Quad-X Swarm

Quadcopter Autonomous Charging

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Introduction

QuadX Swarm is an interdisciplinary team of students, both undergrad and graduate, led by Dr. May-Win Thein with the goal of creating a swarm of quadcopters that are capable of autonomous flight.

With this application, the quadcopters would have the ability to make real time decisions in air as well as the capability of communicating with the other quadcopters in the swarm.
An essential goal is to improve the overall quality of the copters by finding a way to incorporate the landshark, an autonomous land vehicle, so that the quadcopters can land on a platform and simultaneously charge

The electrical and computer engineering discipline within the Quad X Swarm will focus on improving the charging of the system to advance the autonomous features of the copters.

Objectives

- Charging capabilities once it lands on landing platform
- Charging is done autonomously
- Charging and landing platforms compatible to be placed on other unmanned vehicles
- Working efficiently on an interdisciplinary team

Contacts

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Methods

- Weekly advisory meetings with our advisor Prof. Smith to keep making steady progress, as well as ask for troubleshooting advice.
- Weekly group meetings with Quad-X Swarm, included weekly updates from each of the disciplines: ECE, ME, and CS. Each discipline had a lead student for
- Met at least weekly for implementing, testing, and debugging
- Verifying modifications to charging controller and leads were not resulting in loss of power

Figure 1. 3-Cell LiPo Balance Charging Wire Configuration

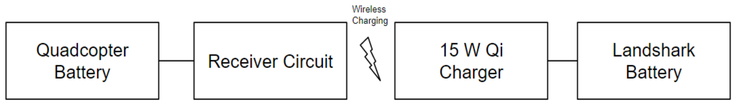

Figure 2. Wireless Charging Block Diagram

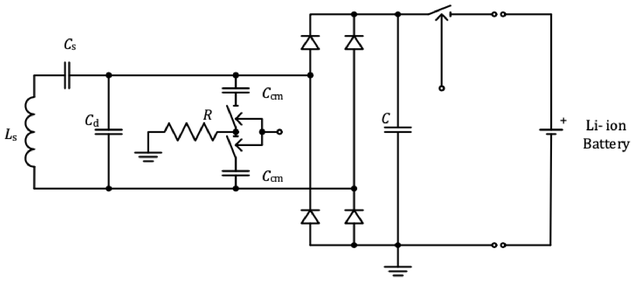

Figure 3. Sample 5W receiver circuit shown in WPC Qi Power Receiver Examples

Results

During our time working on Qi wireless charging, we constructed the receiver circuit as shown in figure 3, and then built a simple coil to place between the receiver a transmitter, outputting to an oscilloscope. Through saving these scope images as .csv data and importing it to MATLAB, we were able to verify that our device was receiving the initial communications defined in the Qi spec, but the receiver and transmitter did not progress beyond this.

Contact charging was initially tested by breaking out each of the six wires that connect the charger to the battery, and laying them out on paper, connecting them together with strips of copper tape. The tape is advertised as being conductive on both sides, but the charging controller blocked charging and returned connection errors until we put copper tape on both sides of the wires. Due to the wire configuration of the battery shown in figure 1, we also tried shorting the two outside balance leads to the power leads, reducing the total contacts to four, which worked with no additional issue.

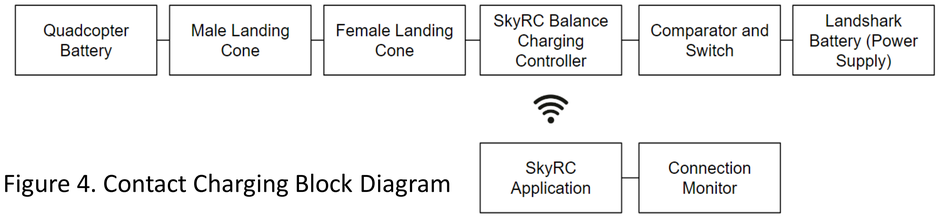

Figure 4. Contact Charging Block Diagram

References

"1.3 Qi Specification". *Wireless Power Consortium*. 2020-04-20.

TJintech. (n.d.). *All about lipo balance connectors*. TJintech. Retrieved from http://www.tjinguytech.com/charging-how-tos/balance-connectors

Challenges

A challenge we came across with our initial plan of developing a wireless charger for the landing pad was that once the landing platform was designed, we realized it would not be wireless charger compatible. With this update in landing gear, we chose to first implement contact charging.

Wireless charging did not seem as conducive to configuring the balance charging connections, as it may require multiple receiver-transmitter pairs.
Signs of heat damage were observed on the LiPo battery leads caused by crossing contacts when attempting to charge with the prototype landing cone. This resulted in our addition of the op-amp comparators to the design, as a method of checking the connections and cutting the power if not all the contacts are connected.

Next Steps

- Op amps to improve charging safety and make sure all connections are made
- Relay to prevent power supply to charger if connection is not complete
- Conduct testing to ensure safety of contact charging with quadcopter
- Make a program to initiate charging on the SkyRC app to completely remove human interaction