

Simulation-Based Engineering Lab  
University of Wisconsin-Madison  
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ART Oak

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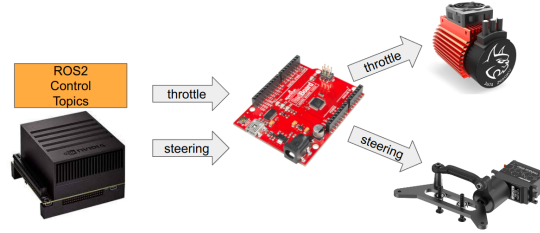
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# 1 Vehicle Platform and Sensors

Our Autonomy Research Testbed (ART) vehicle, shown in Fig. 1a, called Oak, is equipped with a Jetson AGX Xavier for on-board computing, and on-board sensors include a 2D LiDAR, a IMU, and a RTK-GPS.



(a) ART-Oak



(b) PowerTrain Diagram

Figure 1

## 1.1 Vehicle Powering System

The vehicle powertrain system includes a 7.4V battery, a brushless motor (charge throttle), a servo (charge steering), and an Arduino board (as an intermediate control step between ROS2 topic and servo and motor). The Fig. 1b explains the powertrain system workflow for ART-Oak.

## 1.2 Nvidia Jetson AGX Xavier

We use a Nvidia Jetson AGX Xavier, as shown in Fig. 2a, that consists of a CPU having 8 cores and 16 GB RAM at 2.2 GHz. The Jetson runs Ubuntu 20.04 and storage is 1TB. It also hosts a Volta GPU with 512 Cuda cores and 16 GB of global memory.

## 1.3 RPLIDAR 2D LiDAR

The RPLIDAR S2 2D LiDAR sensor is a low cost 2D scanner that is capable of performing obstacle avoidance and navigation for robotics application. Here are some key features of the RPLIDAR S2: (1) measuring radius: 30 meters; (2) scanning frequency: 8–15 Hz; (3) angular resolution:  $0.12^\circ$ ; (4) ranging accuracy:  $\pm 3$  cm.

## 1.4 Wheeltec IMU

The WHEELTEC N100 IMU Module, as shown in Fig. 3a, is a versatile, high-precision attitude sensor tailored for ROS robots, offering dynamic angle accuracy of  $0.1^\circ$  RMS and



(a) Jetson AGX Xavier



(b) RPLIDAR S2 LiDAR

Figure 2

a high output frequency of up to 400Hz. It supports robust data exchange with a Type-C USB interface and is designed for durability, withstanding 10,000 plug cycles. With pitch/roll accuracy of  $0.05^\circ$  RMS statically and  $0.1^\circ$  RMS dynamically, and heading accuracy assisted by magnetometers at  $0.5^\circ$  RMS, it's ideal for precise navigation tasks.



(a) Wheeltec N-100 IMU



(b) Sparkfun ZED-F9P RTK-GPS

Figure 3

## 1.5 Sparkfun ZED-F9P RTK-GPS

The SparkFun RTK-GPS with the ZED-F9P module, as shown in Fig. 3b, is a high-precision GPS unit that leverages Real Time Kinematics (RTK) to achieve centimeter-level accuracy in location tracking. The ZED-F9P is a GNSS receiver, capable of multiple frequency bands, which allows for concurrent reception of GPS, GLONASS, Galileo, and BeiDou signals. This multi-band capability enhances the positioning accuracy to be within 1 to 2 cm.