Autonomous Vehicle Laboratory for Sense and Avoid Research and Hardware-in-the-Loop Simulations

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Introduction and Background

Problem

- Growing complexity of our National Airspace requires increasing autonomy
- Control algorithms often the limiting factor
- Demands for absolute safety necessitates additional research

Task

- Develop a testing facility to allow NASA contractors to address multi-vehicle flight control

Purpose

- Present results of preliminary system integration and trials

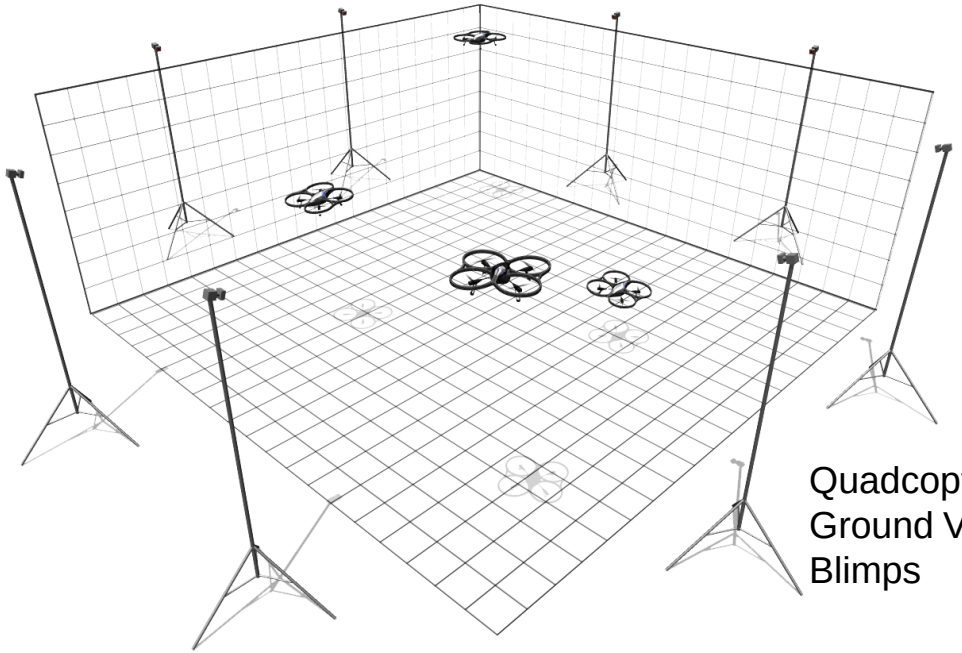
AutoLab Overview

Vehicle Controllers

Wi-fi links to quad-copters

Ethernet

Motion Tracking System Camera System



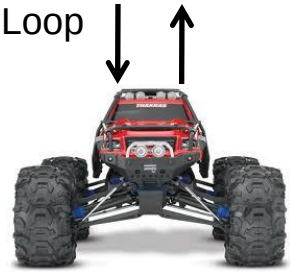
Quadcopters
Ground Vehicles
Blimps

Environment Simulation

Vehicle positions and orientations

Vicon Tracker Software

Hardware-in-the-Loop Simulation



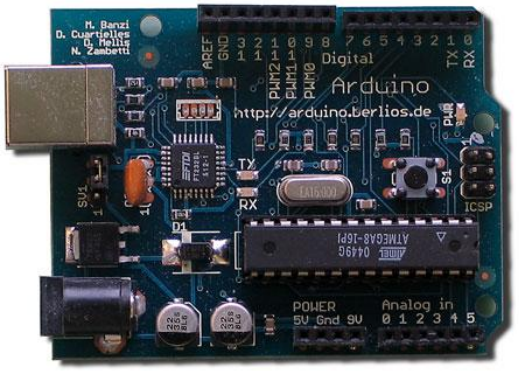
Sensibilities of a HIL Sim

- Hardware in the loop (HIL) simulations can improve decision making algorithms
- Control algorithms often the limiting factor
- Sim substitutes weather and human variability for a safe, repeatable environment
- Autopilot receives sensor and state data from FlightGear
- Vehicle believes it is roaming outside

