IPRO 312: UNMANNED AERIAL SYSTEMS

ILLINOIS INSTITUTE OF TECHNOLOGY

IPRO It takes a team!
INTERPROFESSIONAL PROJECTS PROGRAM

ABSTRACT

The use of Unmanned Aerial Systems (UAS) for intelligence, surveillance, reconnaissance as well as in search and rescue is rapidly expanding in both civilian and military applications at an unprecedented rate which was not foreseen a decade ago. Accordingly, there are significant job opportunities in this field and it is expected that this will continue to grow in the next decade. The design of UAS is truly an interdisciplinary task as it requires team work with expertise in diverse areas ranging from aircraft design to autonomous flight, video and data transmission to visual object recognition, the operation of a ground station such as real time data analysis and antenna tracking. This IPRO project is developing an electric powered low cost UAS that utilizes more autonomy than current UAS designs. Visual is to be done by using image processing algorithms coupled with position determination from GPS receivers and other onboard sensors. The data acquired will then be transmitted to a ground station for post processing and prioritization. The design of the UAS would require the selection or construction of a stable airframe with the flight characteristics required for high quality images and video as well as decent endurance and range for the surveillance of large areas. Furthermore signal transmission, reception and processing methods will need to be developed to ensure functionality at a multitude of ranges and conditions, with provisions being made for
overlapping signal coverage.

TEAM ORGANIZATION

AUTO PILOT

Team Members: Lidens Cheng, Nishanth Samala, Matt Simpson

Leader: Lidens Cheng

VISUAL

Team Members: Kay Traylor, Yaofu Zhou, Jiang Lan, Bernie Mendez

Leader: Kay Traylor

GROUND STATION

Team Members: Artemio Perez, Tushar Nair, Brian Schubert
Leader: Artemio Perez

POTENTIAL MARKETS

· **Military**
   Recon missions
· **Law Enforcement**
   Search and rescue
· **Agriculture**
   Surveying land
· **Construction**
   Surveying sites
· **Maps**
   Supplementing views
· **Customs and Border Protection**
   Surveillance
· **Wildlife and conservation**
   Tracking flora and fauna

STRENGTHS OF DESIGN

Lightweight
Inexpensive
Low emissions
Stealthy
Fast
Low maintenance

FINANCES

Currently, this IPRO has no sponsor. This IPRO is currently using resources from the AIAA club of IIT.

ETHICAL AND LEGAL CONSIDERATIONS

In order to fly, operators must complete **ONE** of the following:
•Obtain an FAA issued **Airworthiness Certificate for UAS and a Program Letter of Restriction**
• Obtain an FAA issued **Certificate of Authorization or Waiver (COA)**
• **Fly in Special Use Airspace**
• **Fly as a Model Aircraft (this is still refined by FAA)**
•There are several ethical considerations concerning this project due to the FAA rules and guidelines. Our aircraft is flying under the Model Aircraft rules, which were released in 1981. The rules specify that a model aircraft can fly up to a maximum of 400 feet above ground level. It must also be visible to the operator at all times. In addition, the aircraft must provide notification if it is within 3 miles of an airport and there can never be fireworks on board.

AUTO PILOT

Team auto pilot improves an open source autopilot software in order for the UAS to operate autonomously.

The autopilot program must be capable of:

· Autonomous Takeoff and landing
· Flight navigation via GPS waypoints
· Automatic search and detection
· Ability to return home in case of emergency

[Left Column shows 4/21/11 test flight]

VISION

• Team Vision uses open source programs to develop a vision detection software. The Open CV program detects targets by color contrast between the target and its background. A post processing script identifies the color, shape and alphanumeric code to fully identify the object.
[Top Left is pre-processing Top Right is post-processing Center is identification]

