AHS Design Team

LIVERPOOL

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Mission

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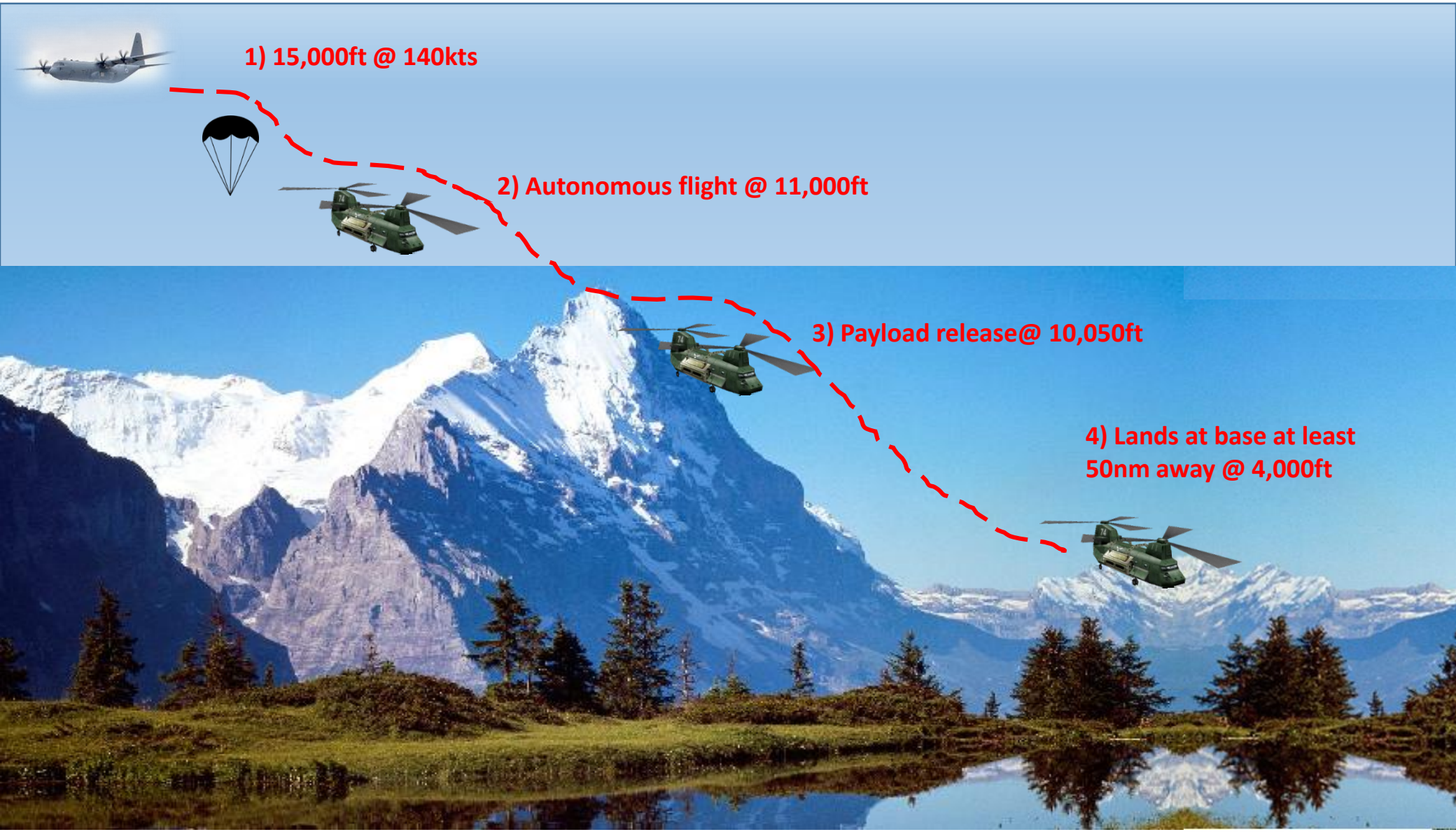
1) 15,000ft @ 140kts
2) Autonomous flight @ 11,000ft
3) Payload release@ 10,050ft
4) Lands at base at least
50nm away @ 4,000ft

