Team 8 AUVSI

DESIGN COMPETITION

Sponsor: Dr. Shih, FIPSE

Advisor: Dr. Frank, Dr. Alvi

Instructor: Dr. Gupta

Students: David Hegg, Christopher Bergljung, Jermaine Dickey, William Di Scipio, Gavarni Leonce, John Murnane, Tavarius Slaughter

Tavarius Slaughter
Interim Design Review

Agenda

- Project & Design Competition Overview

- Design and Material Selection

- Progress

- Stabilization and Flight Test

- Budget

- Schedule

- Final Summary

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Project Overview

"The goal of this project is to work effectively as an international team to create the best possible aircraft for future success at the 2016 AUVSI SUAS Competition."

FIPSE- Fund for the Improvement of Postsecondary Education
- Gained knowledge of international cooperations

Tasks:
- **Design** aircraft, optimizing for competition
- **Build** and modify existing Senior Telemaster plane
- **Program** aircraft for automated VTOL and waypoint navigation
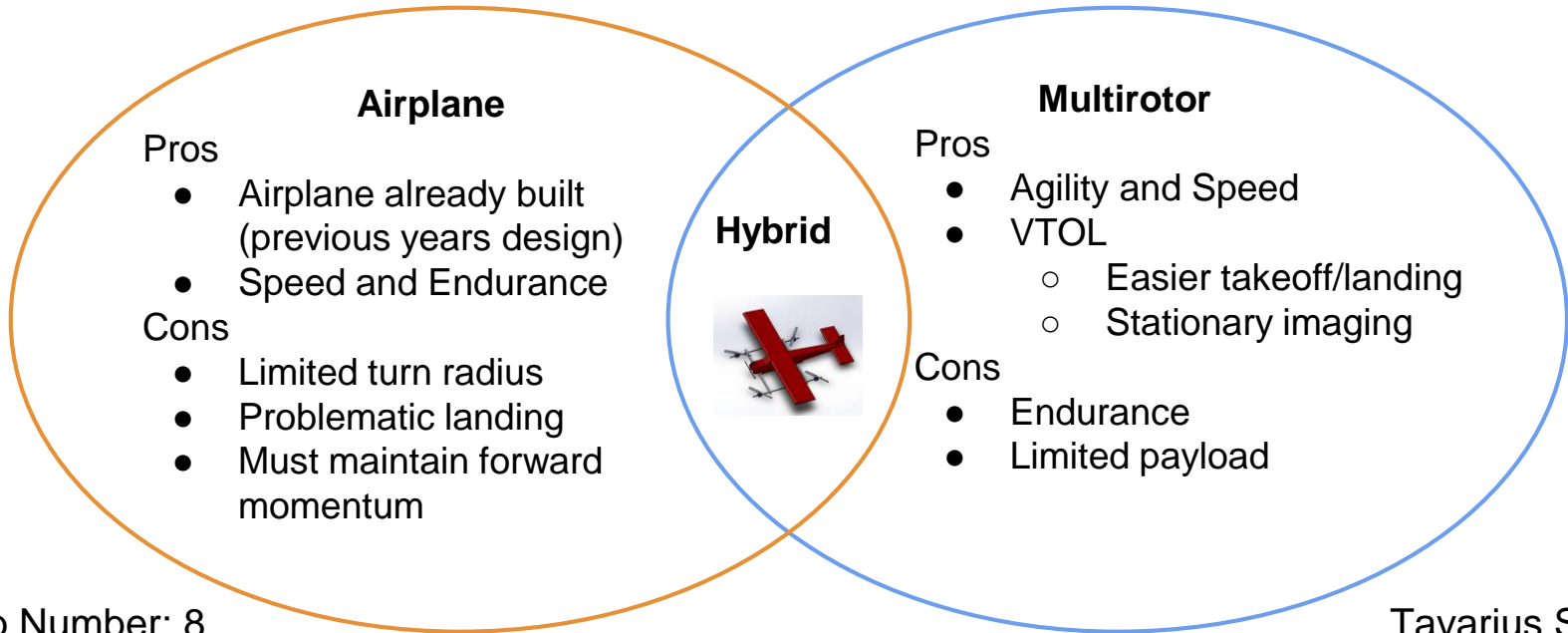- **Test** aircraft and adjust accordingly

