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An Exploration of Software Defined Radio and GNU Radio Companion for Use in Drone-to-Drone Communication

Amanda K. H. Voegtlin
Portland State University

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Maseeh College of Engineering and Computer Science
PORTLAND STATE UNIVERSITY

Amanda Voegtlin / Professor Ehsan Aryafar / Portland State University

Contact: Amanda KH Voegtlin, akharrett@gmail.com

PROBLEM / QUESTION

In a world that increasingly relies on automation and intelligent robotics, there is a need for drones to expand their independence and adaptability in navigating their environments. One approach to this problem is the use of wireless communication between units in order to coordinate their sensor data and build real-time maps of the environments they are navigating. However, especially indoors, relying on a fixed transmission tower to provide data to the units faces connectivity challenges.

HYPOTHESIS

Mounting software defined radios (SDRs) on drones and controlling both using a Raspberry Pi computer, we can coordinate the data collected by the drone's on-board cameras via packet transmission between the drones using software defined radios and digital signal processing software.

MATERIALS

- 2x DJI Matrice 100 quadcopter drones
- 2x Raspberry Pi 3 computers with fan-cooling cases
- 2x NI B200mini Software-defined radios
- 2x Anker cellphone power banks
- GNU Radio Companion (GRC) software
- 4x 50Ω antennas

PROCEDURE

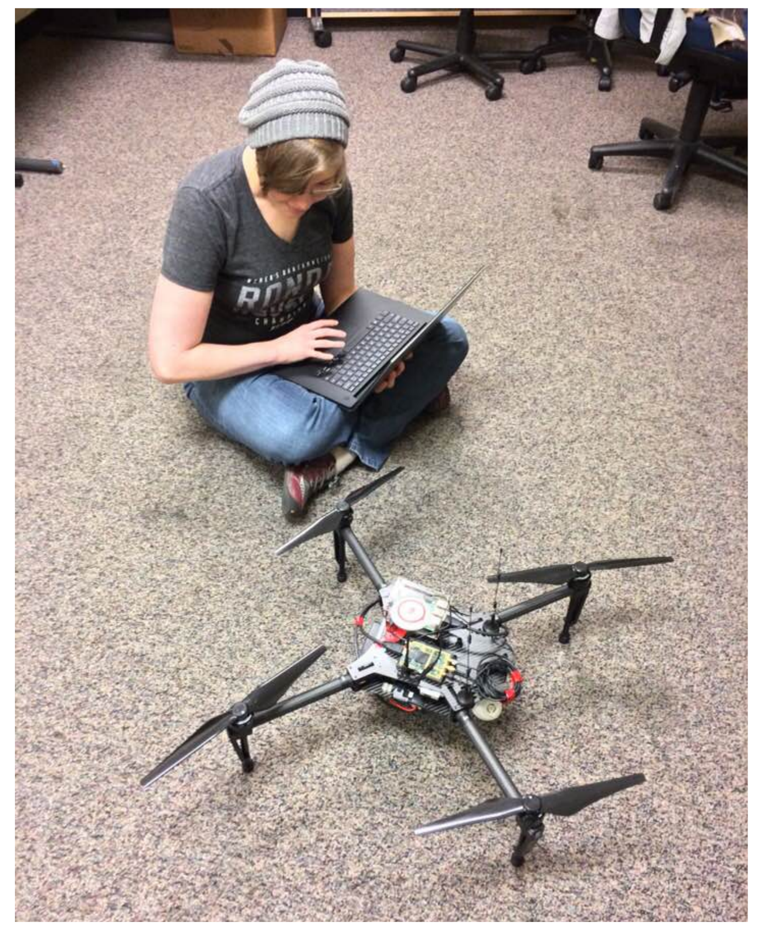

Figure 3: Drone, assembly and author

Using the Raspberry Pi's native operating system, a Linux derivative called Raspbian, Universal Hardware Drivers were installed for use with the SDRs.

