

Demonstration Overview

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Goals

- Resiliency
 - Detect problem and return to safe state.
 - Develop and deploy recovery plan.
 - Complete mission (possibly with modified functionality).
- Trustworthiness
 - Continuous assessment throughout mission.
 - Deeper offline analysis after mission (future work).

Demo Scenario

- Intelligence, surveillance and reconnaissance mission.
- Observe targets then return to base.



Surveillance Missions

- Dozens of companies provide UAV-based monitoring.
 - Agriculture
 - Environment
 - Infrastructure
 - Security
 - ...

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drone security monitoring

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Drones for Agriculture: senseFly SA
<https://www.sensefly.com/applications/agriculture.html>
 Explore the benefits that precision agriculture drones (A.K.A. UAVs or UASs) can ... revolution of recent years, monitoring crops from the sky will drive the next.


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UAV for civil security: police
<https://www.microdrones.com/en/microdrones-offers-uav-drone-based-solutions-such-as-air-monitoring-police-drones/>

Aerial Surveillance & Monitoring
<https://www.microdrones.com/en/microdrones-offers-uav-drone-based-solutions-such-as-air-monitoring-police-drones/>
 microdrones offers UAV / drone-based solutions for...
 gatherings and protests, or even wh...

Images for drone environment monitoring Report images



More images for drone environment monitoring

Drone Environmental Monitoring - YouTube
<https://www.youtube.com/watch?v=IP2bQySjycc>
 Mar 13, 2014 · Uploaded by ReefRescue
 The environmental group, Palm Beach County Reef Rescue, employs an unmanned aerial vehicle (UAV), a ...

UAV survey, environmental monitoring, drone, flood survey ...
www.remoteaerialsurveys.co.uk/environmental-monitoring
 Remote Aerial Surveys—UAV specialists in environmental monitoring, flood surveys, structural inspections, coastal profile monitoring, and forest...

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Infrastructure & Industrial Inspections - Micro
www.microaerialprojects.com/.../infrastructure-inspection
 We use small uavs for your infrastructure & industrial inspecti...
 high ... Critical and preventative monitoring of infrastructure
 on a regular Small Drone Cadastral Surveys for Establishment [...]

Hardware and Software

- Commodity HW
 - 3DR Iris+ PixHawk
 - Radios & controllers
- Real-time OS
 - NuttX (UNIX-like OS)
- Open-source autopilot
 - ArduPilot



Control Systems



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Hijacking drones with a MAVLink exploit


Posted by [microuav](#) on October 15, 2015 at 1:30pm [View Blog](#)

From [Shellintel](#) (via [Hackaday](#))

Recently some of us here at shellIntel have been building quadcopters and autonomous vehicles for fun. We are big fans of the Pixhawk flight controller for its awesome autonomous capabilities. We are also big fans of privacy. As much as we like to build and fly these drones, we realize doing so in an irresponsible way can cause concern. We started looking into the various drone communications and discovered a design flaw that allowed us to take control of any drone flying with a specific telemetry protocol.

Telemetry allows the drone to exchange information and commands wirelessly with a ground station. This includes sending/receiving GPS coordinates, waypoints, throttle adjustments, arm and disarm commands, pretty much anything, including a serial shell.

anti-drone device demo



anti-drone device demo

Control Systems



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The design flaw is not unique to Pixhawk, but rather with the Mavlink protocol.

Posted by [microdave](#) on October 15, 2015 at 1:30pm [View Blog](#)

