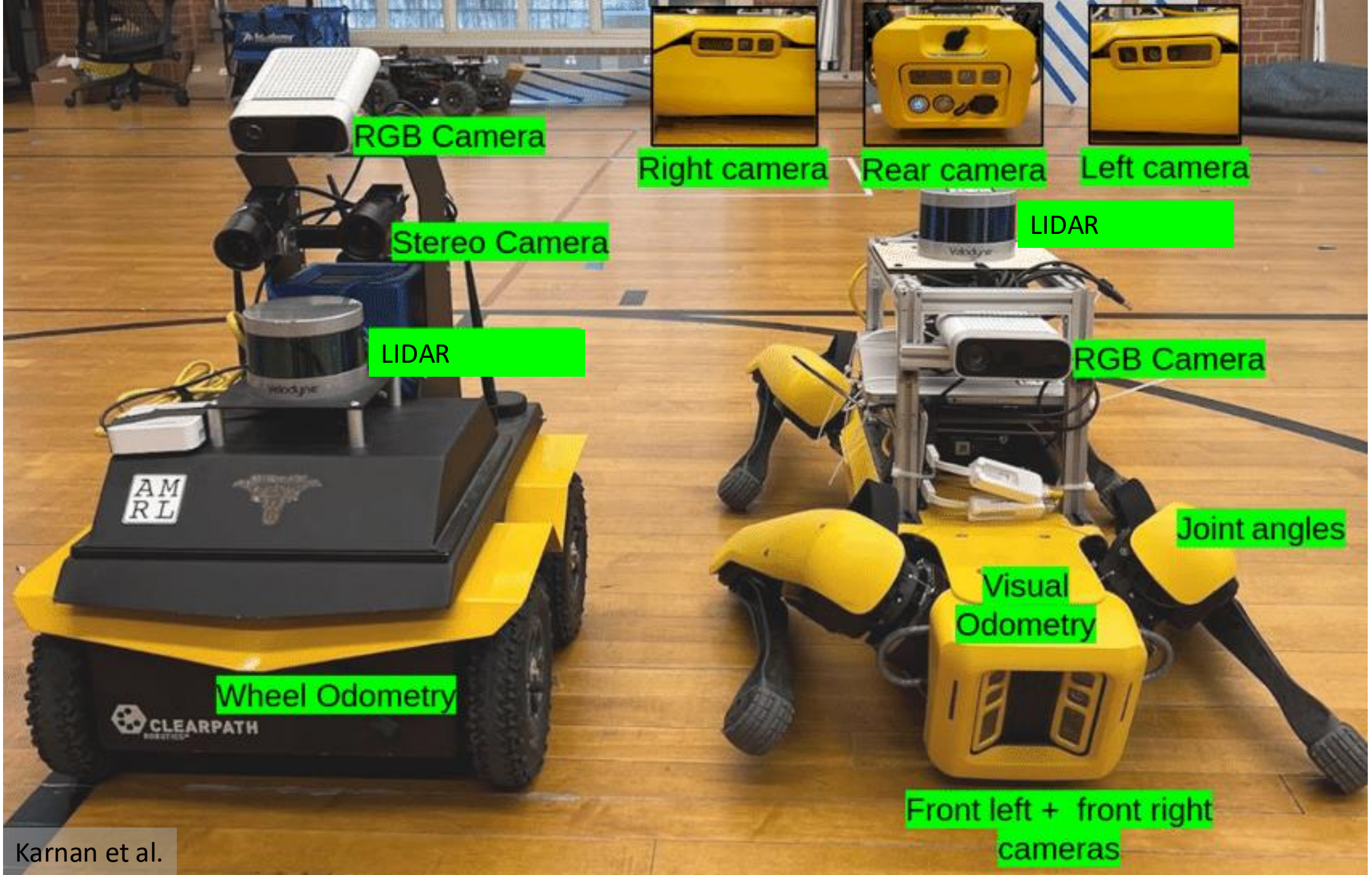
Robot Sensors

CS 3630


CLEARPATH


RGB Camera
Stereo Camera
LIDAR
Wheel Odometry
Right camera
Rear camera
Left camera
LIDAR
RGB Camera
Joint angles
Visual Odometry
Front left + front right cameras

Karnan et al.

Sensor Terminology

- **Odometry:** The use of motion data to estimate *change in position over time*. It's fundamental to robot navigation and helps track how far and in what direction a robot or vehicle has moved from its starting point.

  - **Wheeled Odometry:** A method of tracking position by measuring wheel rotations using encoders. By counting wheel turns and knowing the wheel circumference, the system calculates distance traveled. Can be inaccurate on slippery surfaces.