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AUVSI 2015 Competition

- **Competition overveiw**:
  - Student Unmanned Aerial System (SUAS) Competition
  - 2015 AUVSI rules used as reference for future design
- **Primary objectives:**
  - Achieve autonomous flight
  - Image recognition capabilities
- **Secondary objectives:**
  - Off axis imaging
  - Object detection/avoidance
  - Vertical Takeoff and Landing

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Design Selection

Speed, **Agility**, and **Endurance** will be major factors for success

Airplane

Pros
- Airplane already built (previous years design)
- Speed and Endurance

Cons
- Limited turn radius
- Problematic landing
- Must maintain forward momentum

Hybrid

Multirotor

Pros
- Agility and Speed
- VTOL
  - Easier takeoff/landing
  - Stationary imaging

Cons
- Endurance
- Limited payload

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Design Selection

- Chose to design hybrid vehicle
  - Vertical Takeoff and Landing(VTOL)
  - Decreased space for takeoff and landing
  - Hovering Capabilities
- Innovative design
  - Allows team to separate itself from other competitors

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Mechanical Design

Material Selection:

- ¼" Plywood for the Base

- Quick-Recovery Polyurethane Foam

- 1" Aluminum 6061 square tubes

- ½" High-Strength Rigid Carbon Fiber Rods

- G-10 Garolite Motor Mounts

- Industrial Strength Velcro

Jermaine Dickey
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Electrical Design

Electrical Design Selections:

- 4 cobra 60 Amps opto multirotor ESCs
- APM 2.6 autopilot system
- 4 Cobra 4510 420KV Brushless Motors
- 4 APC 18"x5" props (2 CCW and 2 CW)
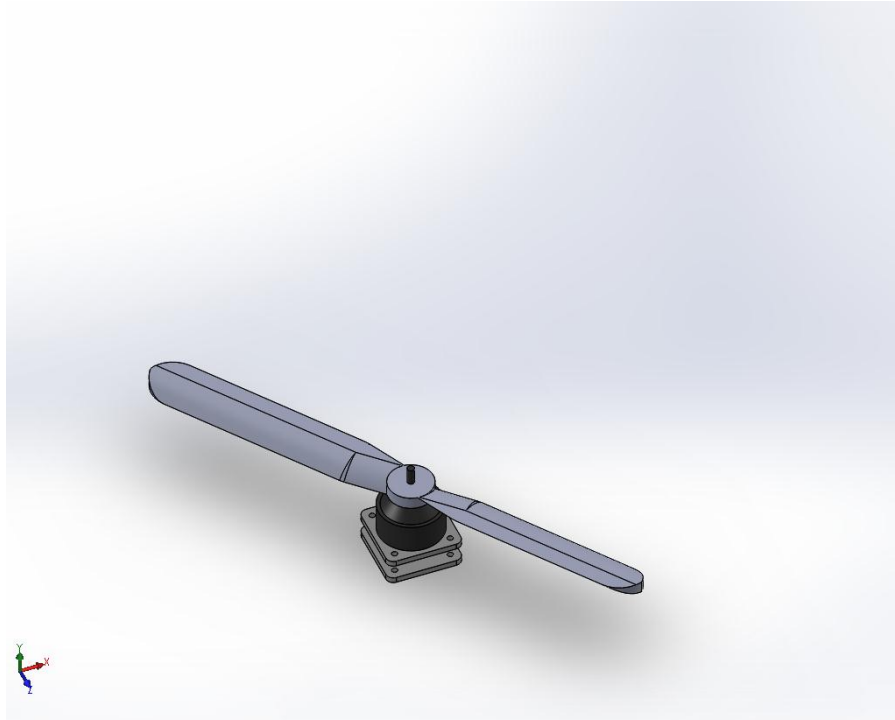- Futaba 6 channel receiver
- 2 Venom Flight Pack batteries