After linking the hardware together, Python scripts for packet transmission were created using GNU Radio Companion and packets were exchanged between Raspberry Pi-SDR rigs. This formed the basis of drone-to-drone communication. A cell phone power bank powered the SDR and Raspberry Pi 3.

DATA / OBSERVATIONS

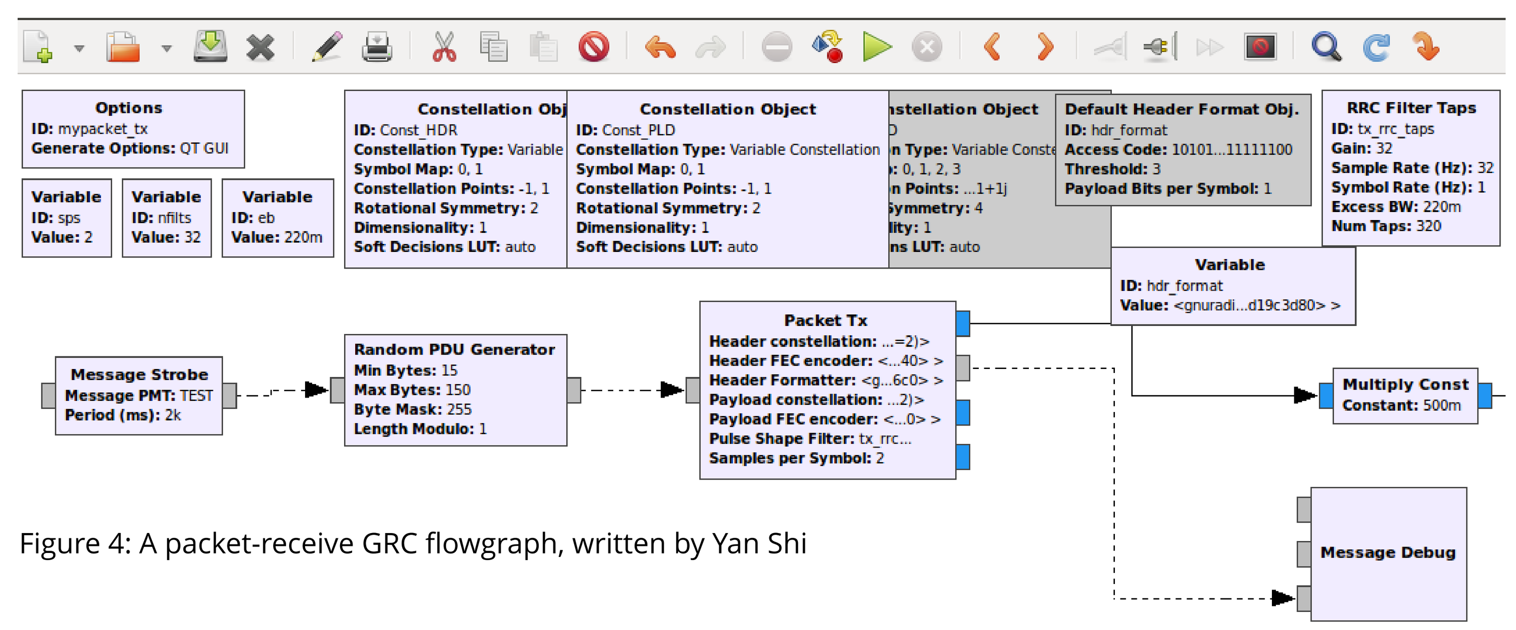

Figure 4: A packet-receive GRC flowgraph, written by Yan Shi

Transmission of information was successful. Packets could be sent between SDRs and transmitted steady signals from one SDR were able to be detected by the other.