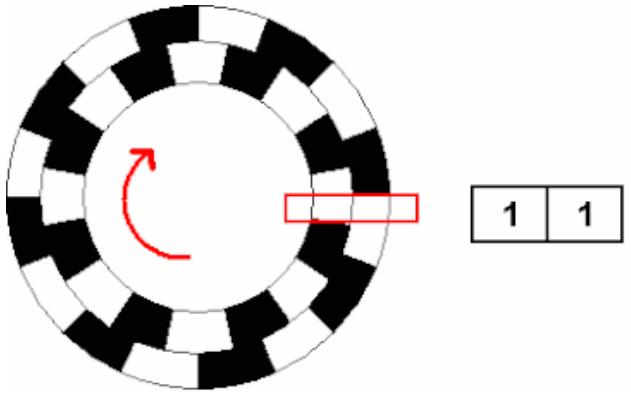
  - **Visual Odometry:** The process of determining position and orientation by analyzing changes between consecutive camera images. It works by identifying and tracking visual features across frames to estimate motion, similar to how humans use visual cues to understand their movement.

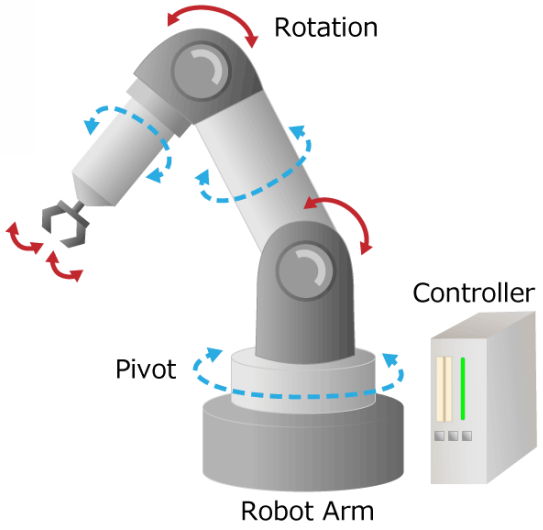
- **IMU (Inertial Measurement Unit):** measures a body's angular rate and acceleration forces.

  - Combines multiple sensors: accelerometers (measuring linear acceleration), gyroscopes (measuring angular velocity), and sometimes magnetometers (measuring magnetic fields).
  - IMUs are crucial for tracking orientation and motion, and maintaining stability

Encoders

- Most commonly **incremental encoders** that measure change over time using a disc with evenly spaced markings and optical or magnetic sensors
- **Absolute encoders** report absolute position rather than just counting changes
- Very high resolution, thousands of readings per minute





Sensor Terminology

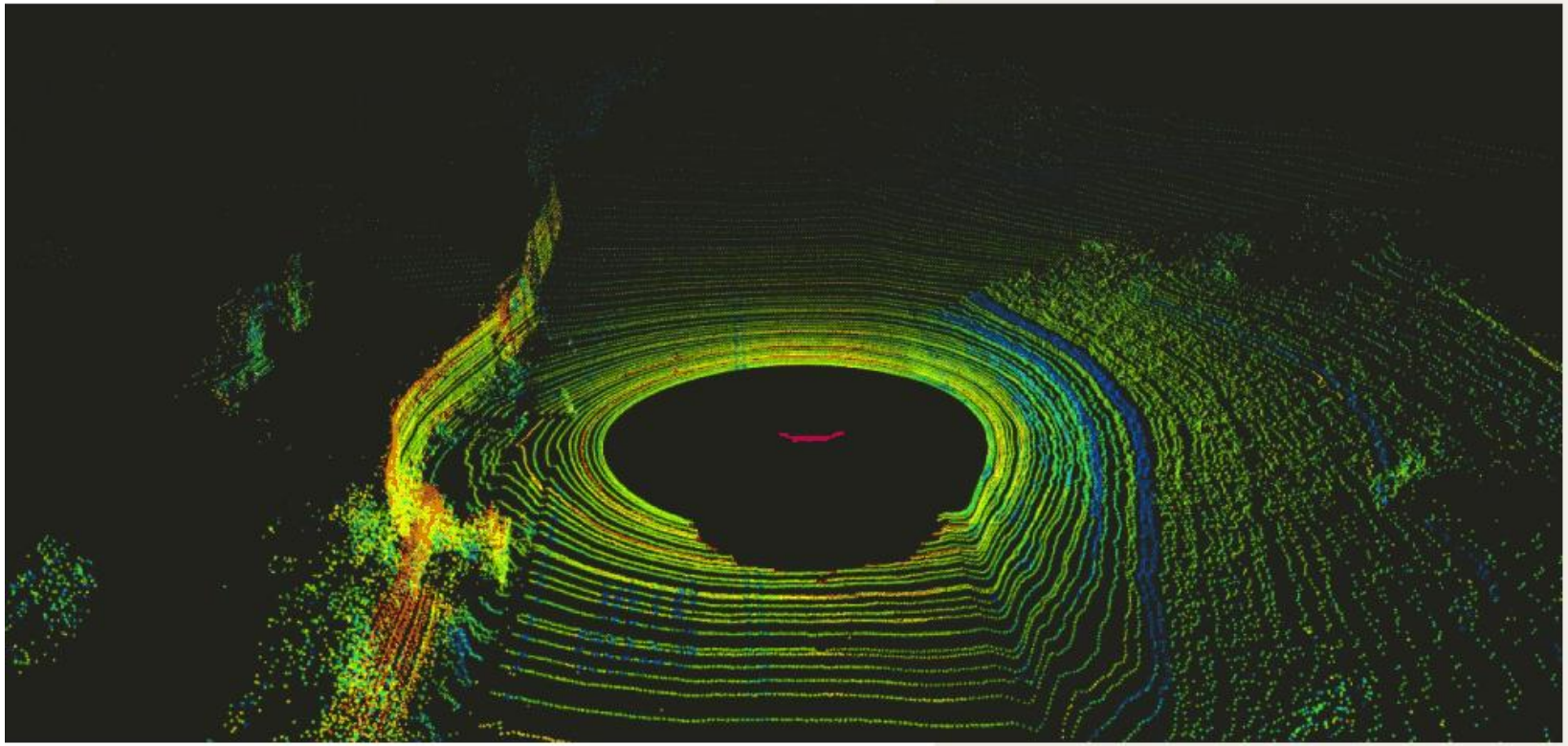
- **LIDAR (Light Detection and Ranging):** A remote sensing technology that uses pulsed laser light to measure distances. It emits laser beams and measures the time taken for reflections to return, creating detailed 3D point clouds of the environment. Essential for autonomous vehicles and robotics.