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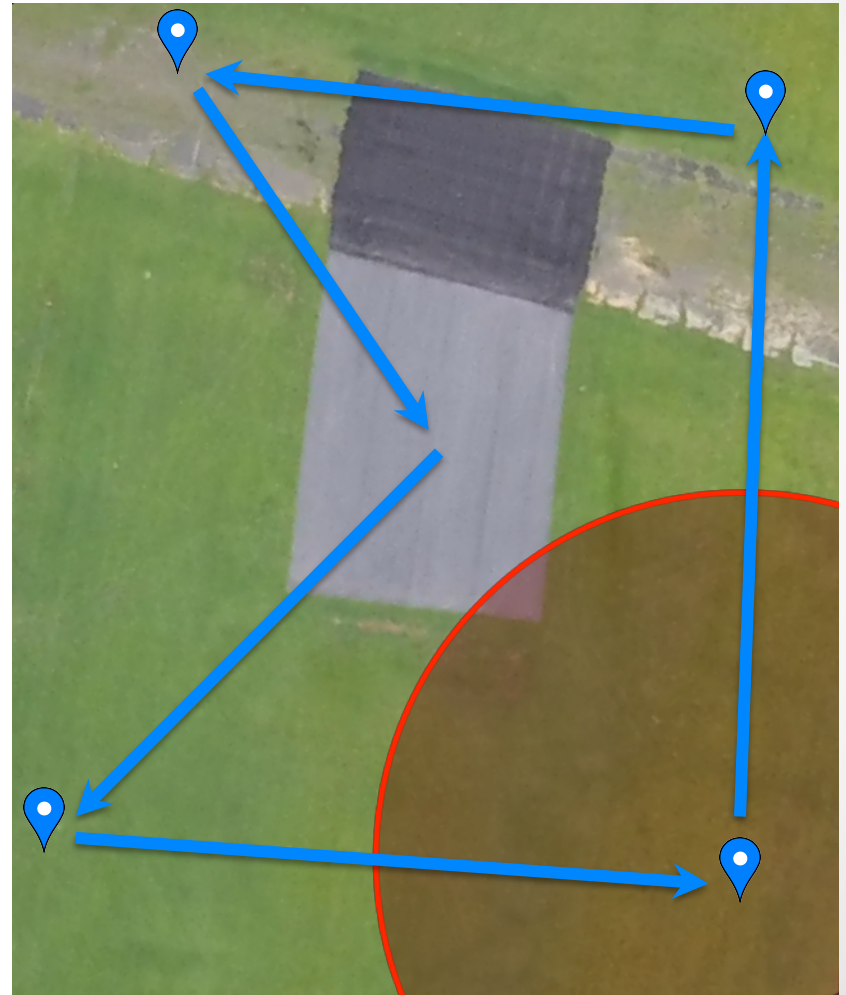
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anti-drone device demo

Attack Scenario

Assumptions:

- Stealthy attack.
 - Skip target, but don't crash.
 - "Wind blew it off course."
 - Relax assumption in later work.
- Limited geographic scope.
 - Affects one target, not all.



