URC Presentation

1. Project Overview – Charlie
   1. Good morning, My name is Charlie Nitschelm, this is Kevin Bucher, Nick Clegg and Reilly Webb and we are members of UNH SEDS, a new inter-disciplinary rocketry organization at UNH. This semester, we chose to compete in the SEDS University Student Rocketry Competition that requires our team to design, build and launch a multi-stage rocket to the highest altitude with a comprehensive recovery system. The combined total impulse of the engines cannot exceed 640N s and we must have at least two stages of the rocket provide thrust.... move right into rocket design
   2. AGREE AND ADDED(Suggestion: end project overview talking about the rocket needing two stages, then transition to rocket design by point to the two stages on the rocket assembly on the poster) -Reilly
2. Rocket Design – Charlie
   1. From the poster, you can see that our design utilizes two stages to propel the rocket, both using separate recovery systems to land the parts back on the ground safely. The booster stage, which initially propels the rocket off the launch pad, will use a single parachute that will release at apogee controlled by the delay charge all cessaroni engines are equipped with. The sustainer stage, which begins at the Forward Fins, will reach the highest altitude. To minimize the drift starting at apogee, we will be using a dual deployment method. This uses our electronics bay, which houses the TeleMega GPS that can send current at specific times during flight to ignite black powder charges to pressurize the sections of the rocket to release the parachutes. The Drogue parachute, located in the nosecone, will be ejected at apogee that allows the rocket to fall at a fast, but controlled speed to ensure the safe deployment of a main parachute, located above the sustainer engine. The main parachute will deploy at a predetermined height closer to the ground. This limits the amount of drift the rocket will experience during its decent. It is crucial to the competition scoring to retrieve all the parts of the rocket directly after launch. As a new organization with all its members starting with zero tangible rocketry experience, we had to really start from the ground up.
3. Improvement Cycle – Kevin
   1. The team utilizes a development cycle for progression and improvement on each rocket iteration. The cycle begins with research of aerodynamic theory to enhance our aerodynamic models used for flight simulations. When the flight sims seem to follow a correct output, rocket dimensions are optimized for max altitude. These dimensions are constantly checked with FEA to ensure safety. The rocket is then manufactured with the optimal dimensions, while attempting to employ better techniques from last build. The rocket is launched, and data is gathered. We are always pursuing better launch techniques to ensure recovery of all components. The data from the flight is reviewed and compared to our flight sims, where the process repeats. (First draft)
4. Propulsion – Nick and Kevin
   1. (Kevin) A static test fire rig was used to test the propulsion characteristics of our engine and ultimately ensure our engines do not exceed the 640Ns constraint. The STFR, as seen here, is oriented such that exhaust is expelled upwards, while a force is applied downward onto the load cell. The experiment was conducted in a field outside, a safe distance from anyone or anything.
   2. (Nick) Results
5. Launch Simulation –
   1. The most important design constraint to simulate and verify is stability. For a rocket to be stable, the center of gravity must be forward to the center of pressure. A caliber is a measure of this destance, with a value of 1 or greater being acceptable. A simulation of how the caliber changes through flight is graphed for each launch in order to verify the stability of the rocket through the flight. Then, rocket trajectories were simulated to provide us with a map of how the rocket will perform. Many factors come into play to accurately model a rockets flight including thrust, drag and atmospheric models. Through the testing we have done with the rockets we have built so far, we have been able to improve our simulation to closely represent what is actually seen in flight, usually in the range of 50 meters or so. In that bottom left graph, you can see this visual representation of our flight, with actual flight data plotted, OpenRocket, which is a standard rocket simulator in the industry, and our MATLAB model. We have been able to refine our simulation to an accurate depiction of the flight, sometimes better then Openrocket's.
6. Design and Analysis – Reilly
   1. Once the basic configuration of the overall rocket is determined, specific dimensions are found by combining our aerodynamic models into a single function, whose inputs are the non-fixed dimensions and the output is maximum altitude. Nonlinear programming is then used to converge on the optimal dimensions, given constraints from required in-flight stability and manufacturing limitations. The outputted dimension are used to build 3D models in SolidWorks, which then undergo finite element analysis to confirm structural integrity.
   2. Once we can trust these models and the overall configuration of the rocket is determined, specific dimensions are found by combining all of our aerodynamic models into a single function, whose inputs are the various dimensions of each rocket component and the output is resulting maximum altitude.
   3. Nonlinear programming is then used to converge on the optimal dimensions that will result in the highest apogee, given constraints from required in-flight stability and manufacturing limitations.
   4. And you can see in this figure that optimization added another 200m to our initial guess of dimensions for this particular design.
   5. The final dimensions are then used to build 3D models in Solidworks and perform finite element analysis to confirm structural integrity of parts that are prone to failure, such as the engine centering ring seen here.
   6. Once we finalize our design we can begin manufacturing.
7. Manufacturing - Nick
8. Close – Reilly

Comments: Need some info on engines, material, we will probably be asked about it. Should we bring the components and break it apart? Under a glass vase or something or on table. Safety?

I have no idea what you mean by glass vase haha. Also I think Manufacturing should go after design and analysis just so it follows the flow chart. –reilly

Glass vase meaning so explosives arent in the open, gives the engine a cover protection. And I agree on the other stuff. Fixing now