All navigation and controls will be done in the Mission Planner software
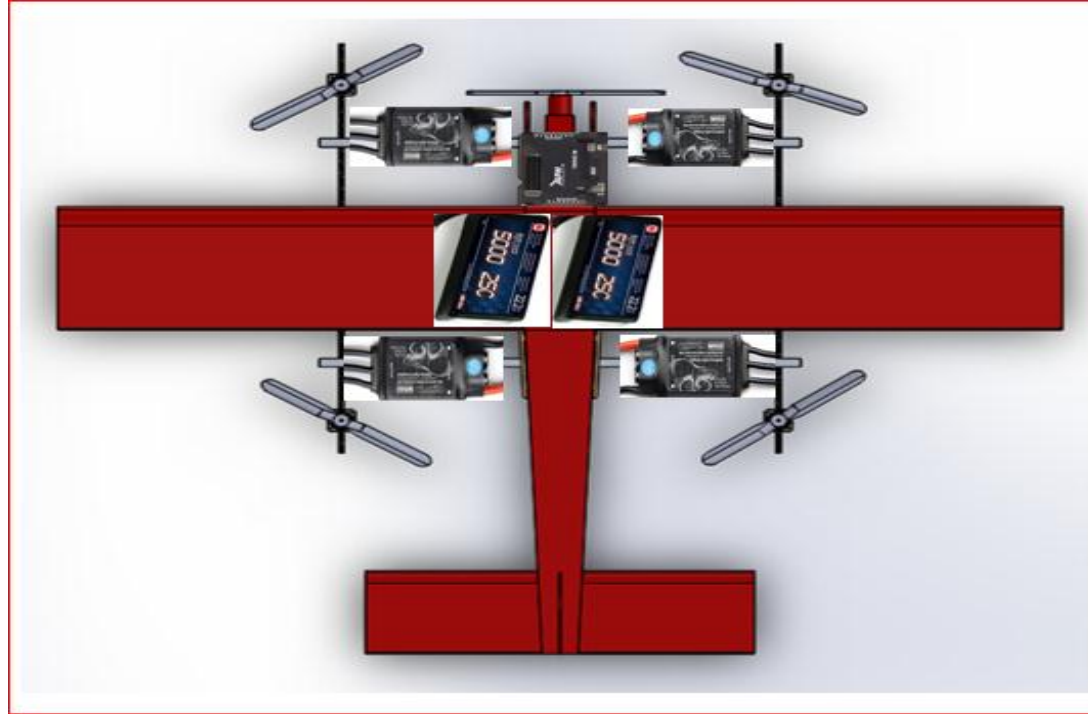
Jermaine Dickey
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Exploded Views

Jermaine Dickey
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Exploded Views

Jermaine Dickey
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Build Progress

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Build Progress

Progress Made:
1. Completed the machining process of all the parts (Rods, Wood frame, mounts)
2. Attached motor mounts to carbon fiber rods using epoxy
3. Attached wood base to aluminum rods
4. Created wring harness to connect power supply
5. Completed initial build (see plane)

Future Work:
1. Need to receive new APM and new screws for mounts
2. Finish wiring of the electrical system
3. Permanent attachment of carbon fiber rods to aluminum
4. Order 3DR Telemetry Kit
5. Finalized build
6. Flight Testing

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Stabilization Testing

- Discontinued testing of Dr. Shih's quadcopter

- Plane will be tethered dependent on:
  - Roll: along the vertical axis
  - Pitch: along the horizontal axis
  - Lastly, at each of the four corners

- Quadcopter frame will be tested on its own
  - Attach equivalent plane weight

- Fully assembled plane will be tested
  - Analyze the effects of asymmetrical body

