

IEEE AESS
Project Report 6/30/2016

1. Project Title: Flight Experience with Quadcopter

Date 2015-2016

2. Project Point of Contact

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Student Participants

Name: Joshua Smith, Graduate Student in Electrical Engineering

Name: Alex Baldwin, Undergraduate Student in Civil Engineering and AF ROTC Cadet

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4. Project Description

A DJI F450 Quadcopter was provided by IEEE AESS to provide flight experience for Missouri S&T students. Two students partnered for this project from January through June 2016. Both students completed the work for academic credit. One student was a graduate student in electrical engineering and the other student was an undergraduate senior in civil engineering (and an AF ROTC cadet). These participants were tasked with 1) developing piloting skills using the RealFlight flight simulation, assembling the quadcopter system, 3) practicing flight using the DJI F450 Quadcopter, and 4) documenting their experiences.

The supplemental documents at the end of this report are flight logs for four formal flight sessions (several informal sessions occurred as well), reflections from the students, and a users manual for the quadcopter system. Also, a draft script for a pre-college demonstration was written. This draft will be developed in future projects.

The quadcopter system, the RealFlight flight simulation, and the users manual will facilitate future educational projects. Students will be sought who are interested in projects involving flight operations, camera applications, pre-college demonstrations, etc. These projects will include academic credit.



5. Supplemental Documents

Flight Logs for 29 April 2016, 1 May 2016, and 13 May 2016.

Operation Reflections

Users Manual for Quadcopter System

UAS FLIGHT DATA RECORD						
Project	Missouri S&T					
DATE	4/29/16					
Mission Commander	Alex Baldwin					
RC-Pilot	Alex Baldwin					
Flight Operator	Alex Baldwin					
Safety Observor(s)						
Safety Observor(s)						
Safety Observor(s)						
Flight Plan	Take off, hover in a square pattern, land					
Takeoff Time						
Launch Type	CIC <input type="checkbox"/>			PIC <input checked="" type="checkbox"/>		
Landing Time						
Landing Type	AUTO <input checked="" type="checkbox"/>		Assisted <input type="checkbox"/>		Manual/RC <input checked="" type="checkbox"/>	
Acquisition Altitude			Planned Line Spacing			
UAS System						
Fuselage s/n						
Avionics s/n						
Wing s/n						
Tail s/n						
Battery s/n						
C.G./Weight/Balance adjustments						
Payload						
Type						
Payload s/n						
Shutter speed						
f stop						
ISO:						
Trigger Type	Automatic <input type="checkbox"/>		Geospatial <input type="checkbox"/>		Other:	
Exposure Setting	Shutter Priority <input type="checkbox"/>		Aperture Priority <input type="checkbox"/>		Other:	
Lens Make/Model						
Focal Length						
GCS s/n			PC s/n			
Weather Conditions						
Temperature	61F					
Relative Humidity	74%					
Dew Point						
Sky Condition	clear <input type="checkbox"/>	fog <input type="checkbox"/>	haze <input type="checkbox"/>	partly cloudy (>25%) <input type="checkbox"/>	mostly cloudy (>50%) <input type="checkbox"/>	overcast (>90%) <input type="checkbox"/>
Max Wind Speed and direction	E 13mph	none <input type="checkbox"/>		gusty <input type="checkbox"/>		stead <input type="checkbox"/>
NOTES: (rough landing, EM anomalies, etc.)						

UAS FLIGHT DATA RECORD						
Project	Missouri S&T					
DATE	4/29/16					
Mission Commander	Smith & Baldwin					
RC-Pilot	Joshua Smith					
Flight Operator	Joshua Smith					
Safety Observer(s)	Alex Baldwin					
Safety Observer(s)						
Safety Observer(s)						
Flight Plan	Takeoff, 360° rotation, hover, left, right, up, down, return to pilot, land.					
Takeoff Time	4:15pm					
Launch Type	CIC <input type="checkbox"/>			PIC <input checked="" type="checkbox"/>		
Landing Time						
Landing Type	AUTO <input type="checkbox"/>		Assisted <input type="checkbox"/>		Manual/RC <input checked="" type="checkbox"/>	
Acquisition Altitude			Planned Line Spacing			
UAS System	DJI F450 quadcopter					
Fuselage s/n	Missouri S&T setup					
Avionics s/n						
Wing s/n						
Tail s/n						
Battery s/n						
C.G./Weight/Balance adjustments						
Payload						
Type	N/A					
Payload s/n						
Shutter speed						
f stop						
ISO:						
Trigger Type	Automatic <input type="checkbox"/>		Geospatial <input type="checkbox"/>		Other:	
Exposure Setting	Shutter Priority <input type="checkbox"/>		Aperture Priority <input type="checkbox"/>		Other:	
Lens Make/Model						
Focal Length						
GCS s/n			PC s/n			
Weather Conditions						
Temperature	61F					
Relative Humidity	74%					
Dew Point						
Sky Condition	clear <input checked="" type="checkbox"/>	fog <input type="checkbox"/>	haze <input type="checkbox"/>	partly cloudy (>25%) <input type="checkbox"/>	mostly cloudy (>50%) <input type="checkbox"/>	overcast (>90%) <input checked="" type="checkbox"/>
Max Wind Speed and direction	E 13mph	none <input type="checkbox"/>		gusty <input type="checkbox"/>	a little gusty	stead <input type="checkbox"/>
NOTES: (rough landing, EM anomalies, etc.)						