NO ATTACK

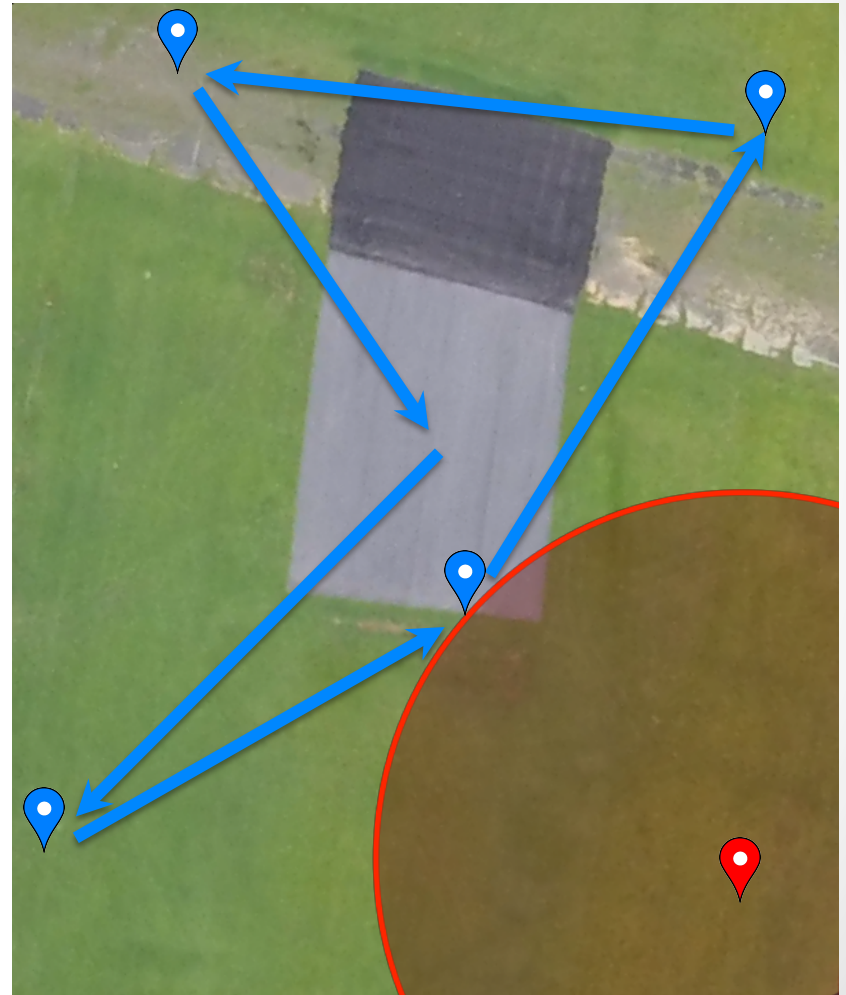


ATTACK



Resilience and Trust

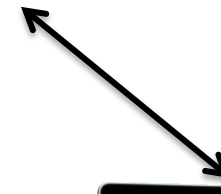
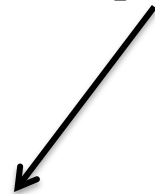
1. Recognize attack.
2. Leave “zone of influence”.
3. Generate new flight plan avoiding attack.
4. Complete mission.



Demo Components



Repair Controller



Ground Control



Trust Assessment



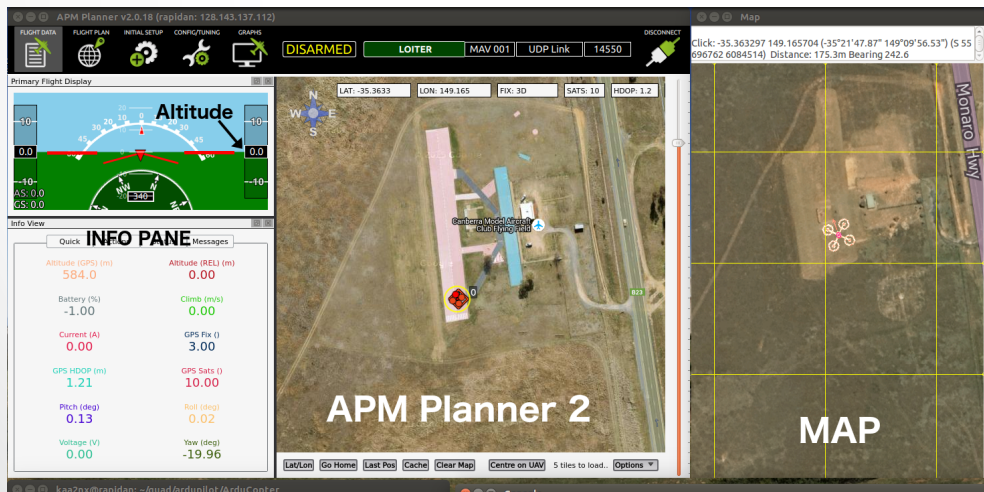
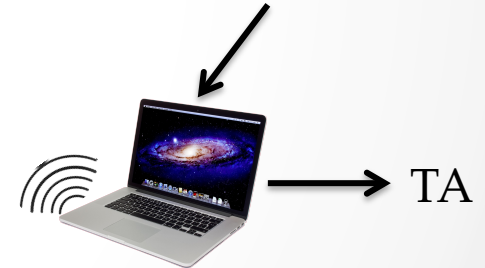
Attacker

Ground Control

- Radio communication with UAV.

