Real Time Data Downlink Device (RTDD) for Live Telemetry from Instrumented Vehicles

Avinash Muthu Krishnan[1], Marc D. Compere[1], Kevin A. Adkins[2]

[1] Department of Mechanical Engineering, Embry-Riddle Aeronautical University
[2] Department of Aeronautical Science, Embry-Riddle Aeronautical University

Abstract

The Real Time Data Downlink (RTDD) device communicates live telemetry from instrumented vehicles and payloads over the cellular network.

This capability is broadly applicable to a variety of observational needs across the sciences including wildlife monitoring, agriculture health monitoring, highway traffic monitoring, airspeed measurements for wind turbines, and climate monitoring. The current application is atmospheric data collection on an aerial platform.

Design

The RTDD device is designed to last over 8 hours of remote operation via an external LiPo battery. The design weights 190 grams total. Programmed with the Arduino IDE, the RTDD device uses its UART communication to connect to any other microcontroller on a vehicle collecting telemetry data . Current design is shown in Figure 1 with:

1. Arduino MRK GSM 1400
2. 3.7V LiPo Battery
3. LiPo to USB Power Converter
4. Arduino Antenna

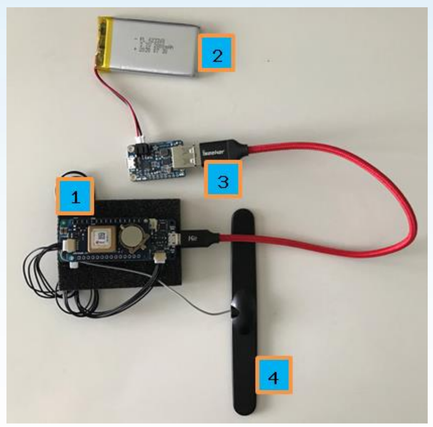

Figure 1: RTDD Device Design

Current Work

The RTDD device will be implemented on four DJI Matrice-100 quadcopters with a sensor suite measuring:

- Pixhawk – GPS
- HydroClip – Temperature and relative humidity
- Multi-hole pressure probe – Wind Speed
- Vaisala AQT400 – Air Quality Transmitter

Each vehicle collects sensor data locally, on-board the vehicle and simultaneously transmits data samples to a data collection computer for real-time experiment monitoring. The data collection computer uses an open-source, freely available software called the Mobility Virtual Environment [1] (MoVE). A sample scenario of how the test would be conducted with the unmanned aircraft is shown in Figure 2:

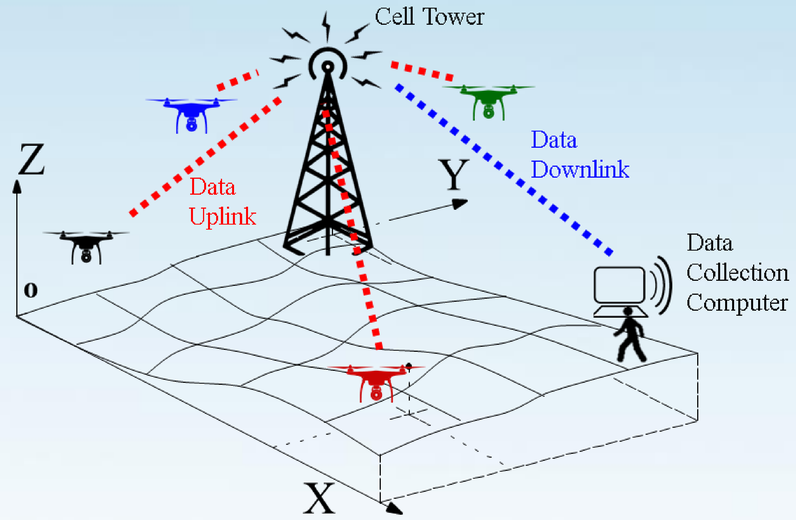

Figure 2: DJI quadcopter test scenario with RTDD device on each vehicle communicating to a data collection computer via cellular network

MoVE

MoVE aggregates all incoming data streams from each vehicle to provide a comprehensive picture of the multi-vehicle scenario. The cellular network connection allows real time updates from vehicles, in flight, to verify operation or adjust the experiment during execution. MoVE provides a live 2D map display of all vehicles and a browser-based table to present the live streaming sensor data, shown in Figures 3 and 4.

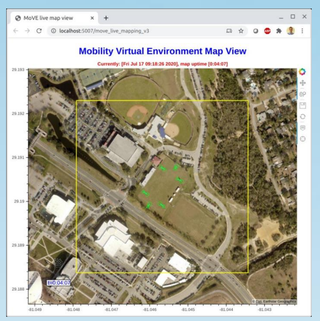

Figure 3: MoVE Live 2D Map

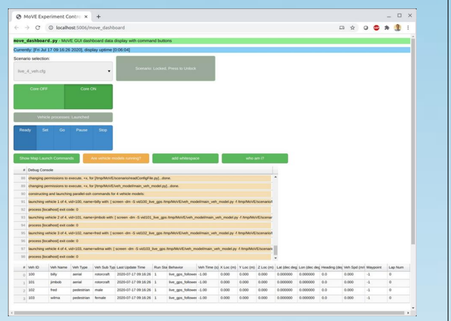

Figure 4: MoVE Dashboard

Conclusion

The RTDD provides on-site, real-time verification that the sensors, platforms, and flight plans are all performing as expected during the flight tests. It also provides a convenient way to insert data markers to delineate when tests start, stop, and have interesting features. This reduces time and effort needed in post processing by timestamping and correlating data across all sensor platforms. The RTDD device is a critical part of realizing successful test results with complex multi-vehicle scenarios.

References – [1] Compere, M. (n.d.). Mobility Virtual Environment publicly available open-source software repository on gitlab.com*: https://gitlab.com/comperem/move*