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ME 424 X-Prize Team Hydra: Hybrid gas electric power for Drone/UAS

Supervisor Meeting #2

**Overview:**

The Shell Ocean Discovery X-Prize is a competition to autonomously map the ocean floor. The Duke team, sponsored by Martin Brooke, is attempting to do so using sonobuoys deployed via drone. The drone features triple redundant flight systems, 18 rotors, and a hybrid gas-electric power system. The hybrid power system utilizes the high energy density of liquid fuel over batteries to provide the electric power for the 18 rotor hover drone, greatly extending flight time.

**Team Mission**:

Previous groups have proven the concept behind the hybrid power system. Our senior design group will characterize the performance of the existing hybrid gas-electric power system, improve upon current structural design, build three independent power systems, and mount the systems to the drone. After mounting the power systems, we will perform flight tests to prove efficacy and reliability of the system.

**Current Game Plan**

1. Characterize the performance of existing setup
   1. Become familiar with the electronic control
      1. Met with last group
      2. Able to spin the motor for the start sequence
   2. Fix mechanical issues
      1. Put keyways into both shafts and order key stock
      2. Re-mount engine and generator
      3. Attach servos, experiment with linkages
   3. Measure
      1. Power output at different throttle/choke (idle and max v. important)
      2. Gas consumption vs power
   4. Battery charge rate (derived from power, but potentially dangerous with LiPo batteries - when charged last semester, extremely fast charging of battery => current ~70A
2. Analyze the structural integrity of the landing base
   1. Determine weaknesses of current design in landing and in flight failure
      1. Do a SolidWorks FEA analysis on the current hexagonal base structure to determine where structural failures can occur
      2. Design support struts to help strengthen these problem areas
      3. Test new structure in flight
   2. Look into other design options for the landing base, as well as test them in SolidWorks and in-flight
      1. Option 1: Triangular base as opposed to a hexagonal one
      2. Option 2: Landing base with shock-absorbing supports
   3. Design and 3D print new rotor joints to accommodate an additional 6 rotors
      1. Must use the ME Department’s Carbon printer in order to remove the directionality of traditionally printed 3D parts (current joints failed due to the direction the parts were printed)
3. Is there a better power system setup?
   1. Research other hybrid systems
      1. Do engines turn on and off?
      2. What kind of redundancy is built in?
   2. Nail down Brooke on power, reliability, fuel consumption reqs
   3. What benefits do we gain from a single larger engine?

After these short term questions and action items have been addressed, we will work on mounting the MG system to the frame, controlling vibration, and running flight tests. If the power system needs to be redesigned, the timeframe will be substantially longer.