GROUND STATION

The ground station team manages the communication equipment including directional antennas, GPS system and tracking software. Ground stations maintains the vision and autopilot hardware and makes sure that the UAS receives commands and returns data. The ground stations also maintains video feed.
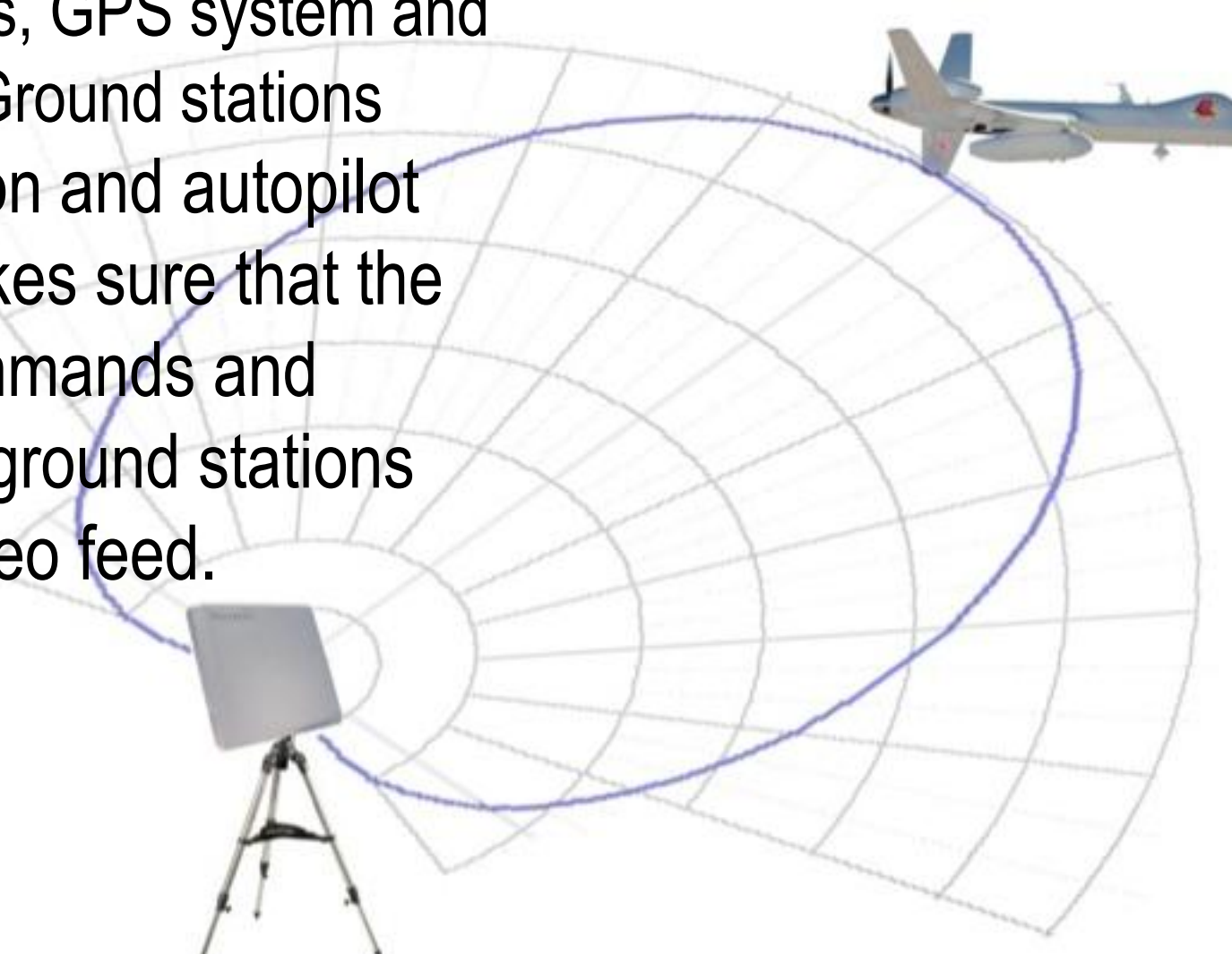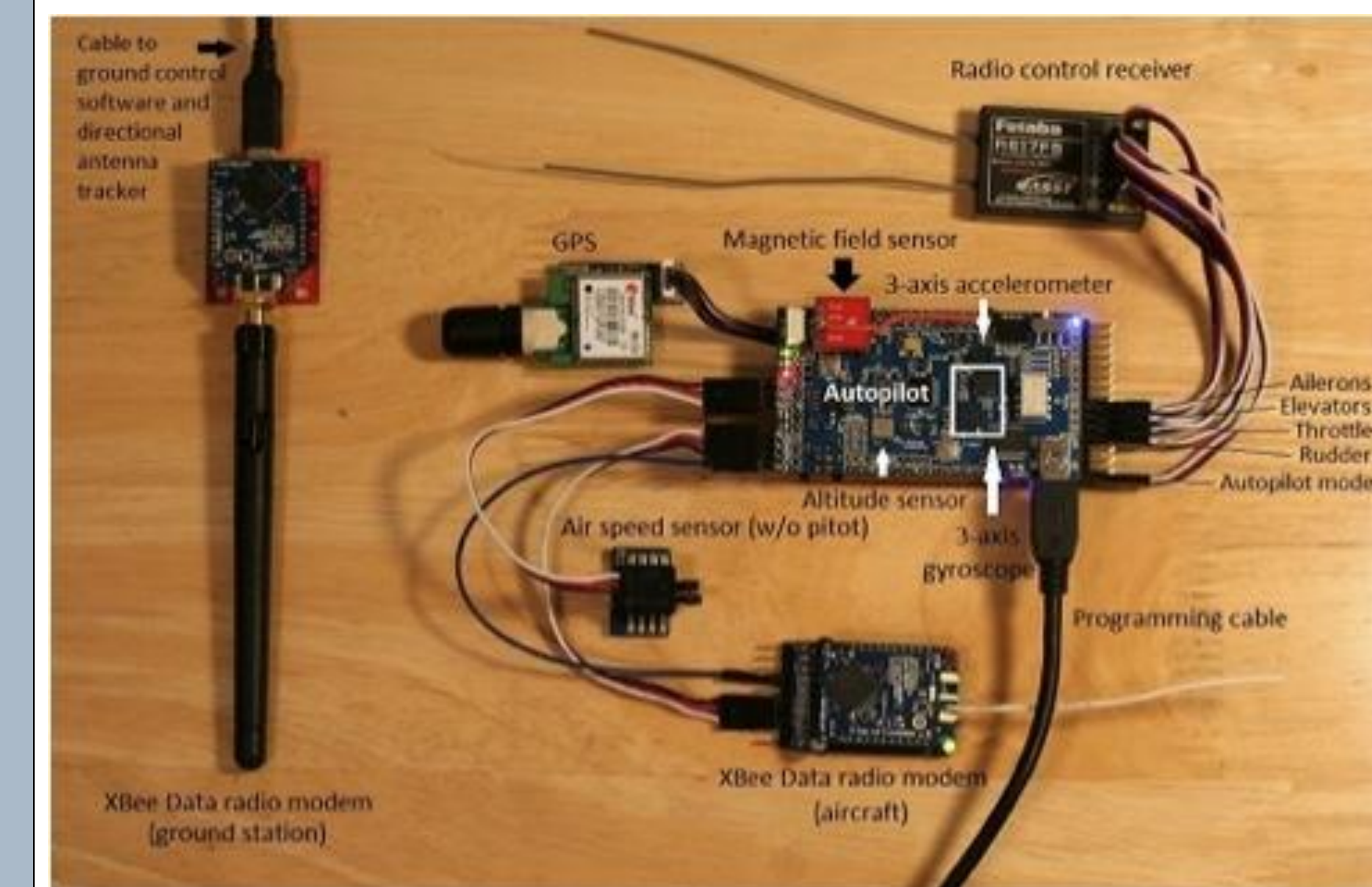
PROJECT COMPONENTS
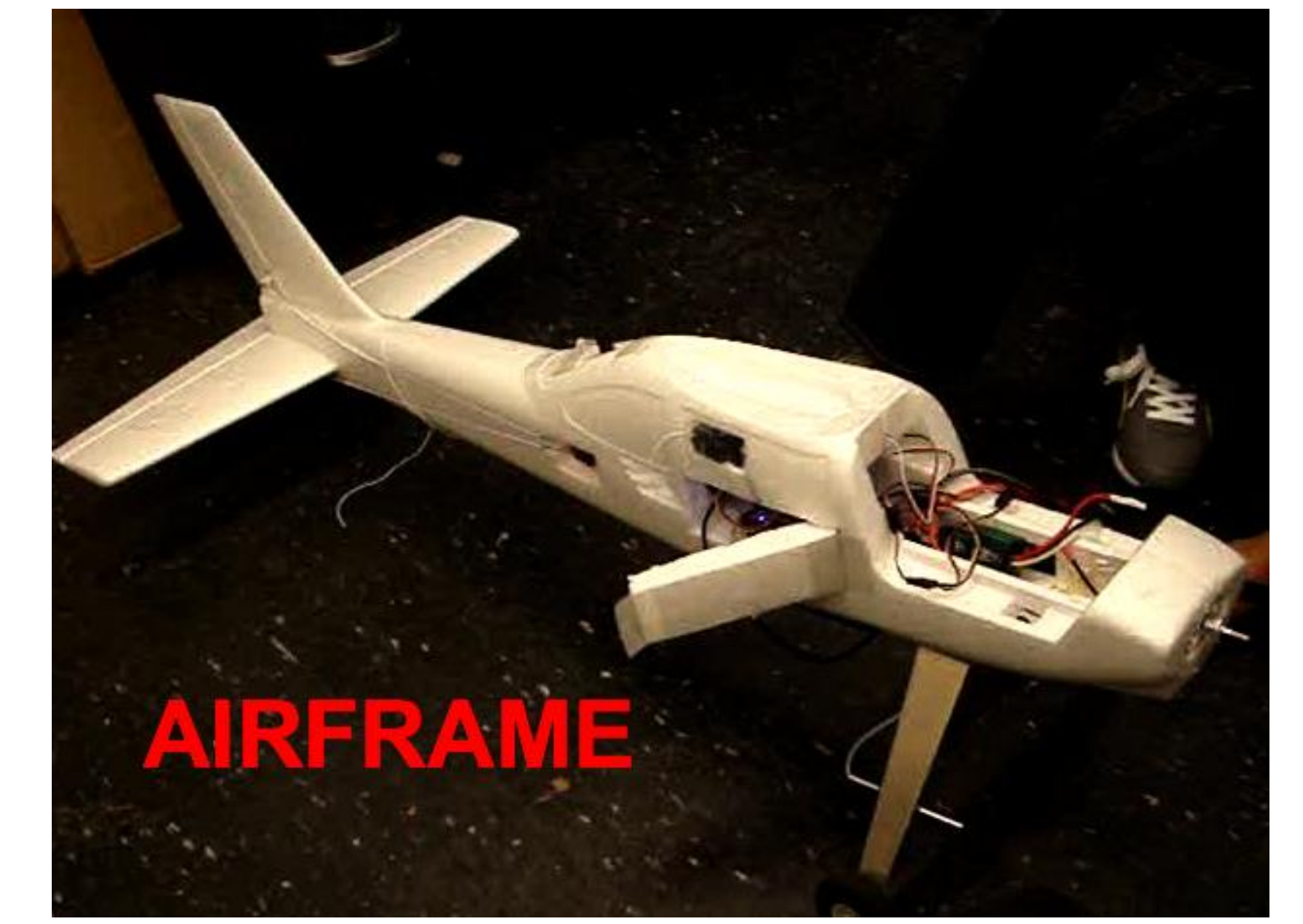
AIRFRAME

ONBOARD ANTENNA

DIRECTIONAL ANTENNA

GOPRO ONBOARD HD CAMERA

POWER SOURCE

CONTACT INFORMATION

IPRO 312: Unmanned Aerial Systems

10 W 32nd St. 243
Engineering 1 Bldg. #253 D
Chicago, IL 60616
www.iit.edu

Kay Traylor: ktraylor@iit.edu
Bernie Mendez: bmendez@iit.edu
Prof. Murat Vural: vural@iit.edu