Real-Time Kinematic Rover Upgrade

UAH Spring 2024 ECE Senior Design Project

Overview of Project

Our task for our senior design project was to create an upgrade to the Global Positioning System (GPS) currently being used on Dr. Piccirillo's QuadRover. The GPS is a system of American satellites that transmits position and time information back to earth, allowing receivers to determine location within a few meters.

The previous system on the QuadRover used a plain unsophisticated GPS with an accuracy error of a few meters, while the new system uses Real-Time Kinematics (RTK) to have an increased accuracy, down to an RMS error value of 1 cm (our goal was below 3 cm).

This system involves a base station with a known location and a rover module. The base station computes the phase between the data of its known location and its own GPS. This correction data is sent to the rover module, where it is used along with the rover's own GPS data to create extremely accurate location data of the QuadRover.

The Prophets of Maxwell

Team The Prophets of Maxwell (From Left, Jacob Knowles, Brendan Mitchell, Seth Schmidt, and Haylee Winters), pictured with the RTK Base Station and the Rover Module in hand.

Technical Specifications

For the base station, an Orbit 57095 Junction Box was used to house and mount the components for the base station. The box contains a 915 MHz radio telemetry module, RTK Module, a Raspberry Pi 4, and a power supply. A metal plate, serving as a ground plane to the attached GPS antenna, is in turn attached to the top of the box.

Two antennas are attached to bulkhead connectors protruding from the bottom of the box, and have a range of 5 km. The cable for the power supply outlet inside the box is fed through a connector gland on the bottom of the box. The cable for the GPS antenna is fed through a separate connector gland also on the bottom of the box.

The box is bolted onto two plastic base plates. One base plate allows for clearance from the metal base of the pole. The other plate has holes in it that are used by heavy duty zip ties to fasten the base station to the pole.

The rover model consists of similar components to that of the base station, consisting of a 915 MHz telemetry module (for receiving the correctional data from the base station), two corresponding radio antennas, its own RTK module for processing the received correctional data, and a metal ground plate for the rover module's own GPS antenna.

The parts are all attached to a small plastic board connected to a metal ground plate for the GPS antenna. The system is interconnected with jumper cables, and the cable slack for the GPS antenna is managed by some zip ties.

The RTK module's data is received by connecting to the Arduino Mega, which translates the final RTK data into readable longitude and latitude for our computers.