John Murnane
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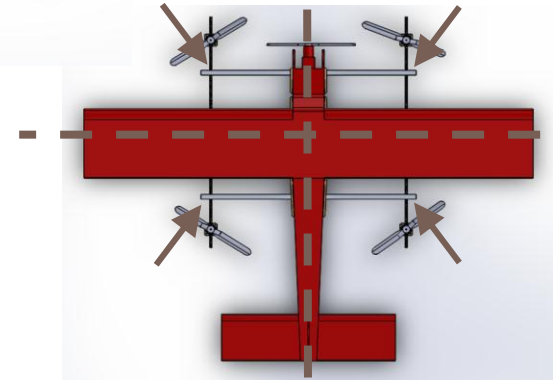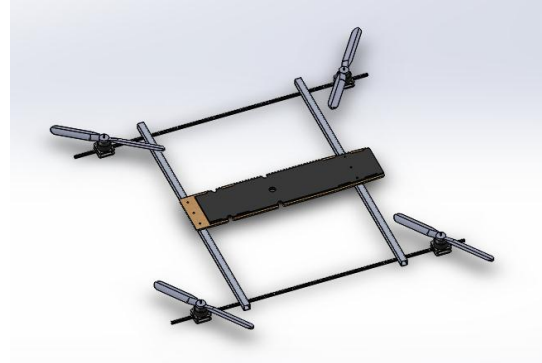
PID Tuning for Stabilization

Goal: **To use the existing Adrupilot PID stability control for our aircraft**
- Software allows users to change PID configuration values to adjust performance
- Roll, Pitch, and Yaw: 3 degrees of freedom
- Goal of PID tuning is to find the balance between moment of inertia and force from motors
- Proportional (**P**), Integral (**I**), Derivative (**D**)
    - Plane will be connected to tether.
    - P gain coefficient
        - Main stability parameter- sensitivity to angular change
    - Second, I gain coefficient
        - Smooths out flying- useful for **irregularities**
    - Third, D gain coefficient
        - Softens or dampens movement of plane- "accelerator parameter"

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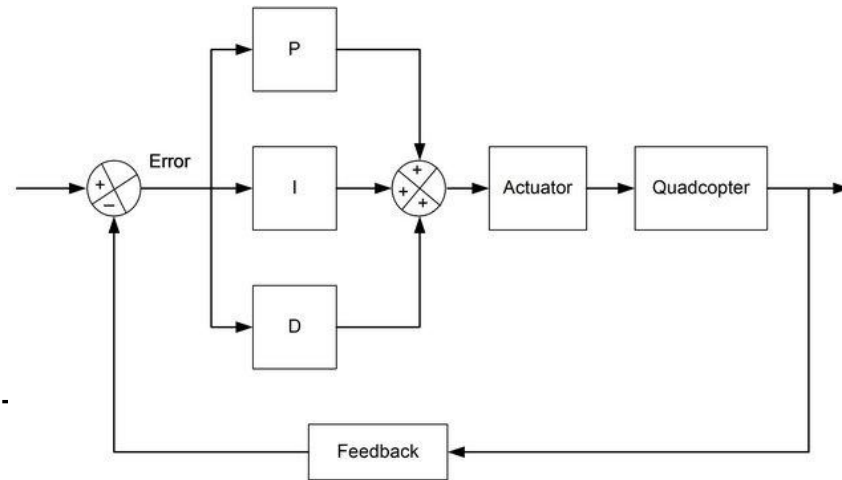
Cost Analysis
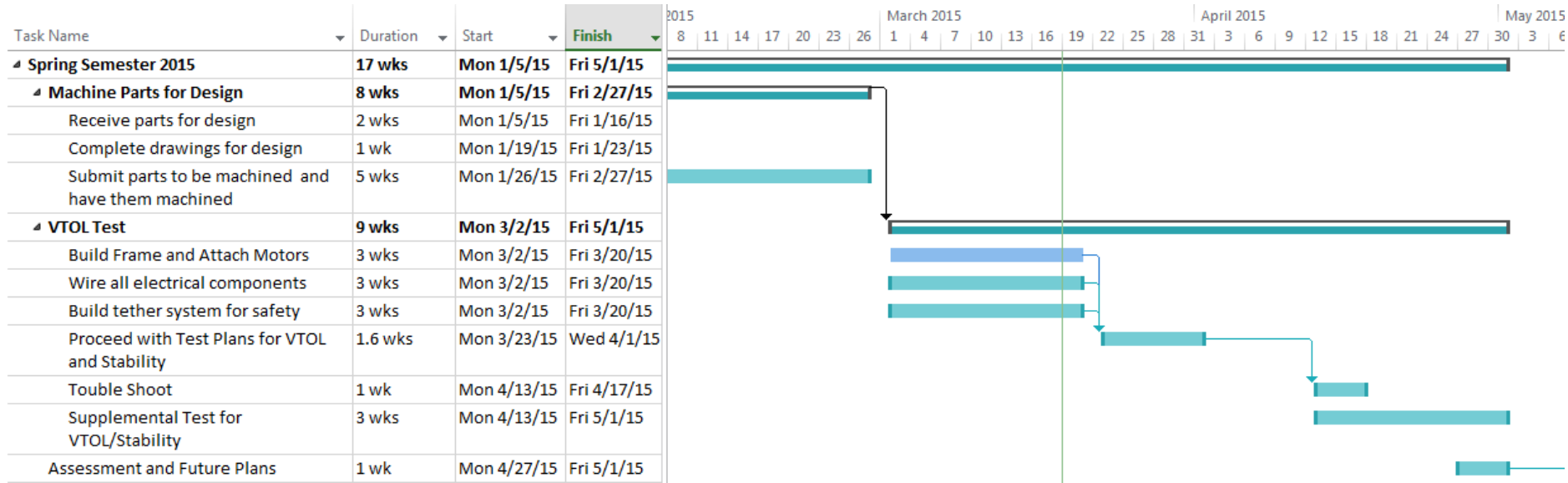
Budget Analysis- $1500

