DALHOUSIE UNIVERSITY
FACULTY OF ENGINEERING
Department of Mechanical Engineering

MECH 04 – Autonomous UAV Landing Platform

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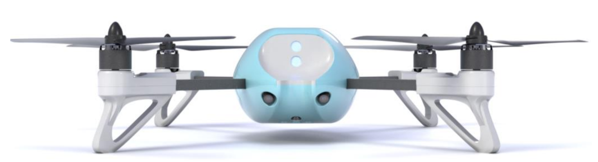
Pleiades

The Problem



Spiri Drone

Current safety practices aboard marine craft are to clear the deck when a drone comes in to land. This poses a problem in rough seas where the drone can slide around on the deck posing a safety risk to itself, the ship, and the crew members. The purpose of this project was to design a landing system that could autonomously secure Pleiades Robotics' Spiri during a landing and hold it in place until it was safe to be retrieved by a crew member.

CCGS Terry Fox

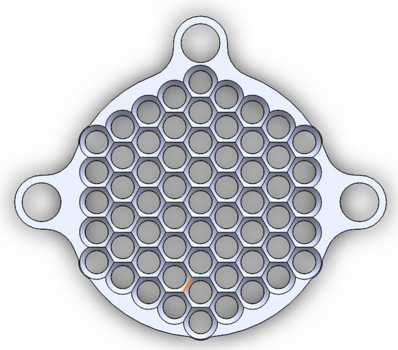
Design Requirements

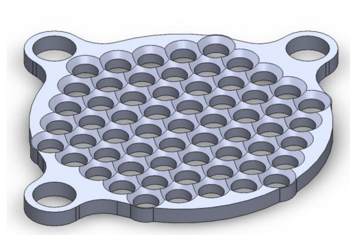
- Autonomously secure drone when it lands ✓
- Accommodate a payload ✓
- Must not interfere with normal operation of the deck ✓
- Withstand a drone free fall of 10 ft. ✓
- Keep drone secured to the platform at inclines up to 45° ✓
- Accommodate drone landing within a 3" radius and a heading tolerance of +/- 7.5 degrees. ✓
- Successfully land and secure the drone during off-axis landings up to 15 degrees. ✓
- The total weight of the new drone feet should be less than 300 g. ✓

