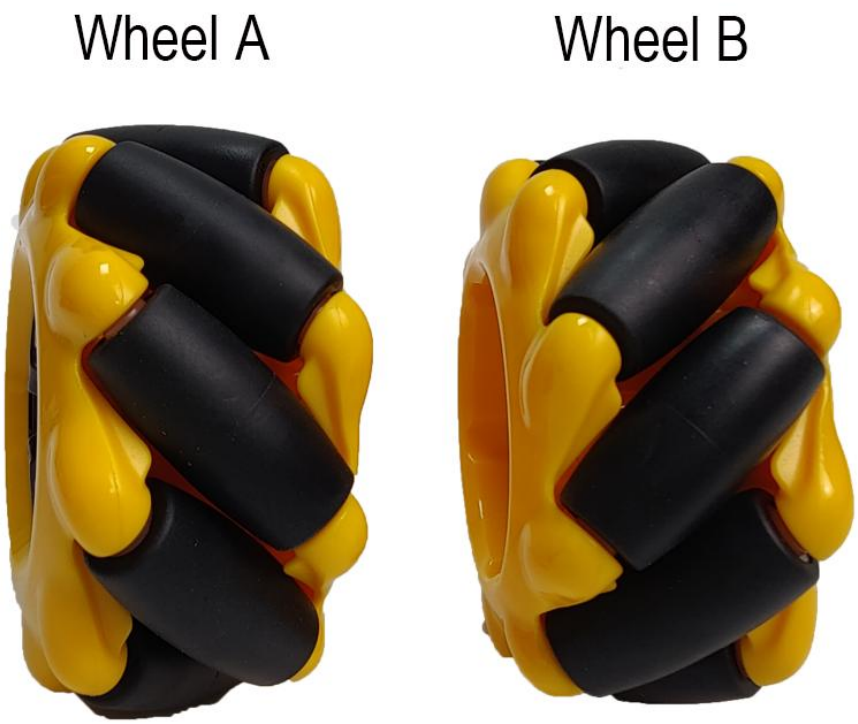
Lesson 2 Introduction to Mecanum Wheel Car

1. Preface

TurboPi adopts mecanum wheels which move in all direction. According to direction of roller, wheels can be divided into wheel A and wheel B which are in mirror-image relationship with each other as pictured.



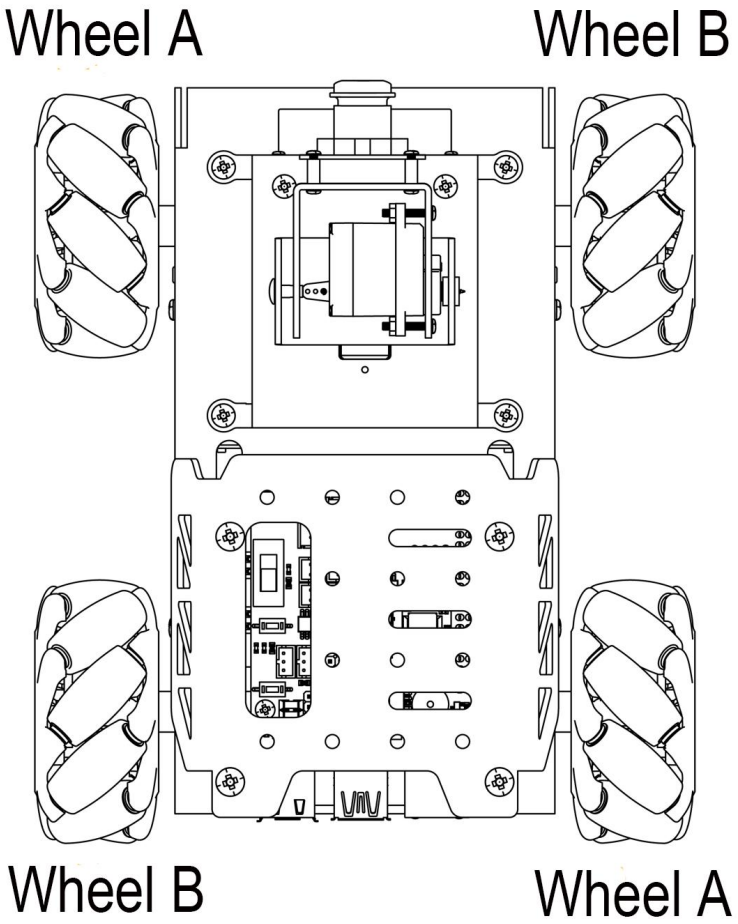
It features 360° movement, flexibility and stability. The combination of four mecanum wheels enables TurboPi to move more flexibly and achieve 360° movement.

