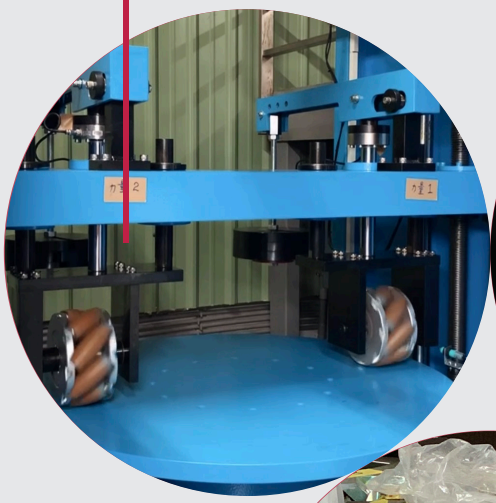
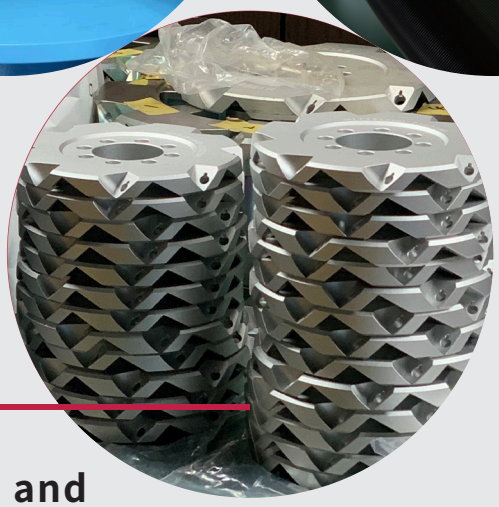
MECANUM WHEEL

Mecanum wheel

consists of a series of rollers obliquely attached to the circumference of the wheel rim. When Mecanum wheel spins, the propelling force is generated only in the direction of the roller axis. Thus, by commanding the wheels to spin in various combinations of directions, the vehicle can move omnidirectionally and in any direction at any time.





Kinematic characteristics

With Mecanum wheels, you can maneuver reliably, even with heavy loads. Such kinematic characteristics makes Mecanum wheel a popular element for automated guided vehicles (AGVs) and autonomous mobile robots (AMRs).

Structural strength and vibration values

HICKWALL continuously improves and upgrades the Mecanum wheel's lifespan. We have equipment specially used to test the endurance of Mecanum wheel, and use multiple grades of materials applying different sizes Mecanum wheel, combined with the most stringent testing conditions, to improve the Mecanum wheels to their ideal state. Our biggest advantage is to extend the endurance of our products and ensure that the vehicle will not cause any problems due to insufficient strength and excessive vibration when driving.

Mecanum wheels consist of a series of polyurethane (PU) covered rollers that are attached obliquely around the circumference of the wheel frame. When the Mecanum wheel rotates, the propulsion force is only generated in the direction of the roller, so by commanding the wheels to rotate in various combinations of directions, the vehicle can move in different motion modes. This kinematic characteristic makes the Mecanum wheel an ideal choice for AGVs. mainstream. But although the shape of the roller is designed so that the circumference of the Mecanum wheel becomes a perfect circle, regular vibrations are often seen as the Mecanum wheel rolls on the ground. We investigated this phenomenon and proposed a solution to the problem.

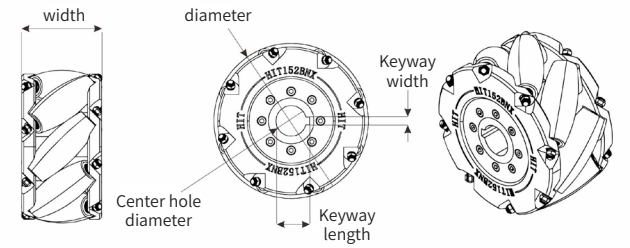


Fig. 1. A typical design of the Mecanum Wheel, which consists of multiple polyurethane-covered rollers trimmed to exhibit a circular circumference.

Structural analysis confirmed that irregular polyurethane stiffness around the mecanum wheel could cause vibration. We achieved uniform stiffness by changing the geometry of the metal core and polyurethane layers. After a series of 3D finite element analyses, the final design was completed.The Mecanum wheel sample used in the research is a product with a wheel outer diameter of 203mm and a wheel width of 105mm. This sample is a widely used representative Mecanum wheel. As shown in Figure 1, it consists of eight rollers. The installation angle of the rollers is is 45 degrees. Viewed from the side of the Mecanum wheel, the arcs of each roller will form a circle when they meet, but in fact there will be a height difference between rollers when they alternate.

Research results show that this height difference comes from the deformation of the roller. Therefore, our research goal is to change the geometric design of the Mecanum wheel so that the deformation at all angles during operation can be unified, so that the Mecanum wheel will not vibrate due to the height difference during operation. We use finite elements to analyze the angle of the roller, the deformation of polyurethane, and the overall bending deformation. Figure 2 presents the meshing of the roller to simulate the entity.Our research has found that the compression deformation of the roller is highly correlated with the thickness of the polyurethane.