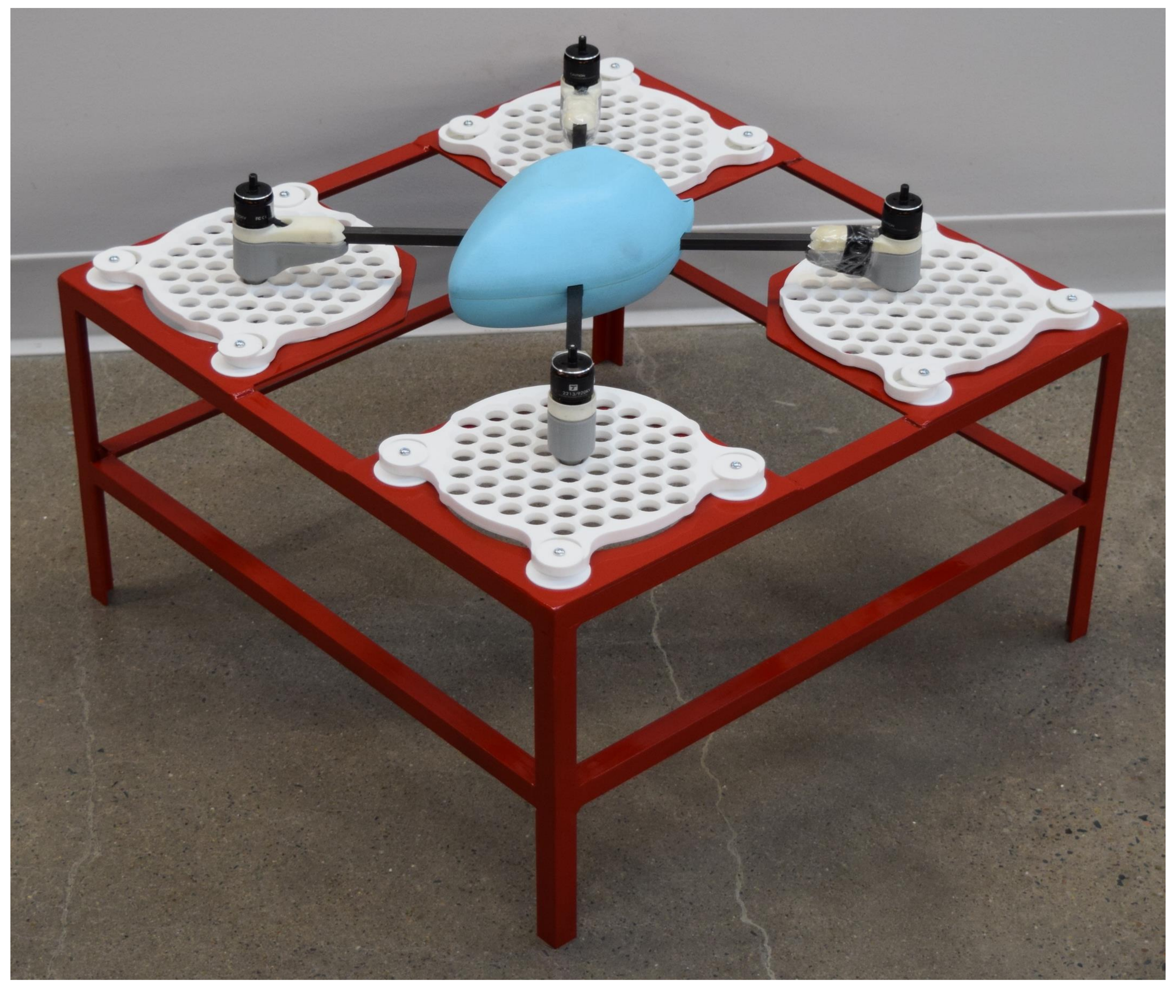
Final Design

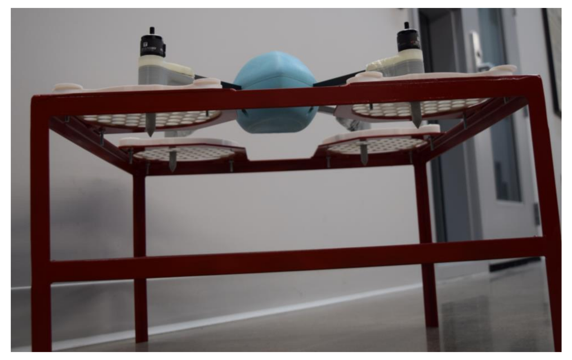
<u>Grid Design</u>

- 15 mm hexagonal holes
- 10 mm thickness
- 45° chamfer on holes
- 3D printed in PLA (25% infill)
- 26 mm mounting holes allow sliding



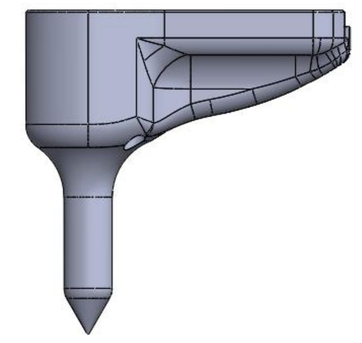


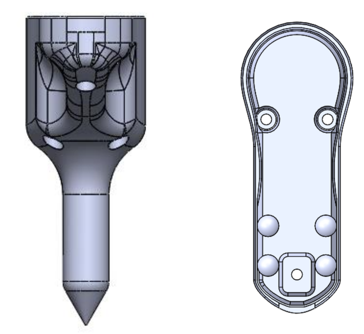




<u>Foot Design</u>

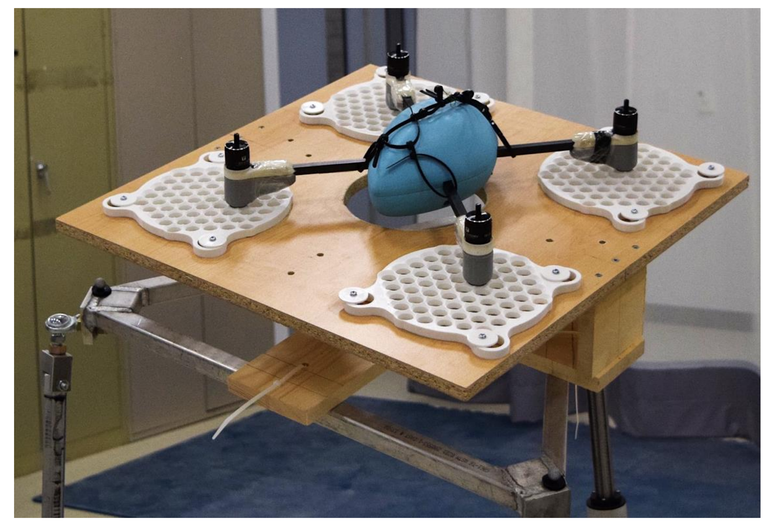
- Seamless integration with existing Spiri design
- 30° conical chamfer on probe
- Lightweight PLA material (50 grams/foot)