Rotorcraft Design

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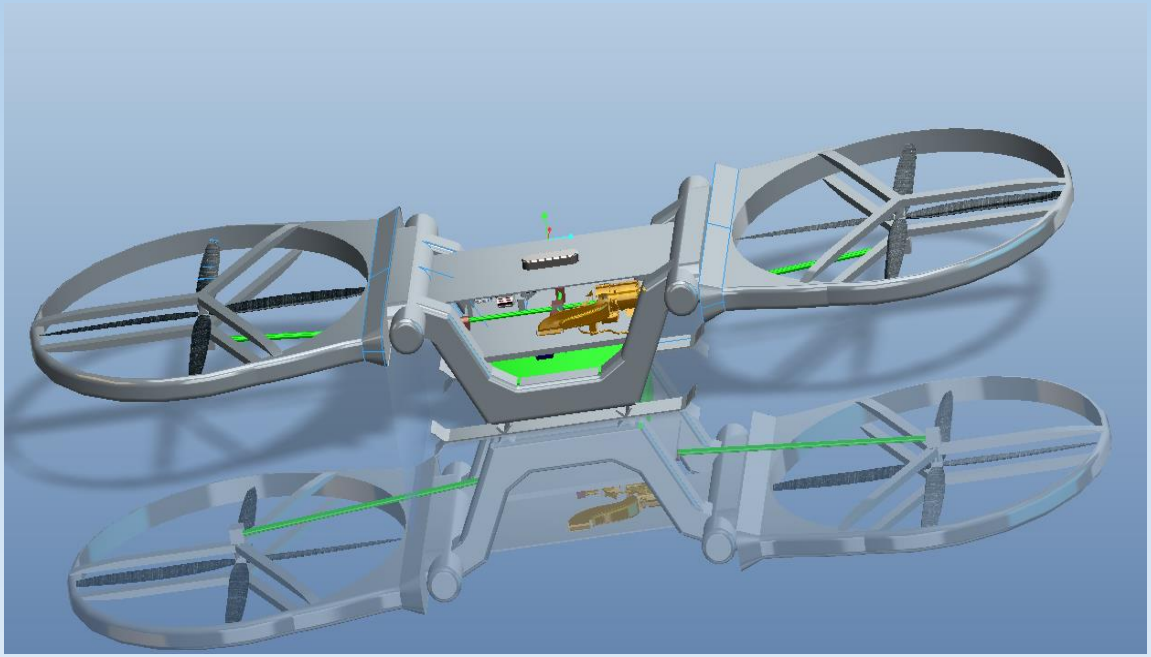
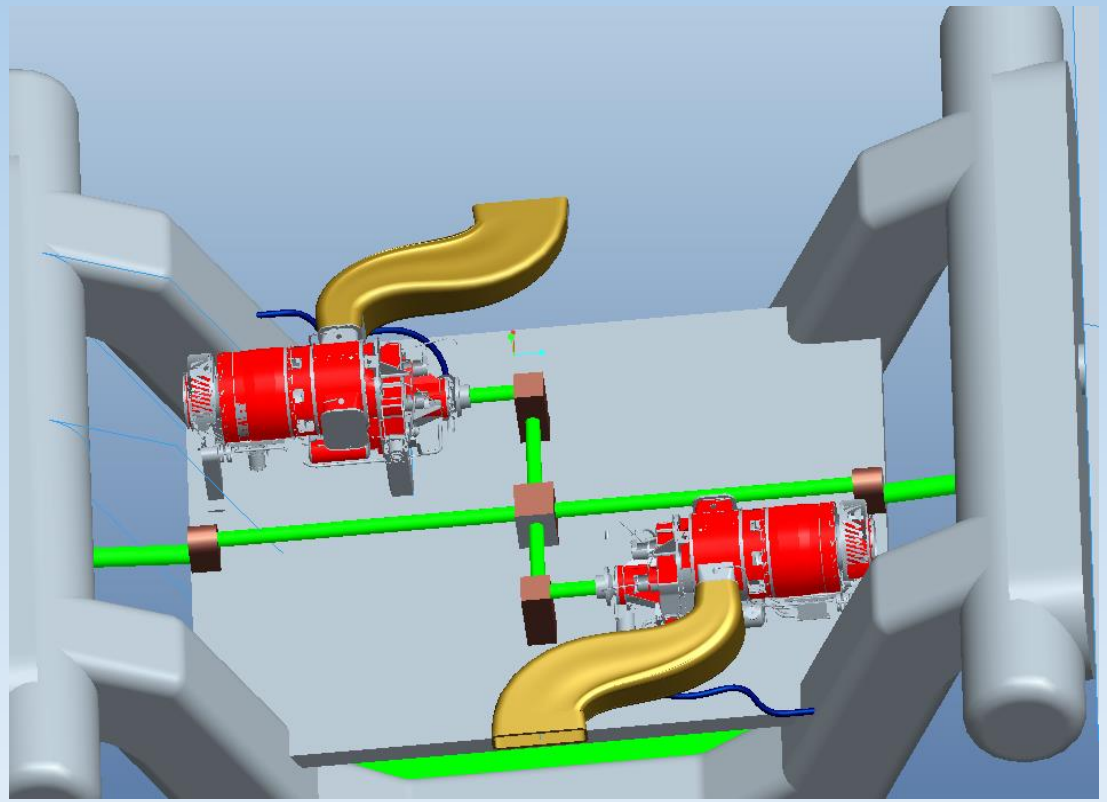
Design Overview



Details:

- Dual-rotors
- Variable hub angle for roll/yaw control
- Powered via two engines
- Maximum payload = 500lbs
- Maximum velocity 45 kts
- Fully autonomous utilizing GPS and predetermined waypoints
- Dimensions
  - 35ft L, 6ft H, 9ft W (with rotor hub angled for storage – 12ft with rotor hub horizontal)