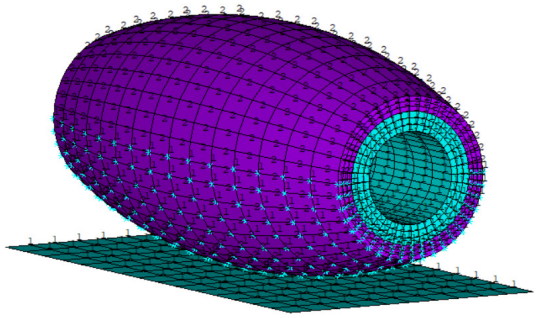


Fig. 2. The analysis results of the overall compression stiffness of the Mecanum Wheel at various angles using a three-dimensional finite element model.

The thinner the polyurethane, the higher the compression deformation, and the thicker the polyurethane, the lower the compression deformation. Therefore, we adjusted the polyurethane thickness of the roller to keep the outer curvature of the roller unchanged. By modifying the iron core in the middle, we changed the amount of compression of the roller when it is stressed.This method can make the mecanum wheel keep the compression amount of the roller at the same height under continuous operation, and analyze the overlap of the roller to simulate the actual operation situation. The adjustment of the thickness of the outermost wall of the roller needs to be linked to the thickness in the middle, which cannot Separate processing requires modeling and continuous analysis in the software, as shown in Figure 3, in order to find the best solution.

The conclusions are summarized as follows:

The source of vibration of the Mecanum wheel comes from the compression deformation of the Mecanum wheel roller. There are different compression amounts under the same force, and there will be regular and high-frequency vibration under continuous operation.

By adjusting the thickness of the polyurethane, the Mecanum wheel can bear a weight of 200 kilograms at all angles, and the compression amount can be consistent, successfully reducing the vibration of the Mecanum wheel.

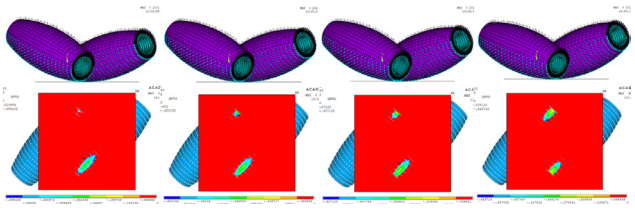
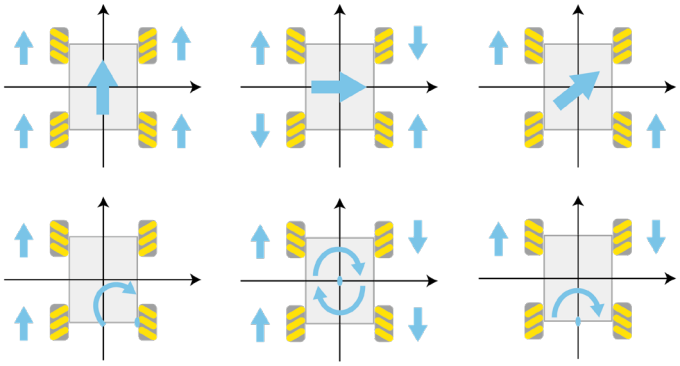


Fig. 3. Finite element results of contact stress during the transition period of two adjacent rollers.

Top: the 3-dimensional finite element model with dual rollers.

Bottom: the contact area and stress distribution shown by the finite element results.

Mecanum wheel



- **Feature**：light duty, medium duty, heavy duty, anti-static, abrasion resistant, omnidirectional
- **Application**：clean room, semiconductor fabrication plant, automated warehousing, spatial limitation area

Fig. Mecanum wheel working principle

Unit：mm

Item No.	Roller material	Frame material	Wheel diameter	Wheel width	Keyway hub length	Keyway hub width	Inside diameter of wheel core	Load capacity(Kg)	Weight(Kg)
HIT152AHD	PU	Aluminum	152	80	33.3 +0.1	8 +0.02	30 +0.02	100	5
HIT203AHD			203	103				200	9
HIT254AHD			254	128				250	15
HIT305AHD		Cast iron	305	156	48.8 +0.1	14 +0.02	45 +0.02	750	40

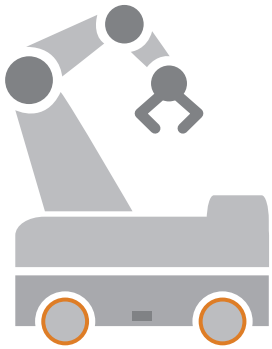


Fig. Apply to robot manipulator

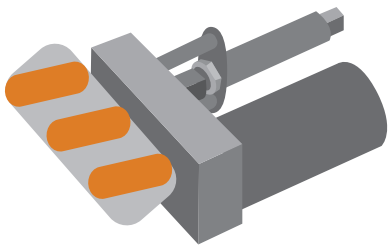


Fig. Mecanum wheel needs to be used with a reducer and motor, and the specifications are matched according to the load of the machine.