CEJS Mid-Year Report

Remote Aerial Vehicle for Environmental Management

By Jon Polka, Faculty Advisor: Dr. Wes Lauer, PE

The primary goal of the project is to develop a remote aerial vehicle for Seattle University's Center for Environmental Justice & Sustainability that can be used for environmental management applications, specifically to aquire high resolution aerial images. A secondary goal is to test the platform as part of a long-term research project focused on floodplain sediment deposition associated with the Elwha River Restoration. The primary goal has largely been met, while the secondary goal is scheduled to commence during spring break.

The project began with a broad literature review that I conducted over the summer of 2013. Dr. Lauer and I discussed the many available directions, while we performed a field work along the Middle and Lower Elwha in August. Additionally, we set aside two days to use a helium balloon with an attached camera to acquire aerial images of engineered log jams along the lower Elwha on the Lower Klallam Tribal Reservation to see the quality of images and get an idea for desired altitudes. We utilized a Canon digital camera loaded Canon Hackers Development Kit firmware; so this exercise provided an opportunity to learn the software and the nuances of the camera.

During the fall of 2013, the goal was to assemble a quadcopter and prepare it for initial flight testing during winter break. Unfortunately, the first month and half of this period was filled with unanticipated frustration as I had to wait for over three weeks for an overseas manufacturer to send me some of the required parts (specifically, a transmitter and some batteries). When I received the package, it was contained an incorrect order, so another three weeks were spent returning the equipment and finally deciding to go with another manufacturer. Despite these challenges, by the end of the quarter, the quadcopter was fully assembled and nearly calibrated and ready for flight.

Winter break was an exciting time for the project because it involved the first flight tests (see Appendix A for photographs). Initial flight testing was performed on Seattle University's campus. I was able to figure out how to program different flight modes and to enter a flight pattern into the "brain" of the RAV so that it could perform a flight route on autopilot. These test flights weren't without some spectacular crash landings, which has helped to shape the flight manual that is currently being drafted. These crashes have also provided some feedback as to what parts of the quadcopter could be improved. One of the major improvements was replacing the landing gear with much stronger carbon fiber ones with a lot more clearance that serves to protect the Canon camera mounted on the underside of the central hub.

On the last day of winter break, I headed out with some friends to the North Fork Snoqualmie River, which is the focus of my senior capstone project, to give it an initial field test. Unfortunately, some sort of fail-safe mechanism prevented the quadcopter from achieving the programed altitude of 475 ft. above ground level. I am currently trouble-shooting this issue and hope to have it resolved before spring break.

As long as the weather cooperates, Dr. Lauer and I plan to revisit the engineered log jams along the lower Elwha to re-photograph them with the quadcopter. Using these photographs, I will have to learn how to use software called Agisoft, which allows the creation of a 3-D topographic surface. We can survey in clearly marked control points before the flights on the Elwha, so that we can tie the 3-D surface to actual coordinates (latitude, longitude, and elevation). This software-based post processing and additional work in GIS will be the focus of the Spring Quarter. Additionally, we have talked about the possibility of developing an alternate platform consisting of a tethered helium blimp with a remote controlled propeller to provide longitudinal control. Lastly, I will also wrap up the flight manual, which will serve as a clear and easy to understand manual for anyone to read and be able to obtain the required data. The manual will include information relating to flight, camera functionality, post-processing, and trouble-shooting. There is a long term plan for publication when a sufficient amount of before and after data is acquired.

APPENDIX A: Aerial Images

Figure 1: Flight test on January 1, 2014. This flight was done completely manually, so the altitude is unknown, but appears to be between 300 to 400 feet.

Figure 2: Flight test on January 4, 2014. This image was taken when the quadcopter was flying on autopilot at 400 feet above ground level.