Remaining Funds $194.94

Total Spent $1305.06
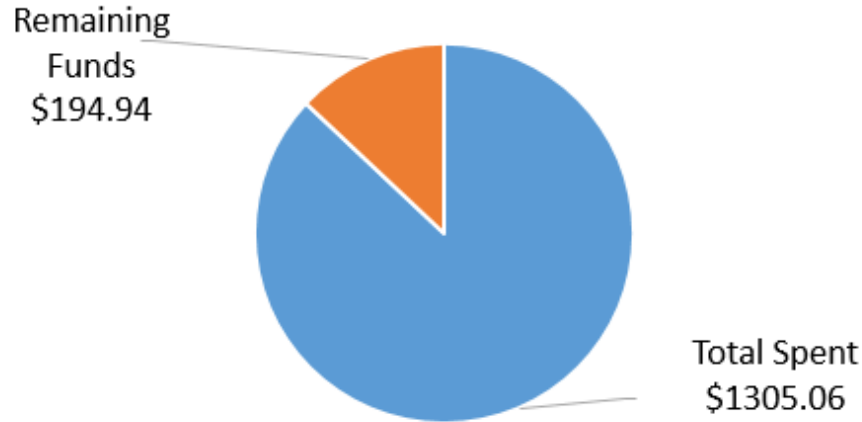
Analysis:

