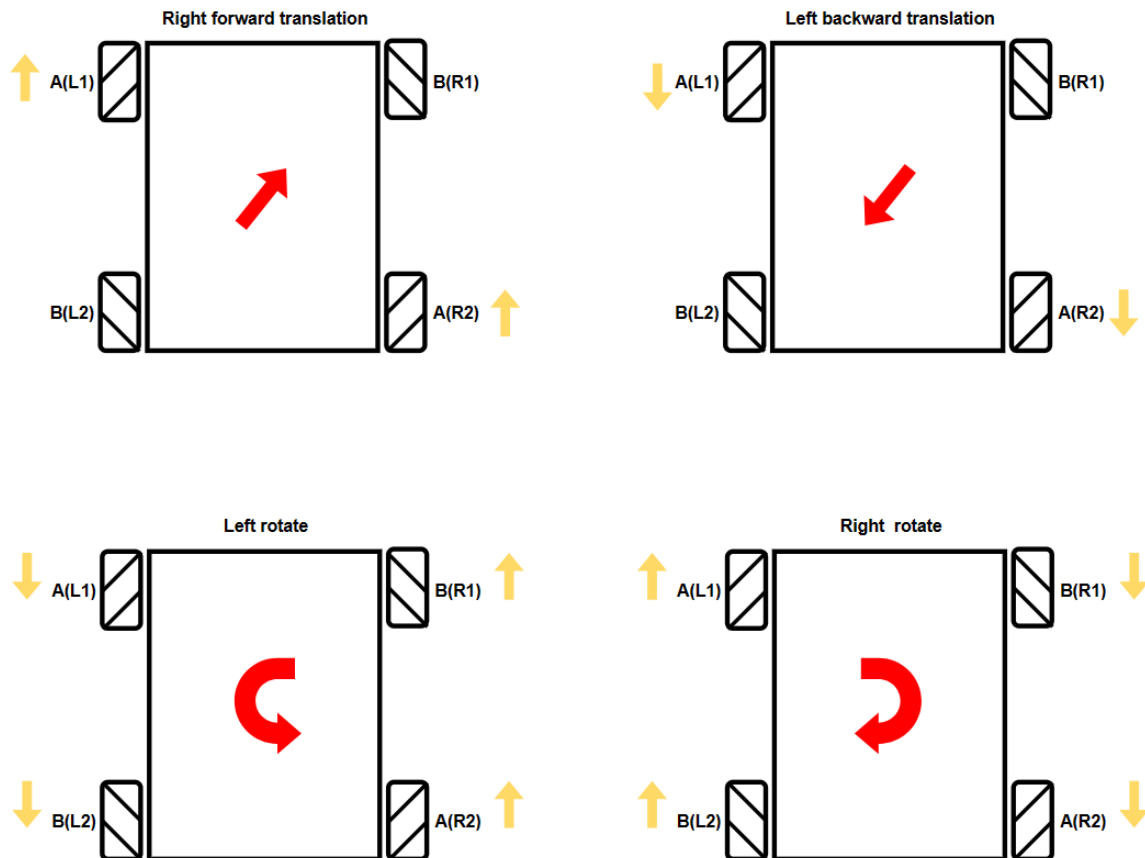
Left/Right Pan



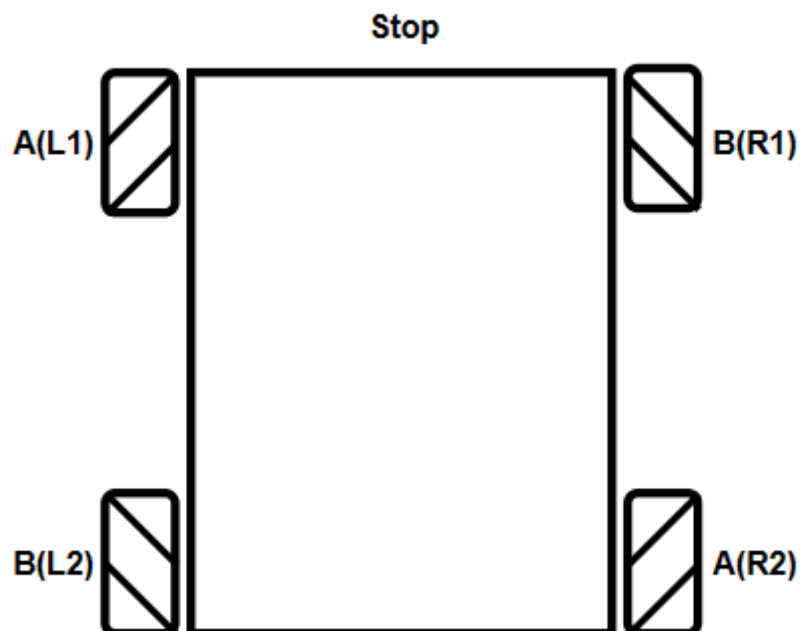
Front/Back Pan



## Rotate in Place



## Stop



## Notes

Due to the influence of factors such as structure, resistance and friction during the actual movement of the car, some movement states are not particularly ideal.

The TTL motor equipped with our Robduino car cannot perform PID speed regulation, so some movement states are not particularly ideal