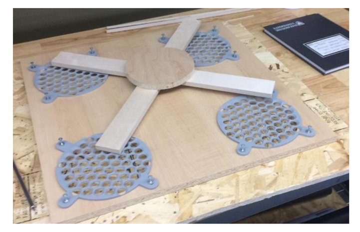


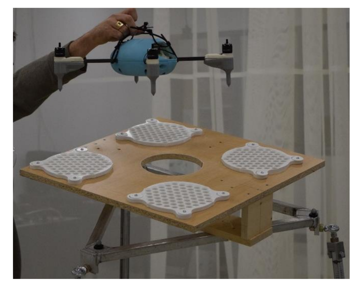


Testing

- Tested statically and dynamically under a variety of conditions to determine the most effective design







Trial	Number of Drops	Average Number of Feet Secured Per Drop
Static 1	10	2.9
Static 2	8	2.25
Static 3	25	3.72
Static 4	40	3.8
Dynamic 1	15	4.0
Dynamic 2	10	3.8
Dynamic 3	30	3.97

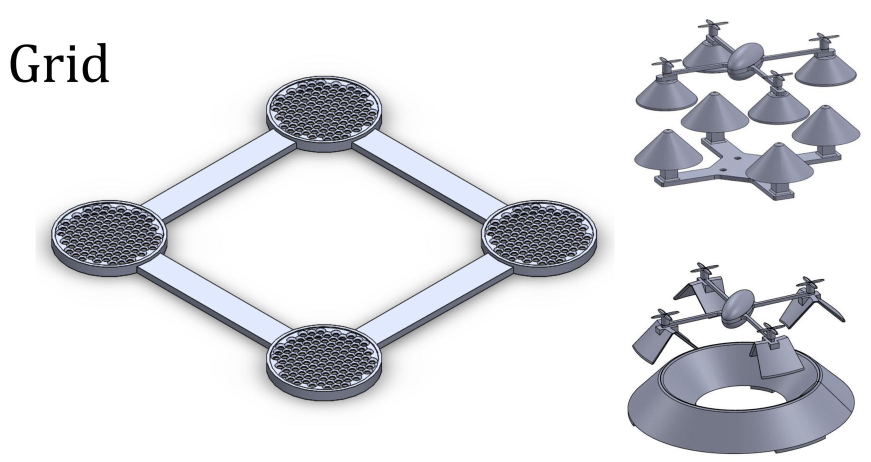
Concepts Considered

Hexagonal Grid

Velcro

Suction

Magnetic



- Each design was ranked using a number of weighted design criteria categories like cost, durability, ease of construction, etc.
- Hexagonal Grid received the highest rank

Conclusion and Recommendations

- Extensive experimental testing showed our design met or exceeded all design requirements
- Depending on operational conditions, alternative grid materials may be preferable for increased service life; namely, polyurethane or 6061 aluminum, although these options are significantly more expensive. These were determined not to be necessary for our project as the 3-D printed material preformed sufficiently and met the design requirements.
- A system for mounting the frame to a ship deck must be designed once the ship that the drone will operate from is identified

References

1. CCGS Terry Fox [Digital image]. (n.d.). Retrieved March 22, 2019, from http://www.shipspotting.com/gallery/photo.php?lid=1741683
2. Crossman, N., Jothiraj, W., Muir, J., & Potter, S. (2017). *Dalhousie University–Mechanical Engineering MECH 4025 –Design Project II Final Design Report - MEOPAR Kinematic Platfo rm* (Tech.). Halifax, NS: Dalhousie University.
3. Edwards-Daugherty, P. (2017, September 4). Spiri Drone [Digital image]. Retrieved from https://www.kickstarter.com/projects/914887915/spiri/posts?page=

Design Evolution

<u>Grid Design Evolution:</u>

1. Increased grid hole size
2. Increased diameter of mounting holes
3. Increased thickness
4. Added material around edge of grids for additional support

<u>Foot Design Evolution:</u>

1. Smaller probe diameter
2. Increased probe wall thickness
3. Fillets at base to reduce stress concentrations
4. Increased chamfer angle on probe tip