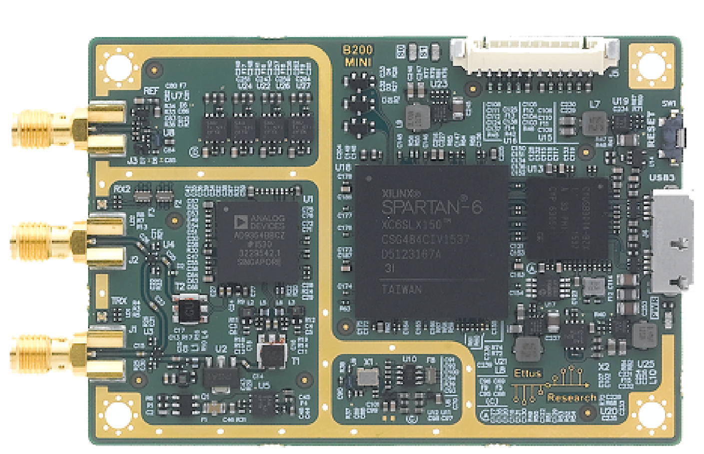

Figure 1: B200Mini SDR (above) and Anker power bank

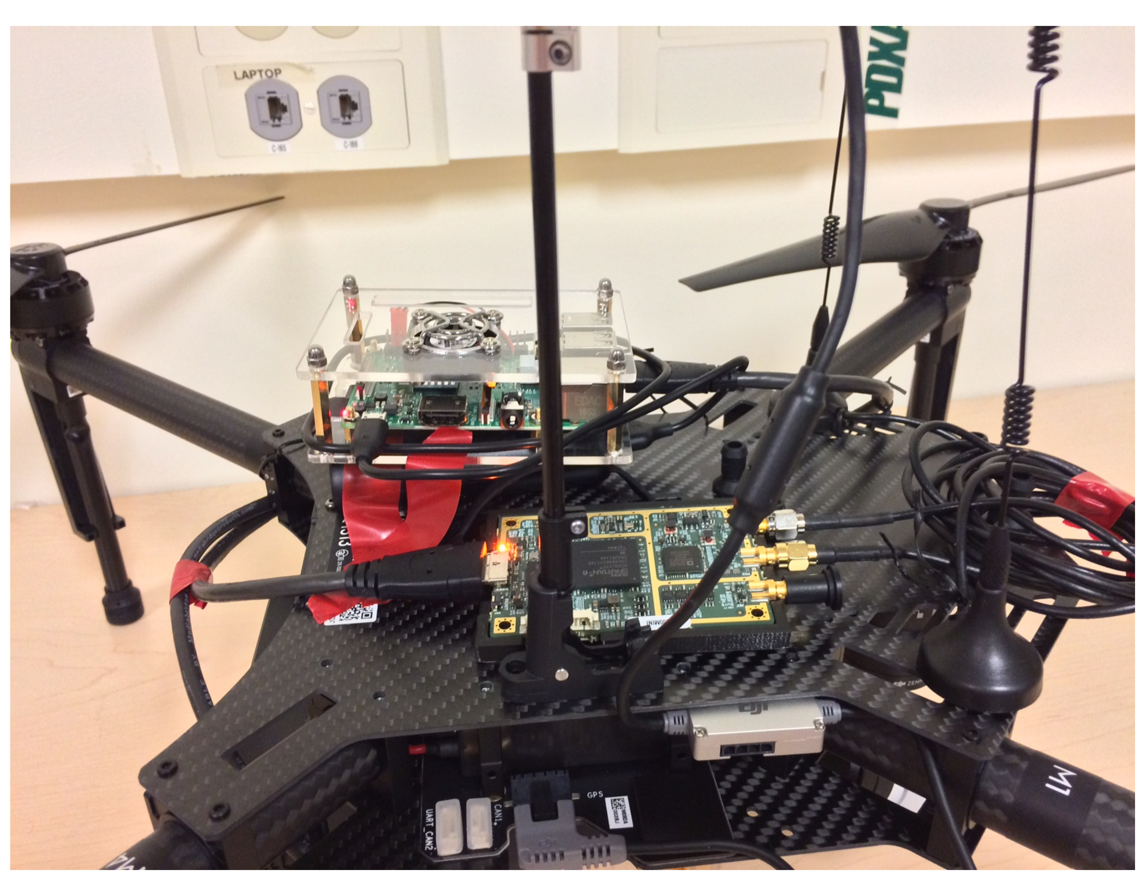

Figure 2: The finished assembly of SDR, Raspberry Pi, antennas, power bank and drone