UAS FLIGHT DATA RECORD						
Project	Missouri S&T					
DATE	5/1/16					
Mission Commander	Joshua Smith					
RC-Pilot	Joshua Smith					
Flight Operator	Joshua Smith					
Safety Observer(s)						
Safety Observer(s)						
Safety Observer(s)						
Flight Plan						
Takeoff Time	4:00pm					
Launch Type	CIC <input type="checkbox"/>			PIC <input checked="" type="checkbox"/>		
Landing Time						
Landing Type	AUTO <input type="checkbox"/>		Assisted <input type="checkbox"/>		Manual/RC <input checked="" type="checkbox"/>	
Acquisition Altitude			Planned Line Spacing			
UAS System	DJI F450 quadcopter					
Fuselage s/n	Missouri S&T setup					
Avionics s/n						
Wing s/n						
Tail s/n						
Battery s/n						
C.G./Weight/Balance adjustments						
Payload						
Type	N/A					
Payload s/n						
Shutter speed						
f stop						
ISO:						
Trigger Type	Automatic <input type="checkbox"/>		Geospatial <input type="checkbox"/>		Other:	
Exposure Setting	Shutter Priority <input type="checkbox"/>		Aperture Priority <input type="checkbox"/>		Other:	
Lens Make/Model						
Focal Length						
GCS s/n			PC s/n			
Weather Conditions						
Temperature	72F					
Relative Humidity	42%					
Dew Point						
Sky Condition	clear <input checked="" type="checkbox"/>	fog <input type="checkbox"/>	haze <input type="checkbox"/>	partly cloudy (>25%) <input type="checkbox"/>	mostly cloudy (>50%) <input type="checkbox"/>	overcast (>90%) <input type="checkbox"/>
Max Wind Speed and direction	~5mph	none <input type="checkbox"/>		gusty <input type="checkbox"/>	small gusts	stead <input type="checkbox"/>
NOTES: (rough landing, EM anomalies, etc.)						
Flew around at will						
Need to test maximum xmitter distance next time						
handiges very well. Flew up, then dropped power to nothing. Increased power - stabilized well.						

UAS FLIGHT DATA RECORD						
Project	Missouri S&T					
DATE	5/13/16					
Mission Commander	Smith & Baldwin					
RC-Pilot	Joshua Smith					
Flight Operator	Joshua Smith					
Safety Observer(s)	Baldwin					
Safety Observer(s)						
Safety Observer(s)						
Flight Plan						
Takeoff Time	4:00pm					
Launch Type	CIC <input type="checkbox"/>			PIC <input checked="" type="checkbox"/>		
Landing Time						
Landing Type	AUTO <input type="checkbox"/>		Assisted <input type="checkbox"/>		Manual/RC <input checked="" type="checkbox"/>	
Acquisition Altitude			Planned Line Spacing			
UAS System	DJI F450 quadcopter					
Fuselage s/n	Missouri S&T setup					
Avionics s/n						
Wing s/n						
Tail s/n						
Battery s/n						
C.G./Weight/Balance adjustments						
Payload						
Type	N/A					
Payload s/n						
Shutter speed						
f stop						
ISO:						
Trigger Type	Automatic <input type="checkbox"/>		Geospatial <input type="checkbox"/>		Other:	
Exposure Setting	Shutter Priority <input type="checkbox"/>		Aperture Priority <input type="checkbox"/>		Other:	
Lens Make/Model						
Focal Length						
GCS s/n			PC s/n			
Weather Conditions						
Temperature	Trying to configure controls - inside building - room temperature, no wind					
Relative Humidity						
Dew Point						
Sky Condition	clear <input type="checkbox"/>	fog <input type="checkbox"/>	haze <input type="checkbox"/>	partly cloudy (>25%) <input type="checkbox"/>	mostly cloudy (>50%) <input type="checkbox"/>	overcast (>90%) <input type="checkbox"/>
Max Wind Speed and direction		none <input type="checkbox"/>		gusty <input type="checkbox"/>		stead <input type="checkbox"/>
NOTES: (rough landing, EM anomalies, etc.)						