2. Working Principle

2.1 Mecanum Wheel Hardware Structure

Mecanum wheel is composed of rollers and axles. Axle serves as main bracket of the whole wheel, and rollers are attached to the axle. The axel axis is at a 45-degree angle to the roller axis. In general, mecanum wheels work in a group of four, including two left wheels and two right wheels. A wheel and B wheel are symmetrical.

There are several combination of four mecanum wheels, such as AAAA, BBBB, AABB, ABAB, BABA. Not all combinations of wheels enable TurboPi to go forward, backward, and move left and right, etc. The combination of TurboPi's wheels are ABAB, which can realize omnidirectional movement. This is the configuration we will be using - See picture below.



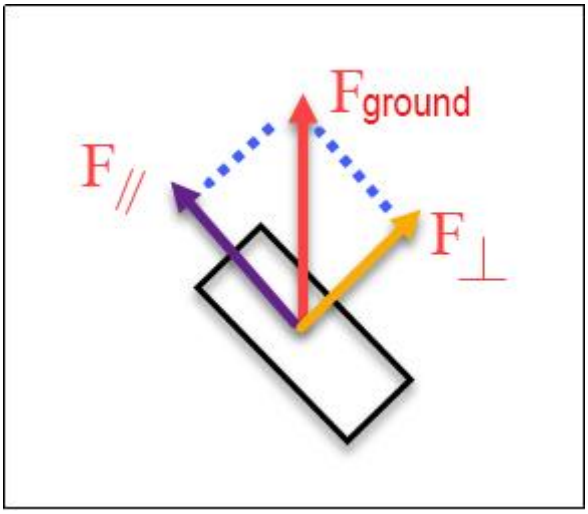
2.2 Mecanum Wheel Physical Characteristics

The omnidirectional motion of the vehicle is achieved as the vector summation of propelling forces on the ground-engaging rollers can be in any direction by adjusting the wheel rotation direction and torque magnitude of the four wheels.

Due to the rollers at its rim oriented at an certain angle to the wheel circumference, the mecanum wheels can slip in sideways direction. The generatrix of small rollers are special. When the mecanum wheel revolves around its fixed axle, the envelope of each small roller is a cylindrical surface so that the wheel can roll forward continuously.

3. Motion Analysis

Take wheel turning forward as example. Only rollers that are in contact with the ground are analyzed. When wheel turns forward, roller touching the ground can be rubbed as a static point. Ground will provide the roller a forward friction. Decompose this friction force as follows:



It is decomposed into the force parallel to roller and the force perpendicular to roller. The force perpendicular to the roller enables roller to rotate. This is rolling friction, which is very small, so it will not have any effect on the movement of the wheel. You can think that the force in this direction will be dissipated by the rolling of the roller.

As roller has physical limit, it will not roll in a direction parallel to roller axis, so the force parallel to roller axis engenders sliding friction. This force is the one that plays a vital role in the movement of wheels, and the direction of this force is the direction in which the wheels will move when rolling forward. That is to say, Mecanum wheel in the figure will move forward to the left when rolling forward.

NOTE: The force analysis is performed on the roller in contact with the ground. In the force analysis of the following materials is conducted from a top-down

perspective, and the force direction is perpendicular to the roller above.