Trailer-Based Support System for Weather-Sensing Drone

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Team

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Background & Problem

- CopterSonde is a drone built by the sponsor team at BLISS to record weather data in the atmospheric boundary layer, an area that is often hard to reach with conventional devices (i.e., ground-based sensing or weather balloons)
- Drone must be manually controlled and charged
- More data could be gathered if the drone and support system were autonomous

Design Constraints

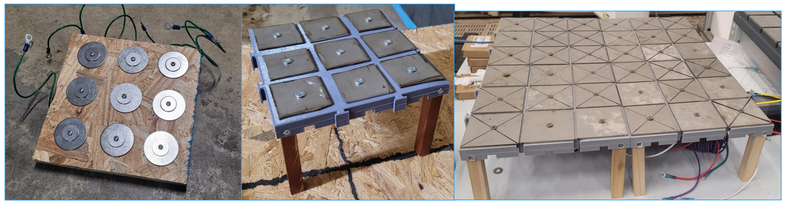
- Max budget of $3500
- All components must fit on 216x84 inch trailer bed
- Charging system to be based around the SkyCharge Bolognini S1 charging landing pad
- Existing SkyCharge landing/charging pad must be expanded to at least twice its original width and length using modular components that fit in the 10-inch cube 3d print volume
- All produced equipment must be able to survive sun and rain exposure

Standards in Use

- A Guide to Form and Style for ASTM Standards, Part H (Usage of SI Units)
- ASTM ISO/ASTM52910-18 (Additive manufacturing - Design - Requirements, guidelines and recommendations)
- ASTM DS56M-EB (Metals and Alloys in the Unified Numbering System)
- Modified ANSI Drafting Standard

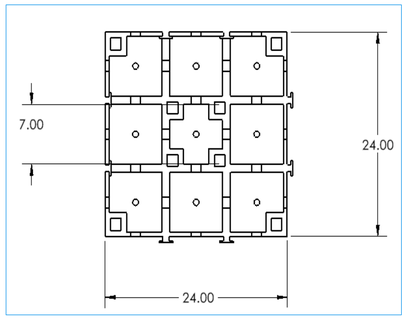
Design Process

- Once the SkyCharge charging pad was disassembled, a wooden testing rig was built and connected to the Bolognini S1 to test the hypothesis of its function (rig shown below), and once this design had confirmed charging, its design formed the basis of future modular designs



Prototype progression (left to right: testing rig, rough cut, and quad-pad)

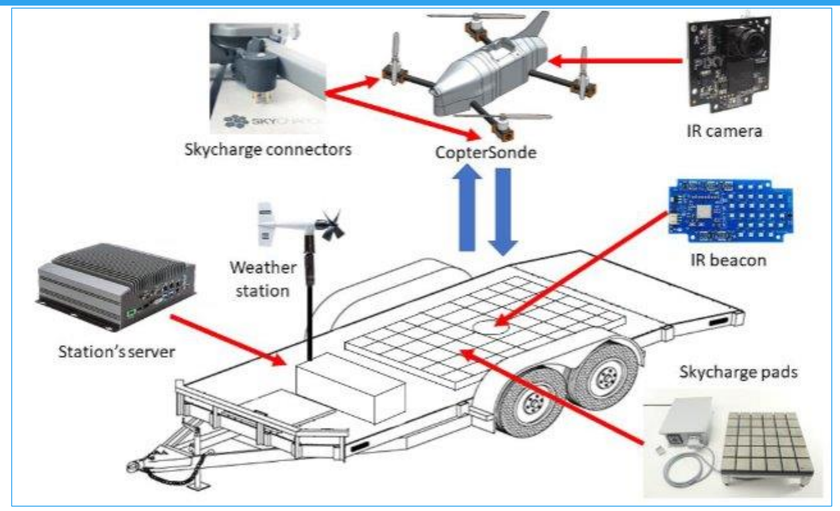
•The modular pad design went through six virtual iterations (Basic CAD drawing shown right) in SolidWorks, with the fourth being the first to be 3-D printed and assembled as the rough-cut shown above (featuring a puzzle-inspired interlock mechanism and a shape that is a 240 mm square)
•The final iteration had modifications for easier assembly into the form shown above, deemed a "quad-pad" consisting of four interlocked modular pads with wiring matching that of the Bolognini S1
•Additionally, the manually cut metal panels of the rough-cut prototype were replaced by pre-made 3x3 inch stainless steel panels (produced as welding training kits), with holes drilled through their centers (marked with "X" on each panel)

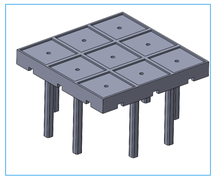


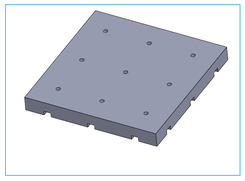
CAD model of modular pad (dimensions in cm)

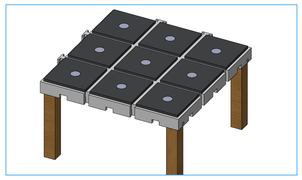
Top to Bottom: Ansys Safety Factor, Finished Charging Pad, and Testing Drone

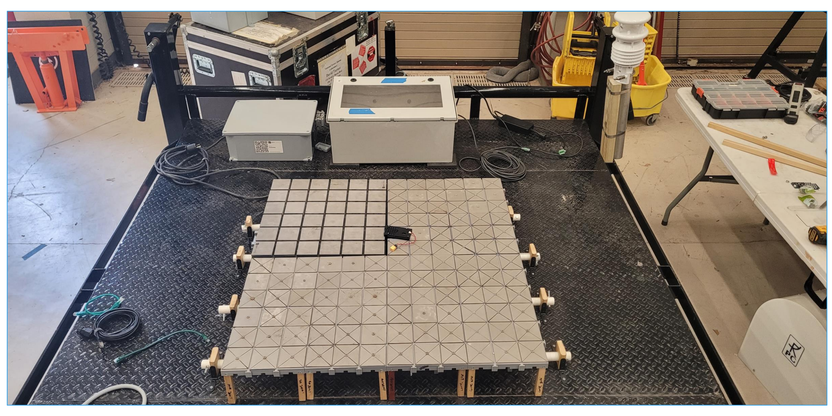
- All iterations of the modular pad showed promise in virtual load simulations in Ansys, with safety factor>15 when the maximum load was 15 pounds (deemed to be double the maximum for typical operation)
- When three quad-pads were complete, their wiring was chained together to form 9 continuous "wires", made separable by plugs and sockets installed on the Bolognini S1 and the quad-pads
- To test the charging and precision landing functionality of the system, a modified Hexsoon 450 dev drone was assembled, with an IR-LOCK precision landing camera and a laser rangefinder added onto its equipment (alongside equipment for GPS, telemetry, and control)











Top to Bottom: Sponsor Proposal, Major CAD Iterations for Modular Pad, and Final Assembly

Final Design & Results

- Charging functionality was confirmed at all stages of construction, starting with the testing rig and ending with the full assembly
- Final assembly includes 38.58 inch (98cm) wide charging pad
- During the first field test, the testing drone was able to complete three consecutive flights where precision landing occurred after troubleshooting the IR beacon and onboard IR camera. Charging was confirmed upon each landing. Charging was confirmed upon each landing, which was repeated in the second field test