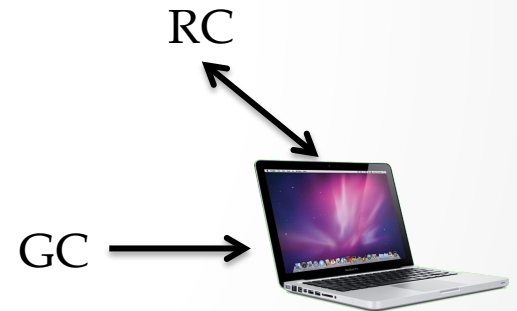


RC



Trust Assessment

- Compares telemetry to mission parameters.
- Detects attack.
- Validates new mission.

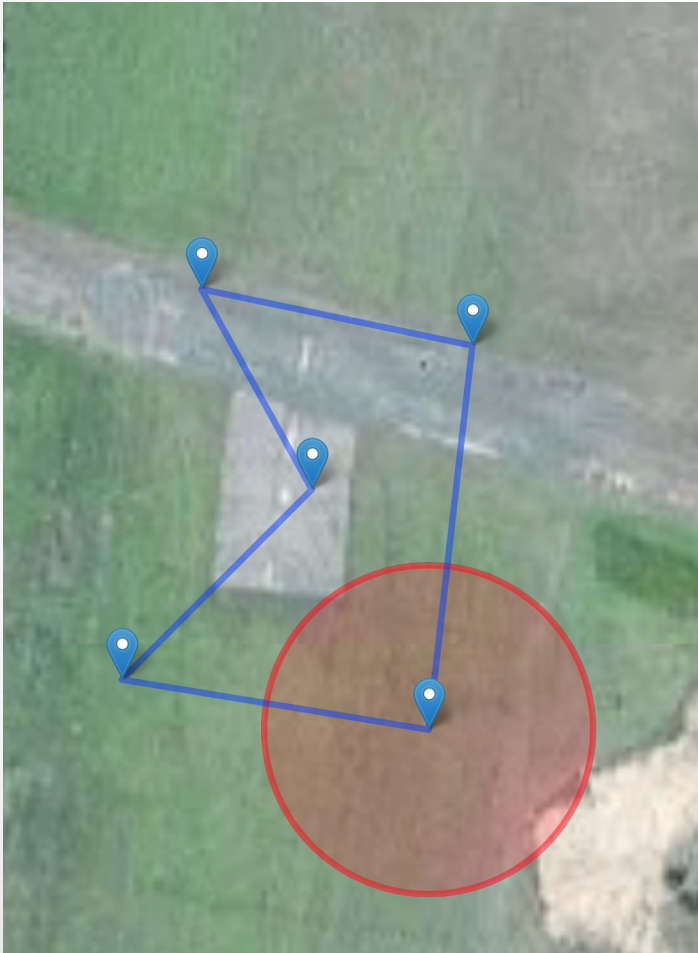


Repair Controller

- Sends out initial mission.
- Develops new mission in response to attack.
- Orchestrates mission deployment.



