

1 Built-in drive modules with steering motor.

2 Drive module with double wheel.

COMPACT DRIVE MODULES FOR OMNIDIRECTIONAL ROBOT PLATFORMS

Background

The use of mobile robots in everyday environments is becoming increasingly popular. In order to get through narrow gaps quickly and reach their destinations safely, they have to be extremely maneuverable. Most of today's commercially available platforms have differential drives or three-wheel kinematics. However, neither of these types allow a robot to change orientation or move sideways while in motion. The required flexibility can only be achieved with the use of omnidirectional drives.

Our solution

In recent years, Fraunhofer IPA has developed several versions of an omnidirectional drive concept that combines the flexibility of standard wheels with the maneuverability of omnidirectional wheels. The modular,

compact drive modules can be used for all types of robot application, from household robots through to automated guided vehicles.

Motion characteristics

The use of several wheels that are driven and steered at the same time has significant advantages over conventional special wheels such as Mecanum wheels: These allow robots to move safely and reliably, even on slippery or unpaved surfaces. The large contact surface with the floor enables smooth, low-noise operation and high payloads to be moved. In addition, the material and elasticity of the tires can be easily adapted to the respective application.

Structure of the drives

When constructing a compact mobile platform, important factors to consider are the height of the drive module above the ground and the space required for a full turn around the vertical axis. Hub drives with integrated gear units are highly suitable because the

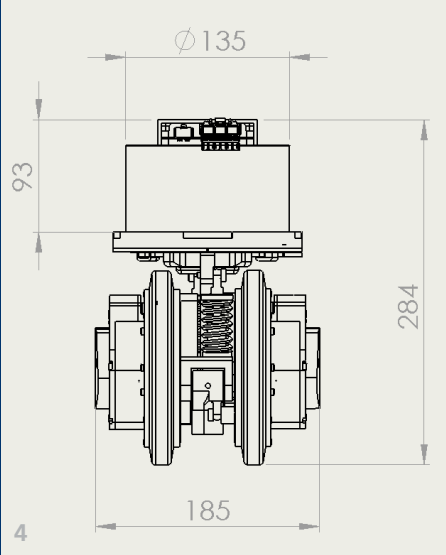
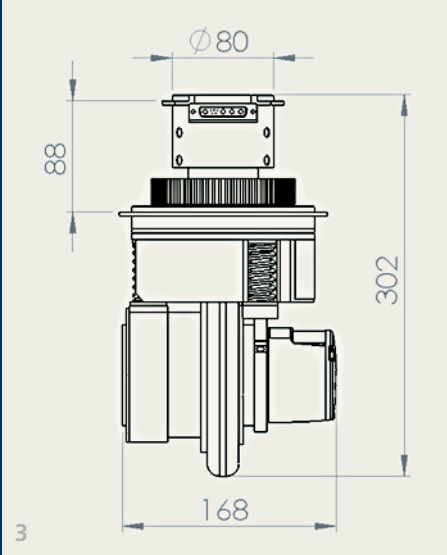
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	Version 1: Drive and steering unit	Version 2: Double wheel system
Payload (per wheel)	50-80 kg	50-80 kg
Max. velocity	1.2 m/s	1.4 m/s
Drive motor	48 V, 40 Nm max.	48 V, 2 x 35 Nm max.
Steering motor	48 V, 9 Nm max., connected via belt	Same as drive motor
External connections	48 V power + logic, 24 V brake, CAN	48 V, 24 V brake, CAN, STO

motor, resolver, brake and planetary gear are all housed in one unit. These are driven by one or two wheel bandages arranged centrally under the axis of rotation. To save space, the control units for the servo direct drives are integrated in the shaft of the drive modules, as are also the electronics required to control the brakes.

The connections for the power supply (48 V power as well as logic voltage or STO) and the CAN bus interface are routed through the top of the drive module via slip ring. This allows the platform to be steered in any direction without twisting the cables.

To assess the advantages of different designs, Fraunhofer IPA has developed two versions of the omnidirectional drives. With the first version, the drive module is steered by an external servo motor. The module is driven by a belt on its shaft. The second version uses a differential drive consisting of two wheel units. Both motors have full drive and steering capabilities. The drive electronics are fully integrated into the module.

Integrated suspension is a further special feature of the drive modules. This protects the control electronics inside the shaft as well as the entire structure of the robot from shocks and improves contact between the wheel and the ground.

Modularity and scalability

Due to their modular design, the drive modules can be utilized to construct any omnidirectional platform according to the modular principle. By selecting a different gear ratio, the ratio between speed and torque can be adapted to the respective application. If required, customized versions with more powerful drive motors in the wheel hub can also be developed.

Reference projects

Care-O-bot® 4

Care-O-bot® 4 is a service robot designed to assist people in domestic or commercial environments. It is the result of more than 20 years of research and development work and is now marketed by a spin-off. It is currently being used to guide customers to the product they are looking for in electronics stores. The omnidirectional drives enable it to move safely even in confined spaces, e.g. between shelves.

Robotic ServiceAssistant

The robotic ServiceAssistant is a mobile robot, which distributes snacks and beverages. It navigates autonomously, recognizes people and actively approaches them. It has already successfully completed a practical trial lasting several weeks in a nursing home, where it

offered drinks to the residents. The aim of the ServiceAssistant is to relieve the workload on the staff and to give residents more independence. Here, too, the omnidirectional drives enable the robot to navigate safely between tables and chairs in common rooms.

rob@work 3

rob@work 3 has been designed as a flexible assistive robot for use in manufacturing environments and is constantly being further developed. With its omnidirectional chassis, it can be optimally adapted to different working environments.

Our services

Fraunhofer IPA helps you to design and construct the drive modules or complete omnidirectional platforms you need for your application:

- Individual requirements analysis, advice and operational planning
- Design and configuration of suitable drive modules
- Platforms fitted with application-specific equipment and appropriate drive modules
- Comprehensive software solutions for platform control and navigation planning

3 Dimensions of the drive modules with single wheel.

4 Dimensions of the double wheel system.

5 Performance data of the two versions.