Windracers Team

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- Designing a fixed-wing aircraft capable of performing autonomous operations in enclosed motion-capture facility
- Enabling operations of multiple drones at the same time

About Windracers

Windracers is a British UAV manufacturer, specializing in long-distance vehicles fit to serve a wide range of use cases (humanitarian, delivery, defense, etc.)



Phase A – Design an autopilot control system controlling off the shelf aircraft:

We select a light-weight aircraft with small stall speed

We design hardware in the loop control system

Ground station computes ArduPilot commands and transmits them to the aircraft

Aircraft performs operations, while having active markers on the wings

Motion capture system monitors the motion of the aircraft and feeds ArduPilot with pseudo-GPS data

We perform the testing of the aircraft and verify capabilities of the autopilot system

Phase B — Design an aircraft similar to Windracers

Perform the sizing of the aircraft

Go through the entire design process to create a scaled-down version of Windracers drone

Phase C – Implement ArduPilot to Windracers replica

Phase D — Replace ArduPilot with Windracers software









Reached our main semester goal of successfully flying a working prototype!

Slight stalling issues present on first test flight which have since been solved (more on that later)

Additional flickering observed during secondary testing, almost certainly due to circumstantial calibration / environmental issues







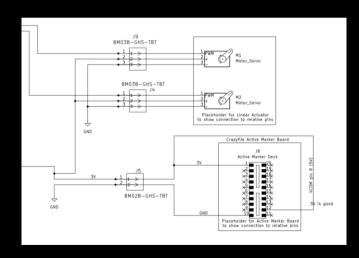


Additionally, we completed a working prototype of the onboard active marker electronics!

After learning last semester that we could power servos + active marker board w/ the same stock battery, we spent this semester making a prototype that successfully shows up on the MOCAP system.

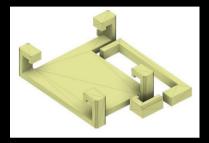


















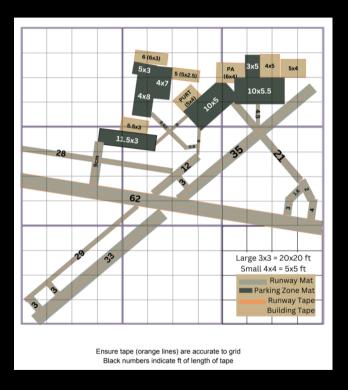




After determining that the aircraft stalled too quickly, we fixed the problem by altering the design of our custom bracket that housed the electronics to eliminate extra unnecessary weight. We also created an intermediary prototype based off the idea that the electronics may be throwing off the center of gravity.



Semester recap

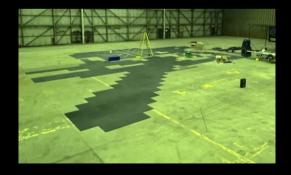


We also continued experimenting in support of eventually transitioning from using local MOCAP coordinates to quasi-GPS

Measured and scaled down airport runway characteristics to construct a scaled model using tile mats

Designed a rudimentary algorithm to translate PURT coords to GPS coords

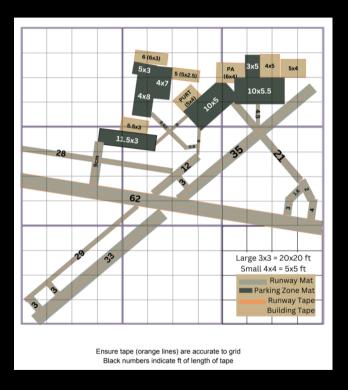








Semester recap

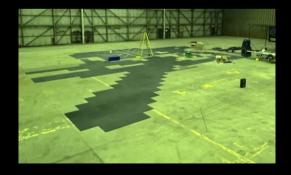


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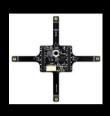
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activeMarker

The Active Marker deck is mainly designed for Qualisys mocap systems and supports Qualisys Active markers, but it can also be used with other systems in a simplified mode. The deck has 4 arms with one IR LED on the tip of each arm and a light sensor in the center of the deck.

The deck is configured using the parameter sub system, for details on which parameter to use, see below.