- **Stereo Camera:** A vision system that uses two cameras separated by a known distance to capture 3D information, similar to human binocular vision. By comparing the slight differences between the two images, it can calculate depth and create 3D maps of the environment.

- **RGB Camera:** A standard digital camera that captures color images using red, green, and blue color channels. It provides 2D images but no direct depth information, much like a typical smartphone camera.

- **RGB-D Camera:** A camera system that combines regular RGB color imaging with depth sensing capabilities. It provides both color information and per-pixel depth measurements, often using infrared structured light or time-of-flight technology. The Microsoft Kinect was a well-known early example.

LIDAR



[Images and exposition take from excellent Voyage Blog post]

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FEATURES

Integrated radiometric thermal camera

Roll cage for crash protection

Spherical camera (360 x 170° view)

Two speakers and microphones enable two-way audio

Protected cabling and sealed electronics

Pan-tilt-zoom (PTZ) with 30x optical zoom

Four pairs of LEDs

USB port available for saving image data

High-sensitivity microphone for auditory inspections

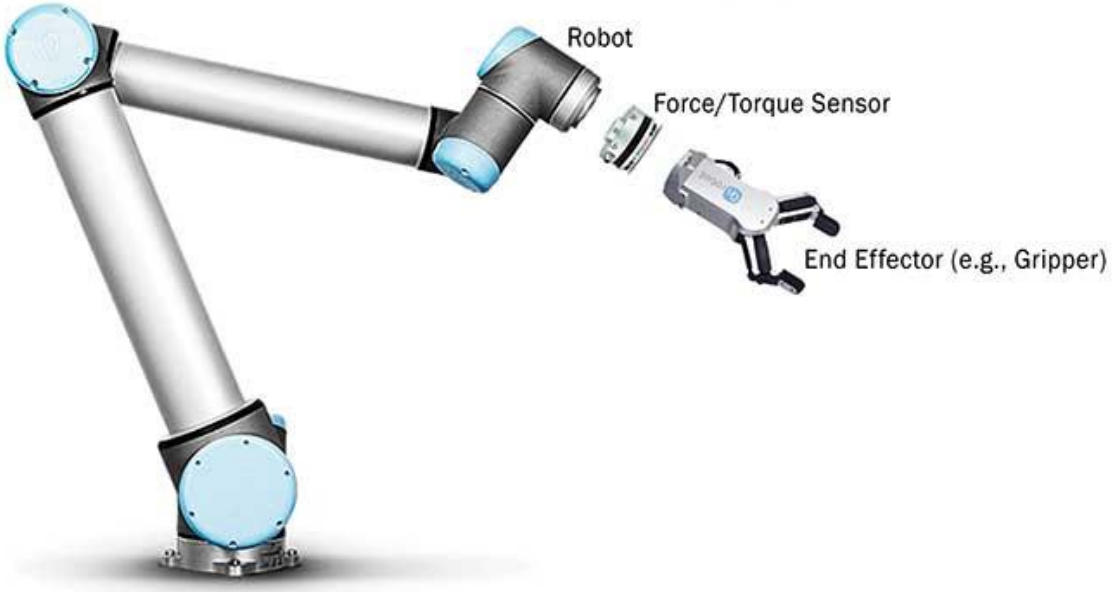
SwiftNav Duro RTK GPS support

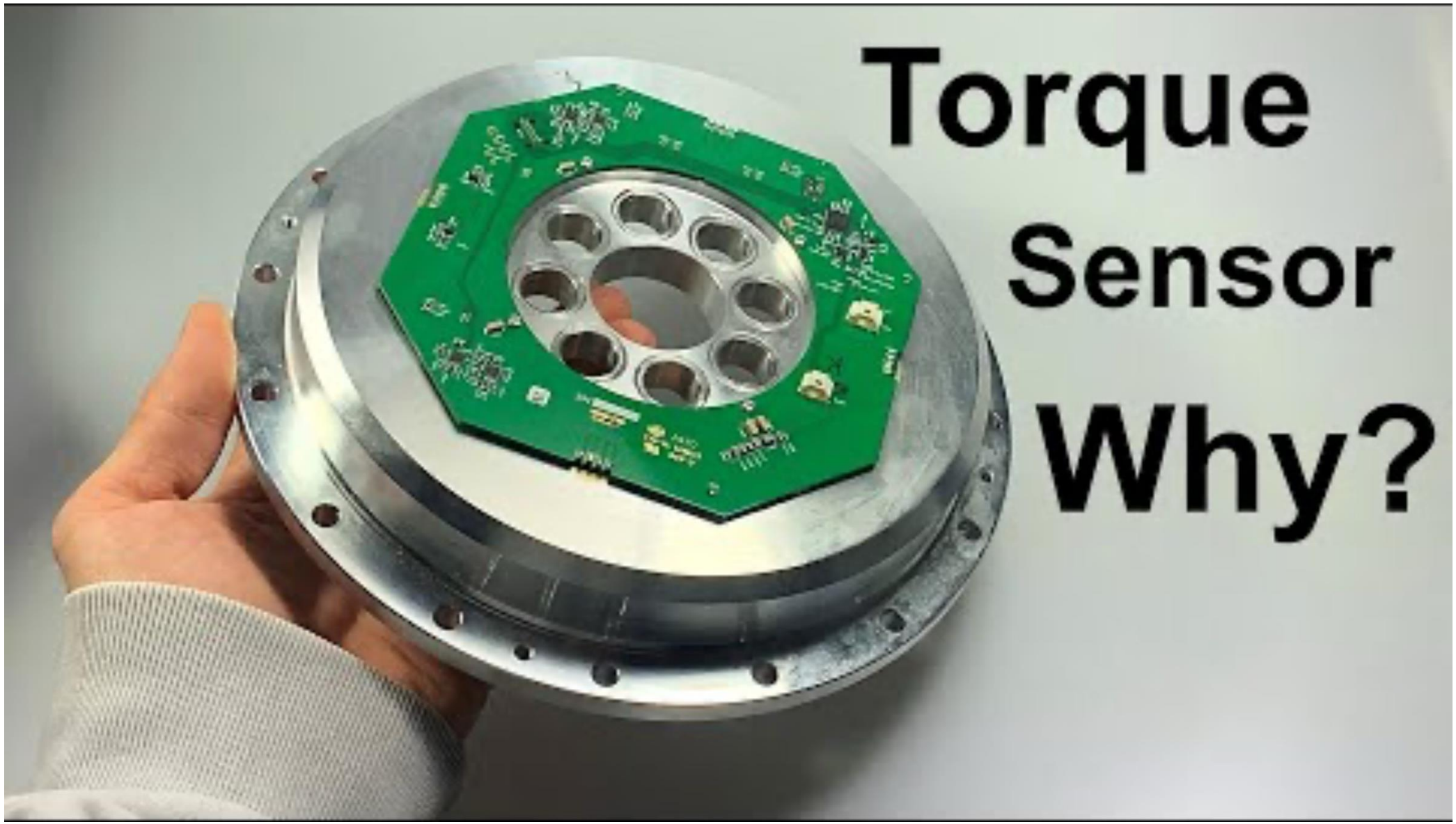
Rail connections for front or rear mounting

https://www.intuitive-robots.com/wp-content/uploads/2021/02/spot-cam-ir.jpg

Sensor Terminology

- **Force Torque Sensor:** measures both forces and torques (rotational forces) along multiple axes - typically X, Y, and Z.
  - Can detect the magnitude and direction of forces being applied to it
  - Common in robotic arms, aids in enabling a robot to apply appropriate force, maintain contact with surfaces, counteract vibrations and respond to human input.
  - Critical in surgical robotics




Torque
Sensor
Why?


FORCE TORQUE SENSOR
ROBOTIQ FT 300
ROBOTIQ
ROBOTIQ


I deliver your
shopping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