1. Remaining funds = $194.94
2. Efficient Spending
3. Surplus Added
4. Need to purchase 3DR Telemetry kit ($100)

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Schedule/Gantt Chart

Task Name	Duration	Start	Finish
▲ **Spring Semester 2015**	**17 wks**	**Mon 1/5/15**	**Fri 5/1/15**
▲ **Machine Parts for Design**	**8 wks**	**Mon 1/5/15**	**Fri 2/27/15**
Receive parts for design	2 wks	Mon 1/5/15	Fri 1/16/15
Complete drawings for design	1 wk	Mon 1/19/15	Fri 1/23/15
Submit parts to be machined and have them machined	5 wks	Mon 1/26/15	Fri 2/27/15
▲ **VTOL Test**	**9 wks**	**Mon 3/2/15**	**Fri 5/1/15**
Build Frame and Attach Motors	3 wks	Mon 3/2/15	Fri 3/20/15
Wire all electrical components	3 wks	Mon 3/2/15	Fri 3/20/15
Build tether system for safety	3 wks	Mon 3/2/15	Fri 3/20/15
Proceed with Test Plans for VTOL and Stability	1.6 wks	Mon 3/23/15	Wed 4/1/15
Touble Shoot	1 wk	Mon 4/13/15	Fri 4/17/15
Supplemental Test for VTOL/Stability	3 wks	Mon 4/13/15	Fri 5/1/15
Assessment and Future Plans	1 wk	Mon 4/27/15	Fri 5/1/15

Group Number: 8
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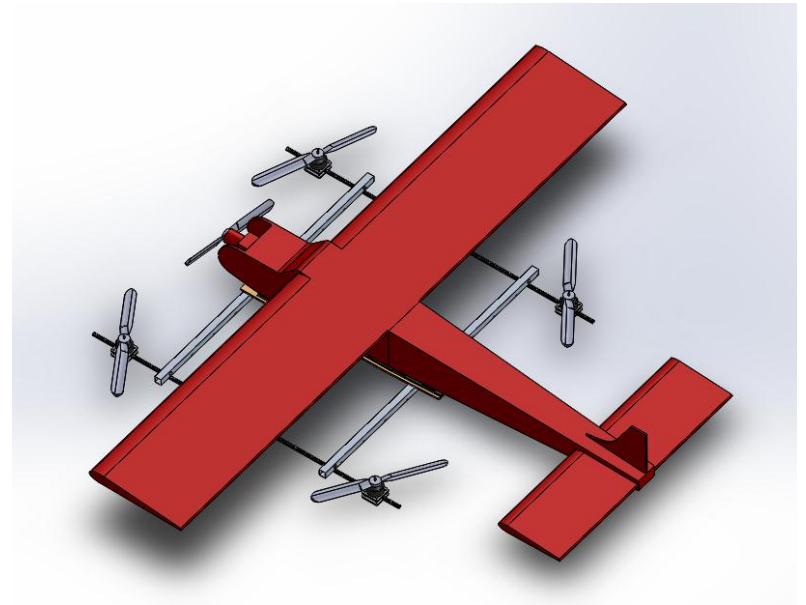Interim Design Review

Lessons Learned

- Previous year parts must be double check

- Use resources better (professors and facilities)

- More accountability

- Detailed Planning

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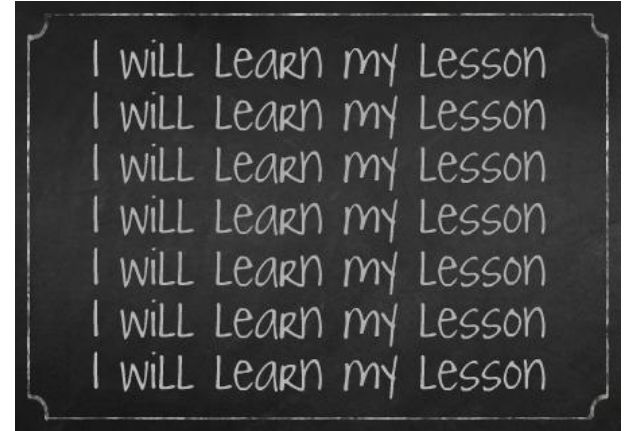
Final Summary

- Design (Pro's/Con's)
  - Optimal for AUVSI competition
  - Requires innovative approach
  - Gives 2016 team the Advantage
- Building process
  - All parts have been machined
  - Frames major parts assembled
  - Waiting for 3DR and Ardupilot
- Flight Test Plans
  - APM Planner being used
  - Testing apparatus
- Budget/Schedule

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References

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Website:
http://eng.fsu.edu/me/senior_design/2015/team08/