Variables

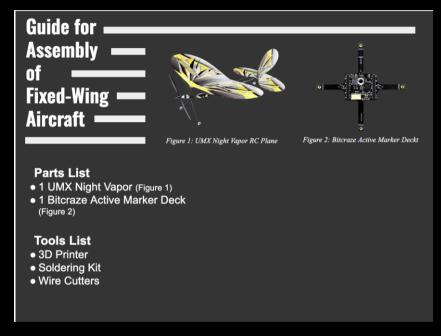
Name	Core	Туре	Description
activeMarker.front	Core	PARAM_UINT8, PARAM_PERSISTENT	Qualisys id of marker for front (default: 1)
activeMarker.back	Core	PARAM_UINT8, PARAM_PERSISTENT	Qualisys id of marker for back (default: 3)
activeMarker.left	Core	PARAM_UINT8, PARAM_PERSISTENT	Qualisys id of marker for left (default: 4)
activeMarker.right	Core	PARAM_UINT8, PARAM_PERSISTENT	Qualisys id of marker for right (default: 2)
activeMarker.mode	Core	PARAM_UINT8, PARAM_PERSISTENT	Off(0), pwm(1), modulated(2) or qualisys(3)
activeMarker.poll		PARAM_UINT8	

We also explored a technical feasibility regarding whether it was possible to "flash" an active marker board with a unique set of electronic ID values without requiring dependence on the stock Crazyflie drone.

After testing, we concluded that it would be rather difficult. This will likely be a consideration during custom PCB design





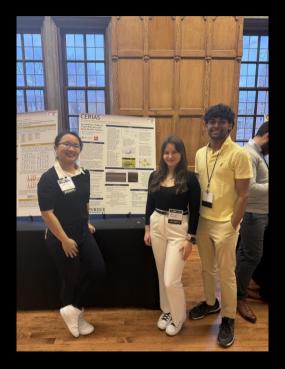


We started work on designing an IKEAstyle instruction manual for how to construct our working prototype, in preparation for having multiple planes in the air simultaneously.

Cover image







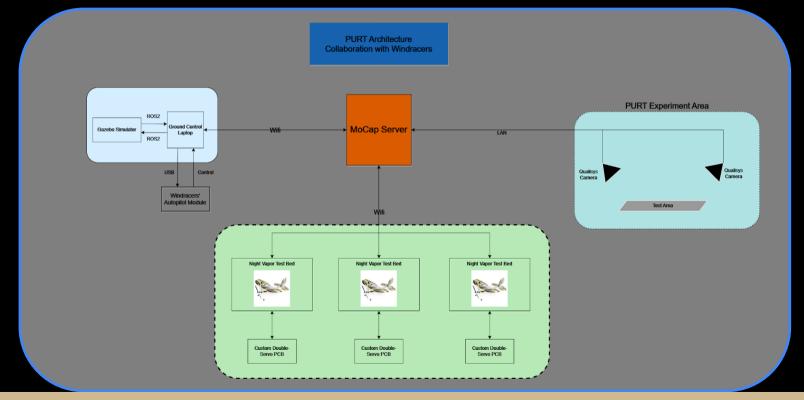
A little bit of bonus outreach!

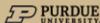
On top of the usual semesterly presentation at the Purdue Undergraduate Research Conference, we also had the opportunity to:

- Present at the CERIAS Annual Cybersecurity Symposium in the "Autonomous Systems" area
- Speak briefly at an AIDA3 February demo event

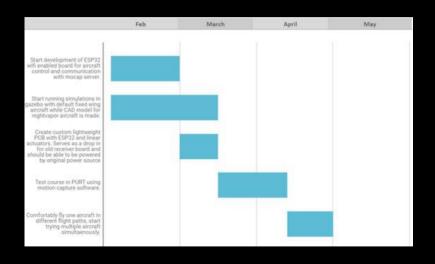
Received exposure + recognition from industry and university representatives











Complete Phase A Integrate autopilot software into the motion capture facility Have multiple aircraft flown simultaneously Design a replica of a Windracers' drone (Phase Further, communicate with Windracers to optimize our platform to the company's needs

