UGV Remote Control Over Deployed Continuous UWB RF Nodes
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abstract
Remote control of Unmanned Ground Vehicles (UGVs) over wireless is seldom uninterrupted especially in high interference or obstructive environments. We designed deployable self-sufficient, low-cost, battery-powered, and seamlessly connecting Ultrawide Bandwidth (UWB) RF nodes to have continuous communication in this environment.

Key Features
- Trivially scalable, efficiency-first design
- Video, LiDAR map, and PIR data transmission
- Novel protocol for half-duplex communication

hardware
UGV
LIDAR & Camera Assembly
Skid Steer Drive
Controlled with Robot Operating System (ROS) on Nvidia Jetson TX2

Node
Decawave Module (DWM)
Passive Infrared Sensor (PIR)
Rack & Pinion Servo Motor
Nordic System-on-Chip (SoC)
AA Batteries 2.6 Inches Width

Deployment Mechanism
Node Deployment Mechanism
Node Slide
Deployed UWB Node

Sensors
Decawave Module (DWM)
Passive Infrared Sensor (PIR)
LiDAR Sensor Using Hector SLAM

printed circuit board
Board Features
- 4 Layer PCB
- 2.5 Inches Width and Height
- On-board RF module
- Qorvo DWM 3000 UWB
- Low Power, High Reliability
- Released in 2020

Remote Station Display
Remote Station Display

transmission protocol
This original “double ack” protocol maximizes efficiency over a continuous link connection given half-duplex limitations. It allows cascading parallel transmission and packet retransmission, much faster than waiting for completion before sending the next packet.

challenges
Node Coordination using Half-Duplex Communication
The UWB module cannot send and receive data simultaneously, creating the need to coordinate nodes’ TX and RX phases.

Speed vs. Reliability Tradeoff
Acknowledgements and retransmission improves reliability, however it adds overhead and decreases speed. Additionally, UWB technology has a relatively short range, which needs to be considered during node deployment.

Robot Implementation
All UGV functionality needed to be individually implemented from the ground up. ROS is utilized on the UGV and remote station for efficient and low level data control.