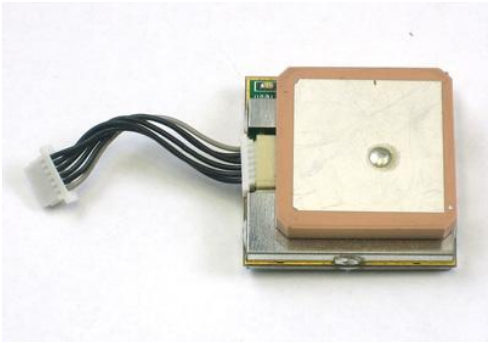
Primary Vehicles and Subsystems

ArduPilot: Open Source Autopilot

Traxxas Summit Rover



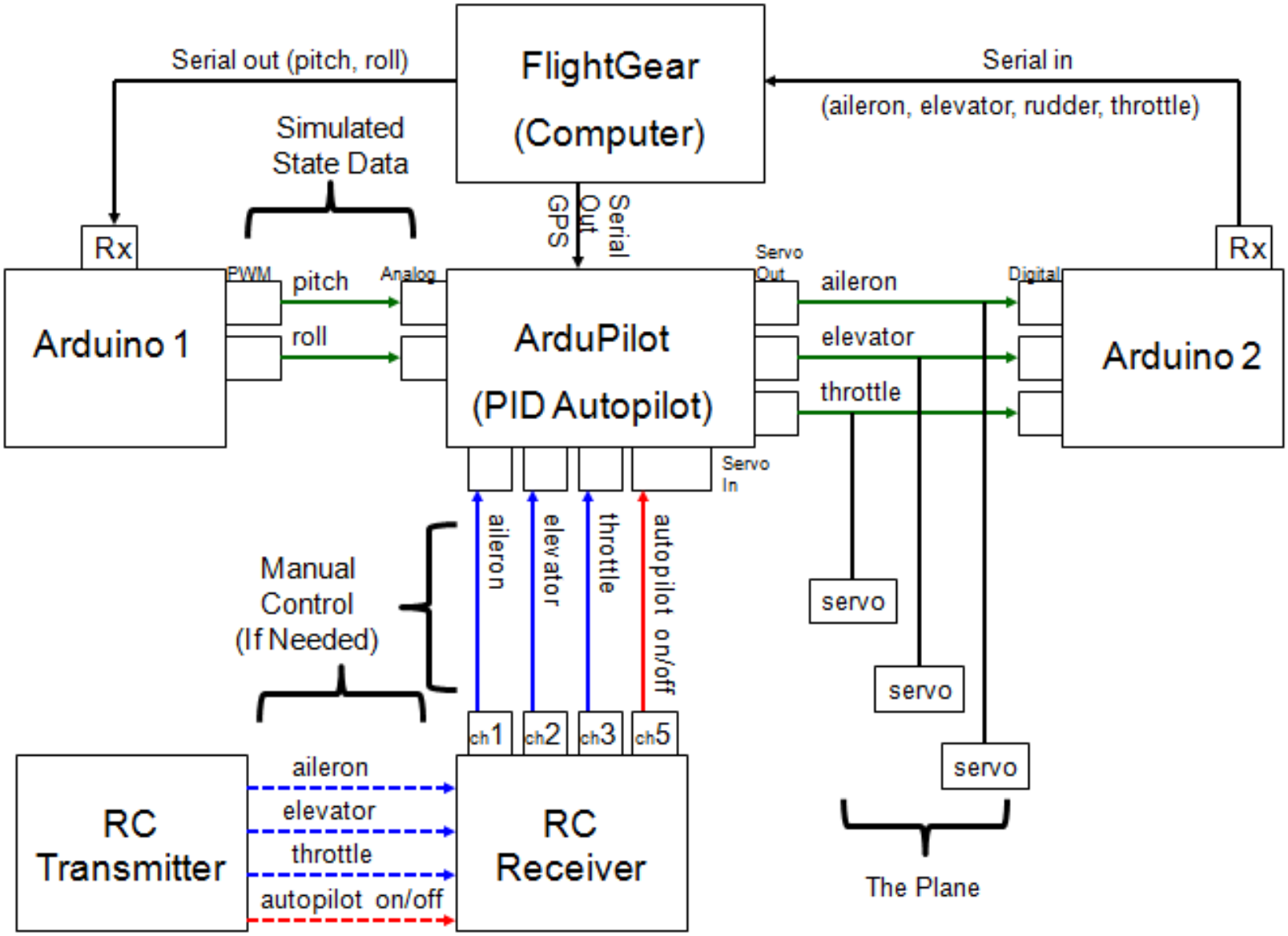
Arduino Microcontroller