Operator Experience - Joshua Smith 2016

I have, just a couple times, flown an RC airplane prior to this experience. So I was inexperienced to flying UAVs, and completely new to quadcopters. Overall, I had a somewhat negative experience and would not purchase the DJI F450 for myself or any other project. I suspect there are many other quadcopters available with better value.

When we first got started flying the quadcopter, we had to look on Youtube for a video of how to start the propellers using the controller. Tilting the control sticks both in/out to turn on/off may be normal to experienced flyers, but is not intuitive to the beginner. There should have been a user's manual written by the manufacturer explaining how to fly it. We were able to find separate manuals for the controller and for the quadcopter, but neither were especially helpful, so Youtube videos were our backup reference for when we weren't able to figure things out easily.

After working with REALFLIGHT to learn how to fly a quadcopter, I was very excited to fly. I got outside and had a LOT of fun. I flew with the manual controller and Alex flew with the tablet controls. I found the controls easy to pick up and intuitive (probably years of video games helps), and was doing some wild stunts in no time: rotating while flying straight, free falling and lifting, gliding along the ground - I never seriously crashed though. The aerodynamics of the quadcopter were great and probably the feature that impressed me the most.

While I was flying one day, the quadcopter started acting buggy on me. I was getting ready to leave for the day, and the quadcopter was out at a distance away from where I was sitting. So, I decided to fly it to my location. I took off and brought it near my feet, but then, when I landed and turned the control sticks out to power off, the propellers started to speed up! The quadcopter nearly took off before shutting down. After that, the controls were scrambled. Up went down, the left stick did the right stick's job, and the configurations for on/off were changed. We were troubleshooting for many days after that before we figured out the right configuration to have it operating as it was originally. Even after that, we still had concerns, since it had shifted the control scheme without either of us consciously adjusting any settings.

Finally, the camera seems to have its own battery inside, but we did not have a charger for it. On top of that, the transmitter for the camera feed would be too hot to touch after a short period of operation.

Overall, I was not impressed with the operation of the DJI F450. It may be excellent aerodynamically, but the electronics operated poorly and the menu could use a few adjustments. Maybe we just got a buggy quadcopter, or maybe we were just too inexperienced with drones to know what to do. If either of those two situations were the case, then that still attests to the user-unfriendliness of this product.

Operation Experience – Alex Baldwin 2016

Looking back on the semester I have learned a lot working on this UAV project. The most important of which was ingenuity. When the UAV first arrived there was minimal instruction on how to operate the drone and equipment. We had to figure out everything on the go which could be frustrating at times. Hopefully, future students will have more success with the UAV after reading the operations manual for instructions and help. All in all, I would say that the UAV operation learning process was broken down into three different phases.

The first phase was using the Real Flight simulator on the computer to practice flying. The program is very effective in learning UAV operation and helped to gain control over the drone. The program was easy to use and very quick to learn.

The next phase of the process was equipment familiarization. This phase was less clear on instruction and consisted of myself and fellow student Joshua reading a lot of user manuals on the controller, drone, camera, and Dragon Touch tablet. The problem with this was that not everything we learned was for the exact equipment we were using and thus gave us some trouble trying to figure it out.

The last phase of the learning process consisted of the actual flying of the UAV. While this phase was the most fun, once we got the UAV flying; it was also the shortest lived. We only flew the drone a handful of times before the end of the semester and ran into problems with the controller that halted progress for at least a week.

In conclusion, flying the UAV was a fun hands-on-project initially but turned into frustration later on due to confusion with the equipment. By the time we became familiar enough with the operation of the drone, the semester was over. My recommendation for the future is that this needs to be a yearlong effort for students. That would give them one semester to become confident with the drone and a second semester to conduct active testing and research with the UAV.