9-20-2016 Motor Analysis

Tuesday, September 20, 2016
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This is the final analysis of the "Bad Motor" issue on Whirlybird. Below are all of the graphs and images showing the before and after effects of changing the Left Back Motor which had a noise which started this entire investigation.

All flights were at least 13 to 17 minute flights which provides a full load of flight time ensuring that the AC is fully utilizing it's entire spectrum of telemetry and mechanics. There are only 3 flights involved to get all of the data due to time available, ordering and receiving various tools, and researching through Phantom Pilots and it's experts great information with which to test, analyze, and affect a proper repair for this "Noisy Motor Issue". I cannot list all that I have learned and absorbed from the experts. I can only say a very Hearty Thanks!!

Static Data
All 3 flights monitored are between 13 to 17 minutes in time.
Flight software is DJI Go App
Aircraft is the DJI Phantom 3 Advanced which has had 5 crashes.
All flights are in the same general area and winds between 5-10 mph (excluding gusts).
All maintenance required from Healty Drones website have been kept up.
Nothing has changed on the AC, RC, Antenna, or Monitor.

Below are the 3 flights used in this analysis. The flight telemetry is different for each flight. The flights are color coded to show the different flights.

At the beginning of this "Noisy Motor" issue, I wanted to evaluate the various items that I had determined on my own, and also what I had learned from you Phantom Pilots. Early on, I new there was a noisy motor because I could hear it when landing the AC after a flight. Early on, I got a mechanics stethoscope and listened to each motor. The Left Back motor was definitely noisy. I don't have the reason for that. Below are those items learned and not in the order learned or tested.

1. Speed
2. Load
3. Heat
4. Sound

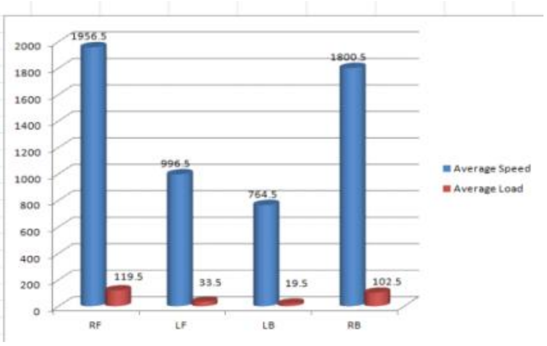
First I tested the speed and load as I could do that using DatCon to extract the information from the DJI Dat files. Here is what I got.

As you can see, it is very impressive information. The manner in which it is presented is so very detailed that it would take Mr. Data from Star Trek to analyze it. I found it interesting but not helpful.

Then I decided to average the thousands of electronic tic marks. From that data I was able to graph it and then we have a picture of the data. That showed me much more than the speed and load graphs.

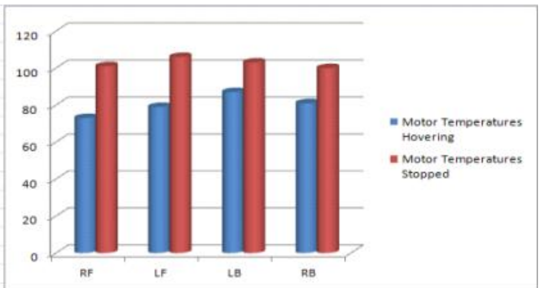
I was astounded to find that the Left Back Motor (Noisy motor) was performing at a much slower rpm than all the other motors. But also that the Left Front Motor was also performing much slower. This is an average so, out some 30K tic marks, you cannot say it is because the AC was turning, or climbing or whatever. This is an average of the entire flight. The load does not appear to be out of the ordinary one motor to the next even on the bad motor. So, the motor is not struggling to do what the ESC tells it to. But, it is definitely underperforming. I will keep this evaluation to the Left Back motor for now disregarding the data of the left front motor. See below.

Motor	Average Speed	Load
RF	1956.5	119.5
LF	996.5	33.5
LB	764.5	19.5
RB	1800.5	102.5



During this time of testing, I had learned that heat could be a problem. But, I needed to find a way to measure the heat in the motors. I heard of an infrared thermometer on Phantom Pilots (Thank you whoever mentioned that). So, I bought one and it took awhile to arrive. Once it arrived. I took my AC out for a flight. When I was done (flight at least over 10 minutes), I measured the side of the motor with the AC hovering. This was easy to do because the thermometer has a laser beam which can be aimed directly on the side of the motor as it is spinning. I recorded the temperature of each motor hovering and only one time after the motors had stopped. I learned after the data was recorded that the hovering (most importantly shows full operational load) and has nothing to do with stopped motors (heat buildup without an external source to dissipate the heat) has nothing to do with the other. Data graph below.

Motor Temperatures		
Motor	Hovering	Stopped
RF	73	101
LF	79	106
LB	**87**	103
RB	81	100



As you can see from this graph, the Left Back Motor (noisy) is hotter than all the rest by at least 6 degrees. Six degrees doesn't seem that much until you compare that with the previous speed/load graph above, where the speed is disproportionately slower. So, it is working less but creating more heat. For what reason?

This is when I decided to replace the Left Back Motor. See Motor Analysis 9-20-2016 Phase 1b.