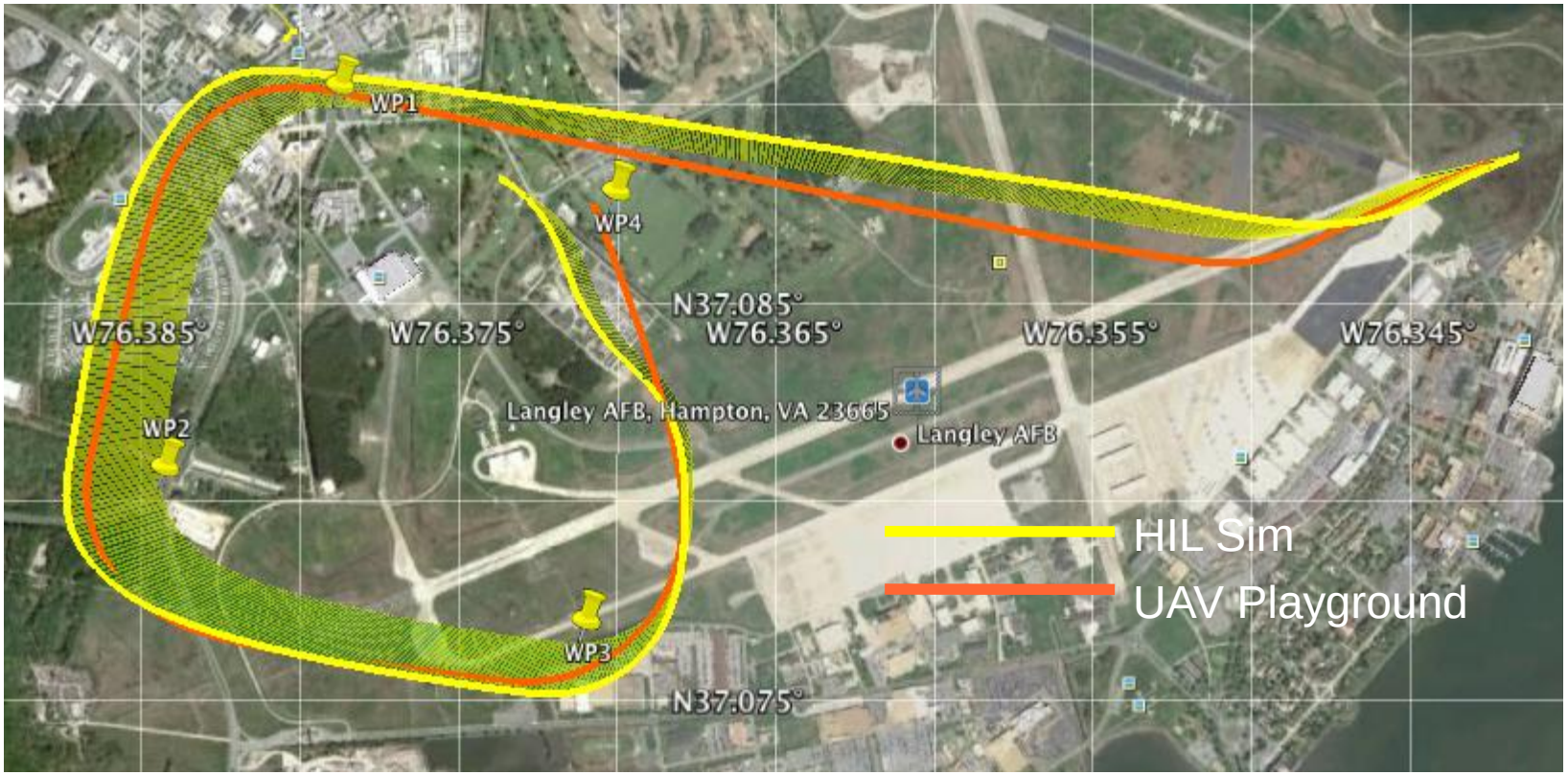
EM 406A 1Hz GPS Receiver

Flight Gear

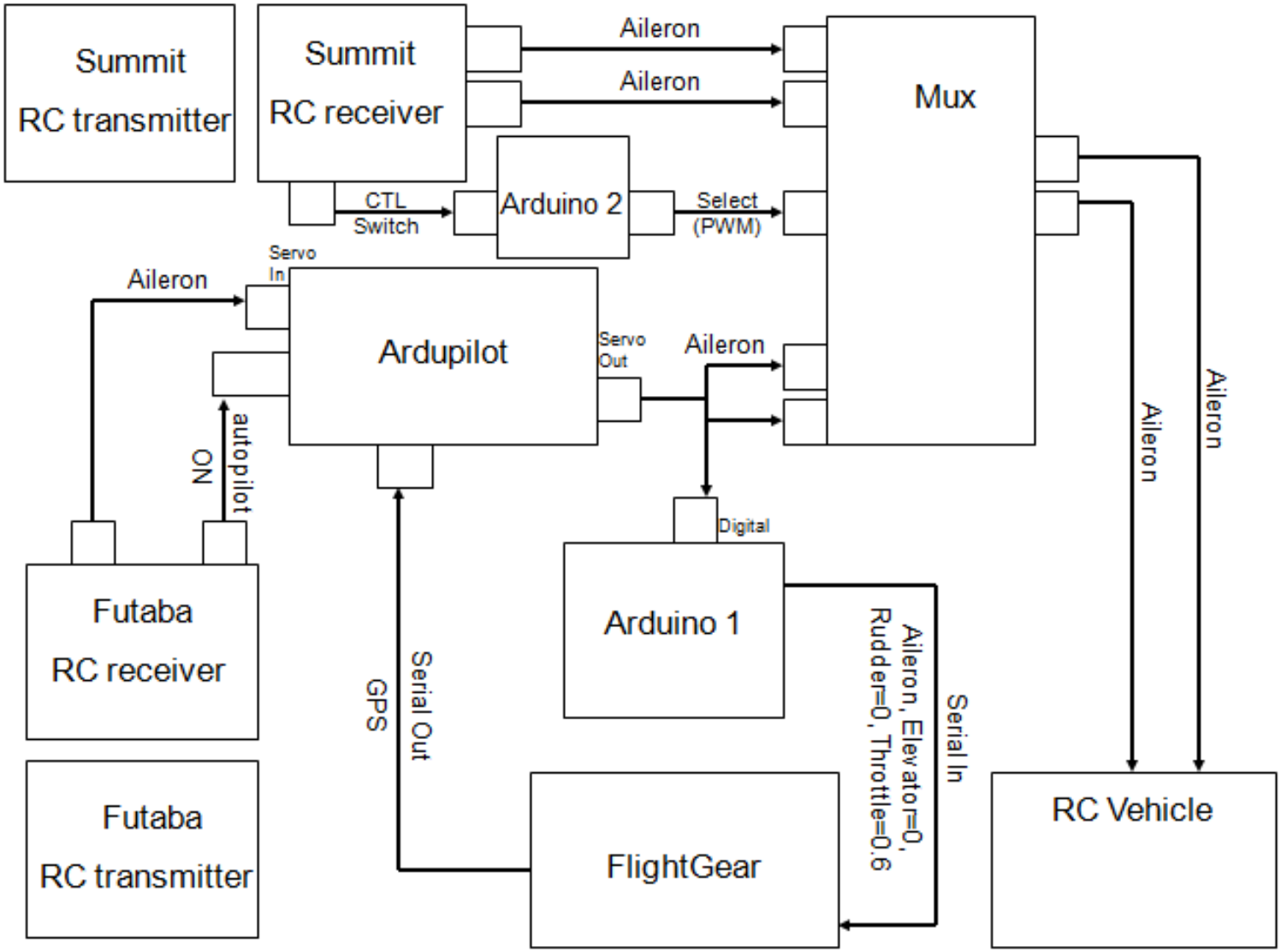
Aircraft HIL Simulation



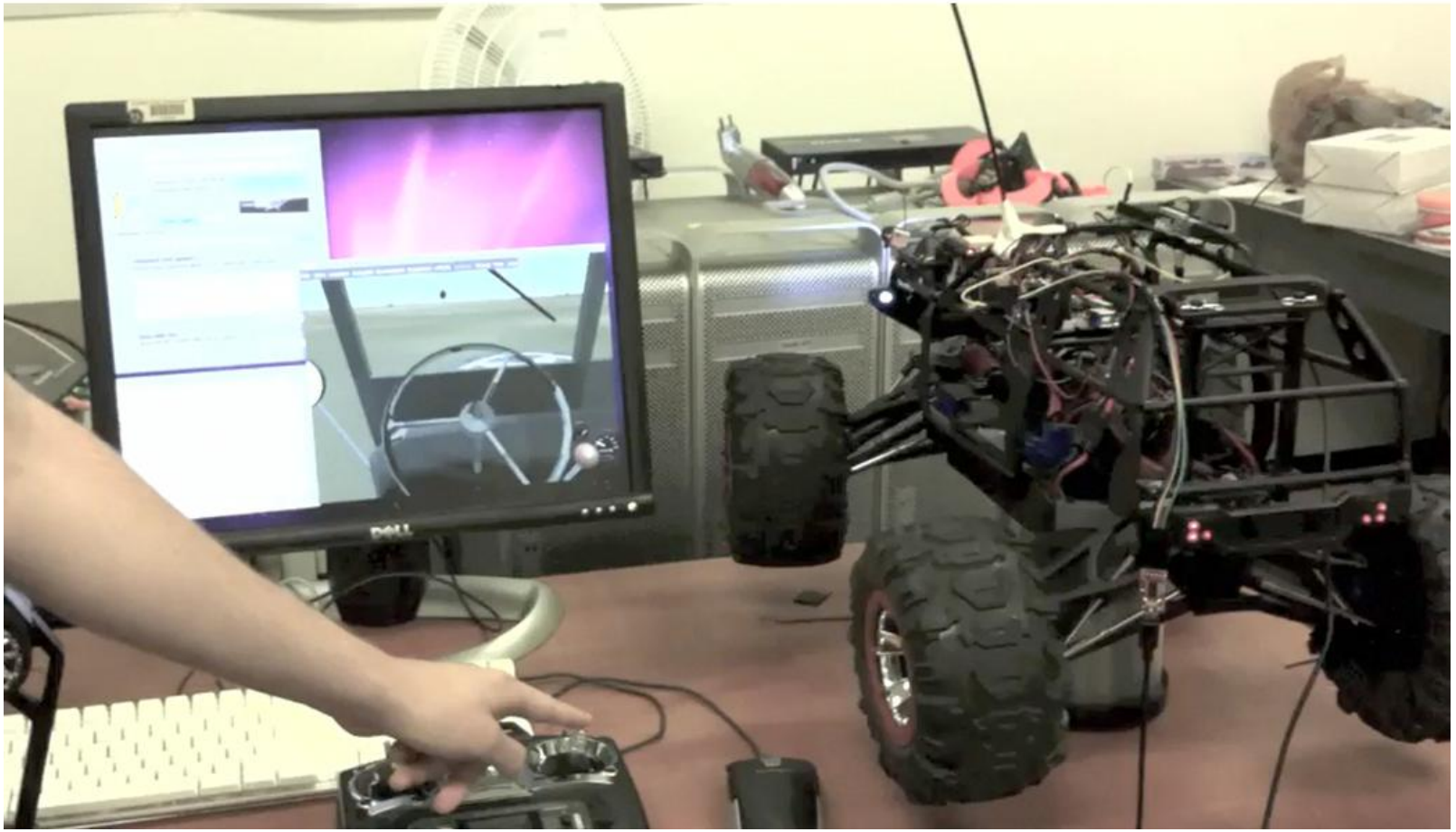
