Structural Optimization of Quadcopter Landing Gear

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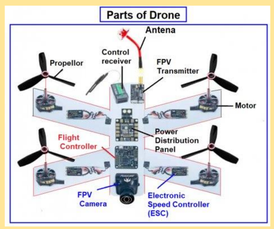
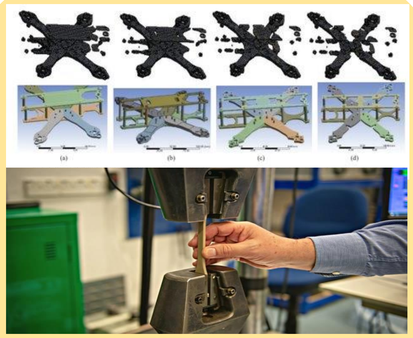
Objective: To design and optimize a landing gear with a small carrying apparatus that will be attached to a drone. This drone will be used to carry emergency medication from a nearby pharmacy to a hospital.

Background



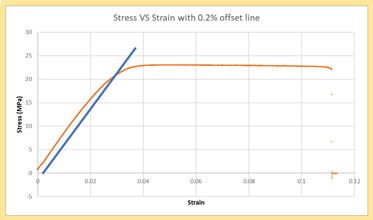
Drone Research:
- Parts
- Function
- Performance

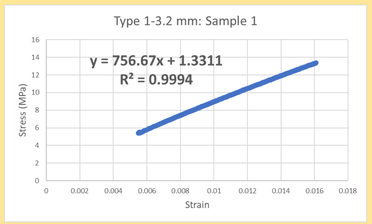


Further Research:
- Topology optimization
- Types of material testing for additive manufacturing materials

Japanese Wood Joinery:
- Inspiration for leg joint connection

Drone for Project
- Thanks to Drone Express

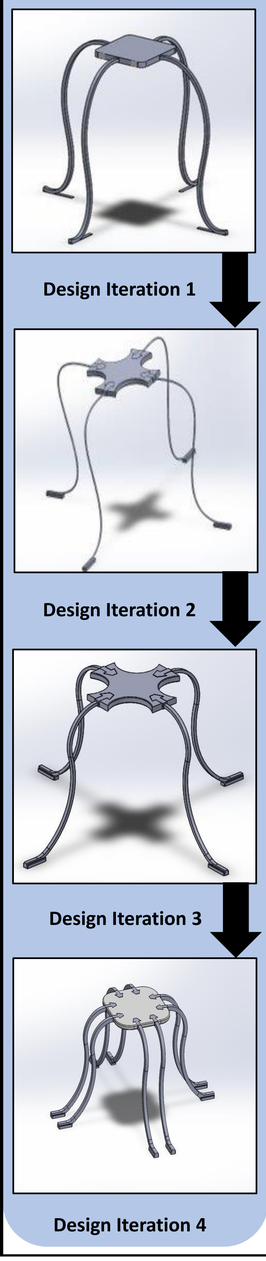




Results from tensile testing of ABS:
- Yield strength – 21 MPa
- Elastic modulus – 756.67 MPa

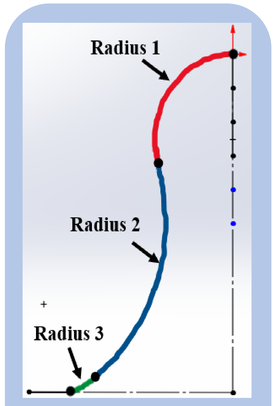
Tensile testing:
- extract material properties from ABS

Design & Analysis



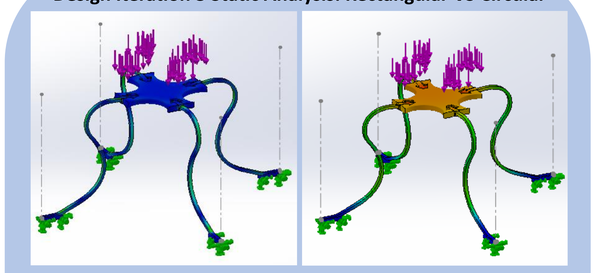
Cross-section of legs:
Circular (left) vs. Rectangular (right)

Final optimization of leg resulted in:
R1= 57 mm, R2= 133 mm, R3= 62 mm

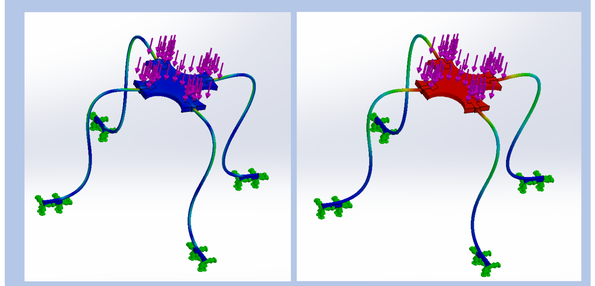


FEA Optimization of leg:
- Minimize stress and weight
- Based off the 3 radii above

Design Iteration 3 Static Analysis: Rectangular VS Circular



Stress (left) and Displacement (right) results from static analysis of design iteration 3 with (6 x 5) mm rectangular cross-section.



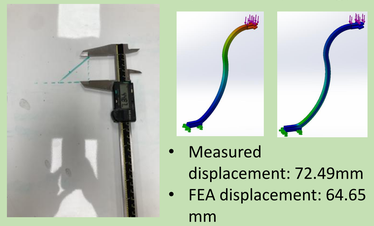
Stress (left) and Displacement (right) results from static analysis of design iteration 3 with 5 mm diameter circular cross-section.

Results

Printing: Landing gear legs/design iteration 3/design iteration 4—all ABS material

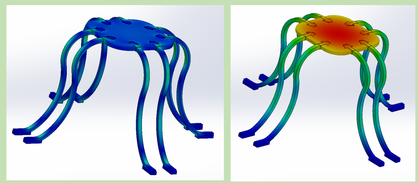
Static testing of landing gear assemblies and leg followed by **dynamic testing** of assembly.

Static Test Stress and Displacement (one leg):



- Measured displacement: 72.49mm
- FEA displacement: 64.65 mm
- Error: 10%

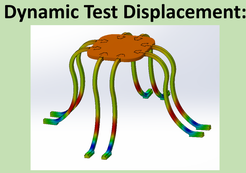
Static Test Stress and Displacement:



Design Iteration 4

Safety Parameters:
- Drone landing in enclosed cage on landing pad
- Careful communication between pilot and receiver
- Mandatory safety lessons

Dynamic Test Displacement:



Design Iteration 4

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