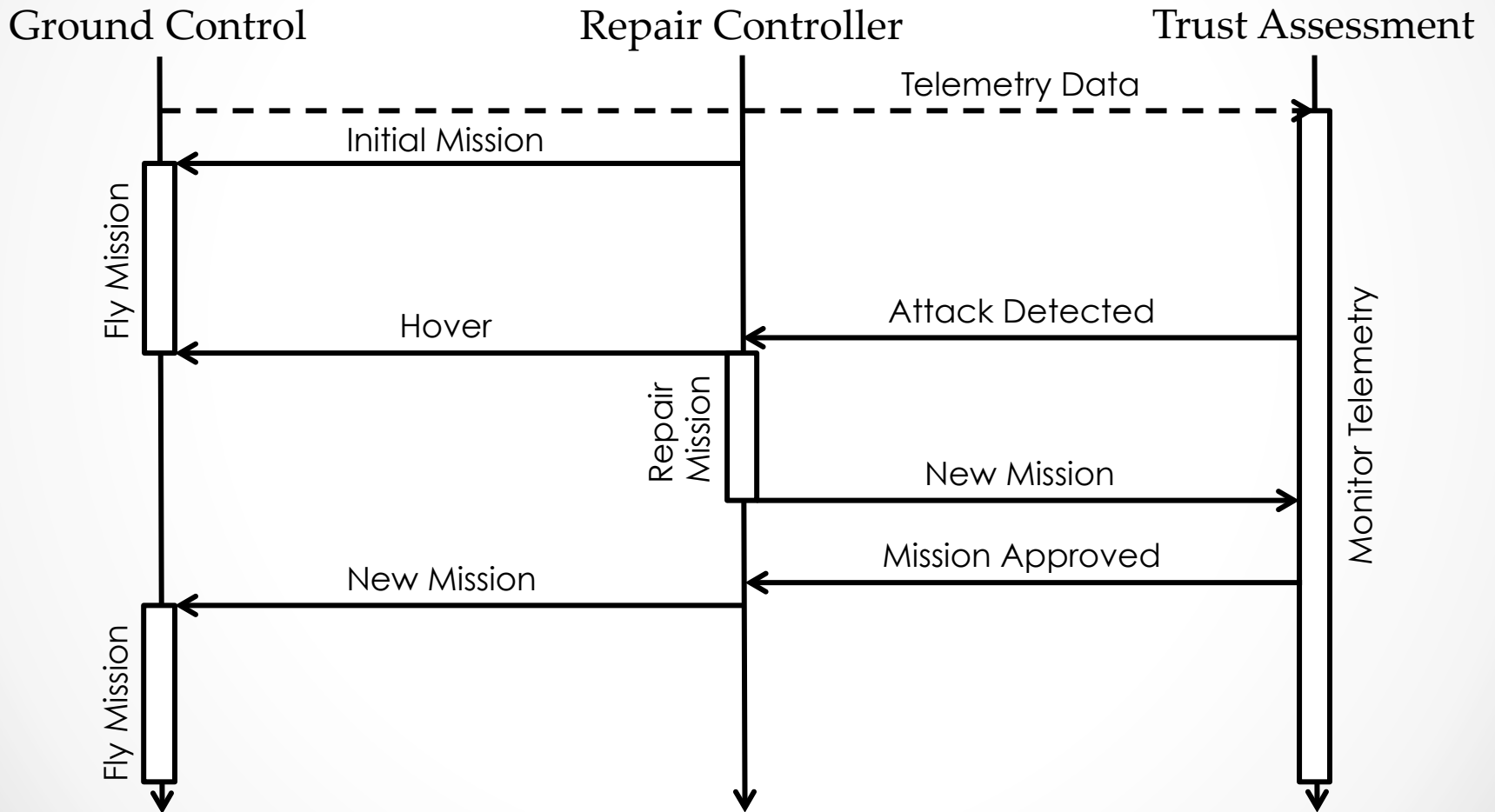
Flight Path Construction



Genetic algorithm

1. Avoid attack zone.
2. Prefer fewer extra waypoints.
3. Retain order of targets.
4. Get close to targets.
5. Prefer shorter paths.

Sequence of Events



Evaluation of Success

- Resiliency

- Detect problem, recover, and return to safe state.
- Develop and deploy recovery plan.
 - Minimal modification to mission while avoiding attack.
 - Under 60 seconds from detection to deployment.
 - No need to land!
- Complete mission (possibly with modified functionality).
 - View target from outside attack zone if necessary.

- Trustworthiness

- Continuous assessment throughout mission.
- Emphasis on unchanged mission components.



Future Scenarios

- Repairing flight software.
 - Detect software-based failure.
 - Enter safe mode.
 - Generate and deploy patch.
 - May be more expensive: leverage parallel repair.
 - Resume mission.
- Post-mission trust assessment.
 - Evaluate mission logs and repair offline.
 - More thorough evaluation of trustworthiness.