Performance of Autopilot in Flight



Ground Vehicle HIL Sim

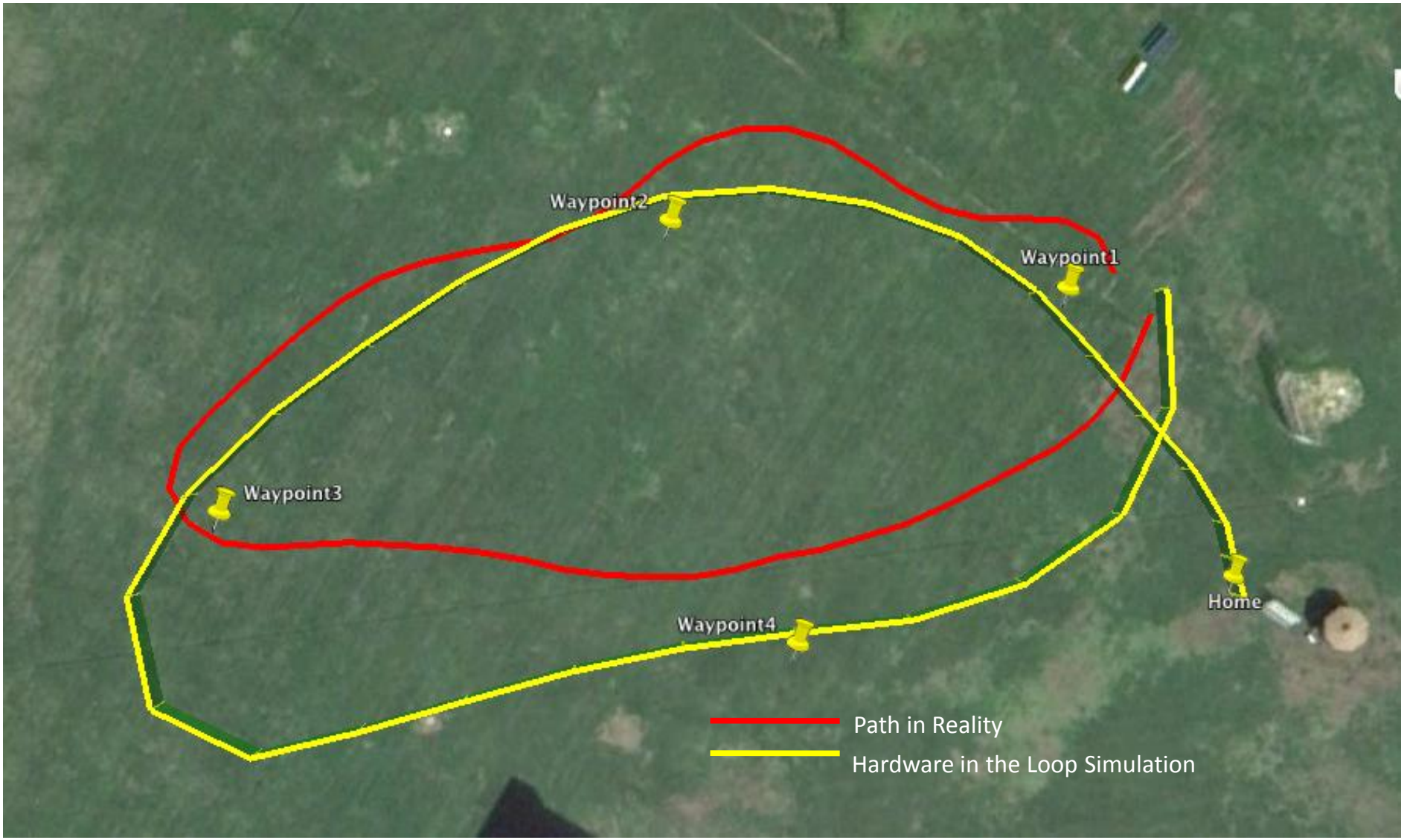


HIL Sim Prior to Outdoor Test



Outdoor Testbed

Vehicle Performance vs. HIL Sim