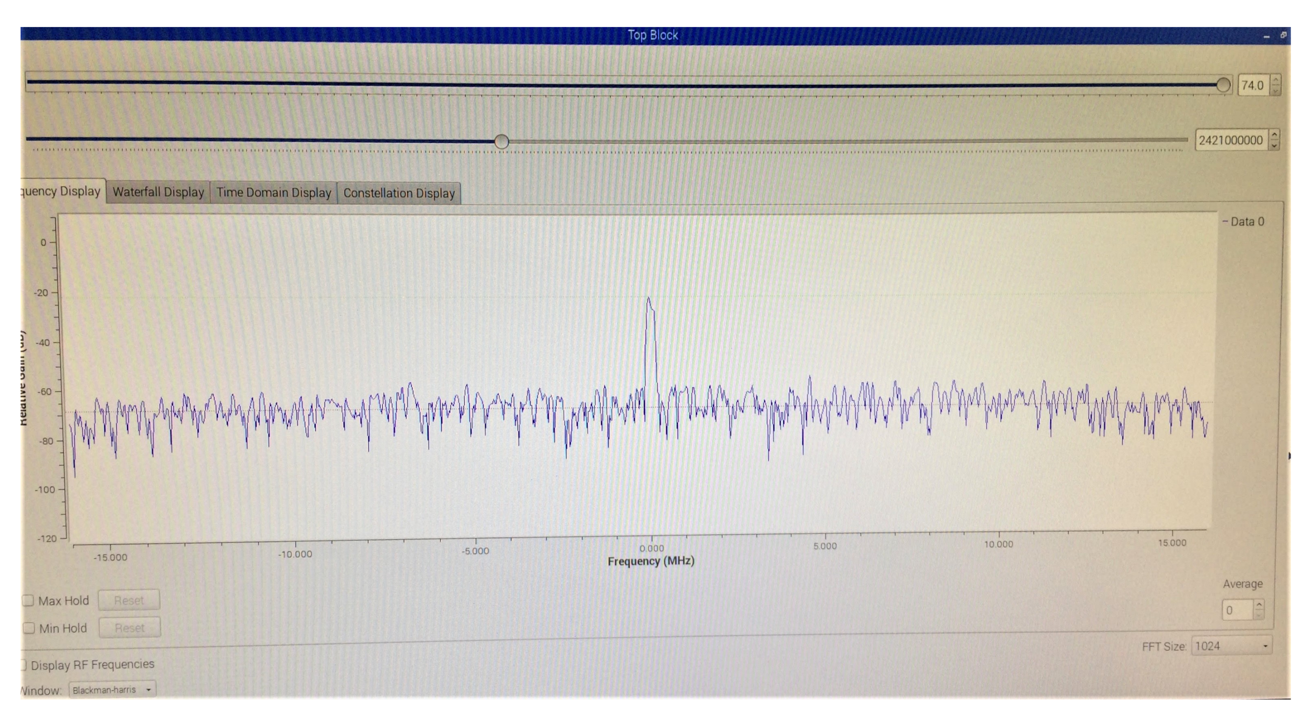

Figure 5: Early signal detection by SDR in radio spectrum analyzer configuration

RESULTS

We were able to use a cell phone power bank to generate enough power to use the computer and SDR assembly wirelessly while aboard the drone. The SDR-Raspberry Pi 3 rigs were able to exchange data packets, providing proof of concept for using SDRs to enable drone-to-drone communication.

CONCLUSION

Packet transmission using SDRs and Raspberry Pi 3 computers is a viable method of drone-to-drone communication. The hardware and software combination we used to demonstrate it leaves room for improvement. The B200mini lacked adequate flexibility for more advanced use, and our use of open source software brought with it a lack of dedicated professional help when issues arose. With those areas identified, future directions for this research are to take this proof of concept and integrate it with a more flexible model of SDR and professional-grade digital signal processing software.

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