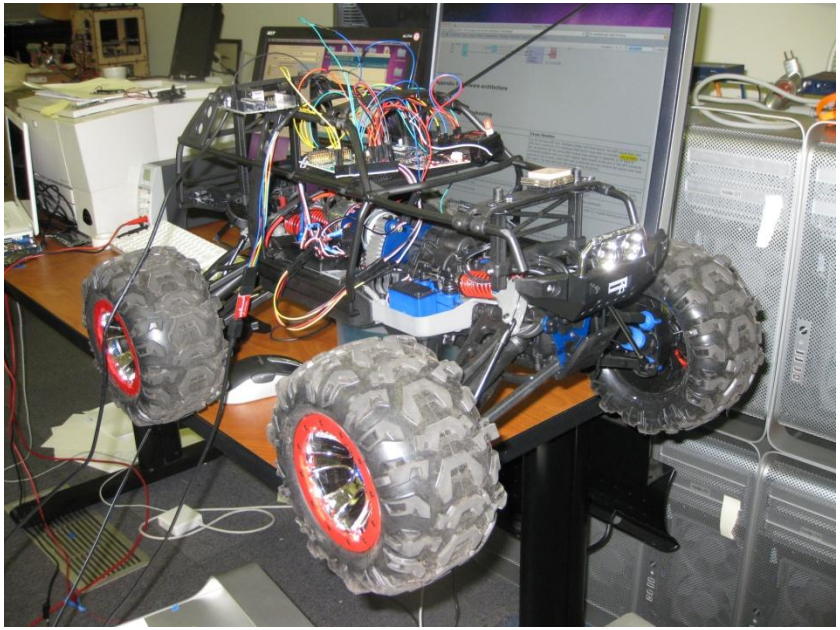
Conclusions

The AutoLab:

- Serves as an intermediary step between software protocols and full scale reality
- Accelerates the contributions to Unmanned Vehicle safety

- Encouraging preliminary demonstrations of system integration
- Future work includes vehicle construction and refinement of control algorithms

Autonomous Multi-Vehicle Testbed



Thanks!

Questions?