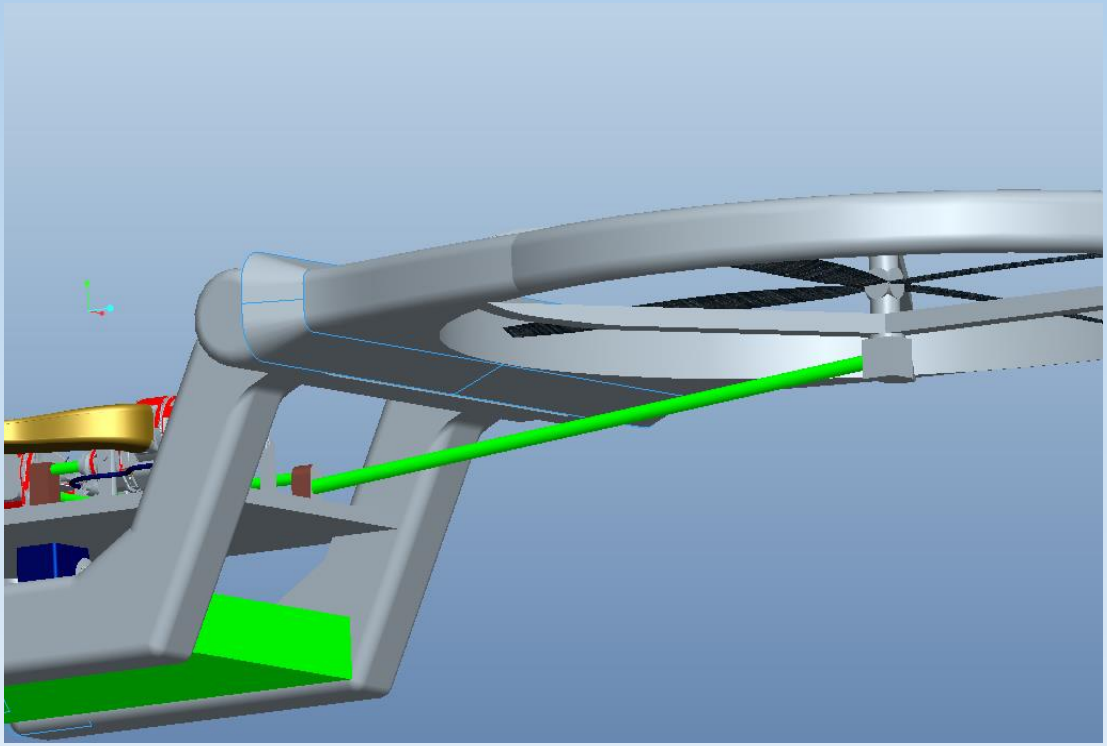
Engine and transmission



Details:

- 2x TS100 PBS rotorcraft engines
  - -56.7kg X 2
  - -287Nm
  - -180kW
  - -829 x 398 x 330mm (L xW x D)
  - -TS-1 Fuel 9according to GOST 10227 – 86)
- Split differential central gearbox to maintain equal rotor speed unless required otherwise
- Centrally exiting exhaust gases via exhaust fixings to prevent unwanted yaw in flight

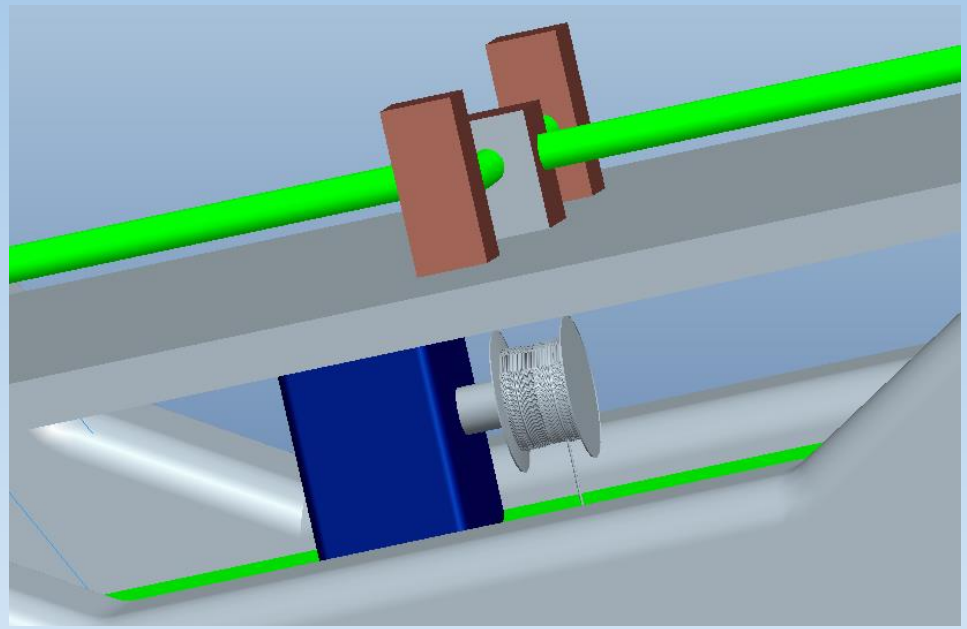
Transmission to rotor hub



Details:

Uni-axial Thompson coupling CV joint to allow twisting of rotor hubs whilst maintaining transmission from engines

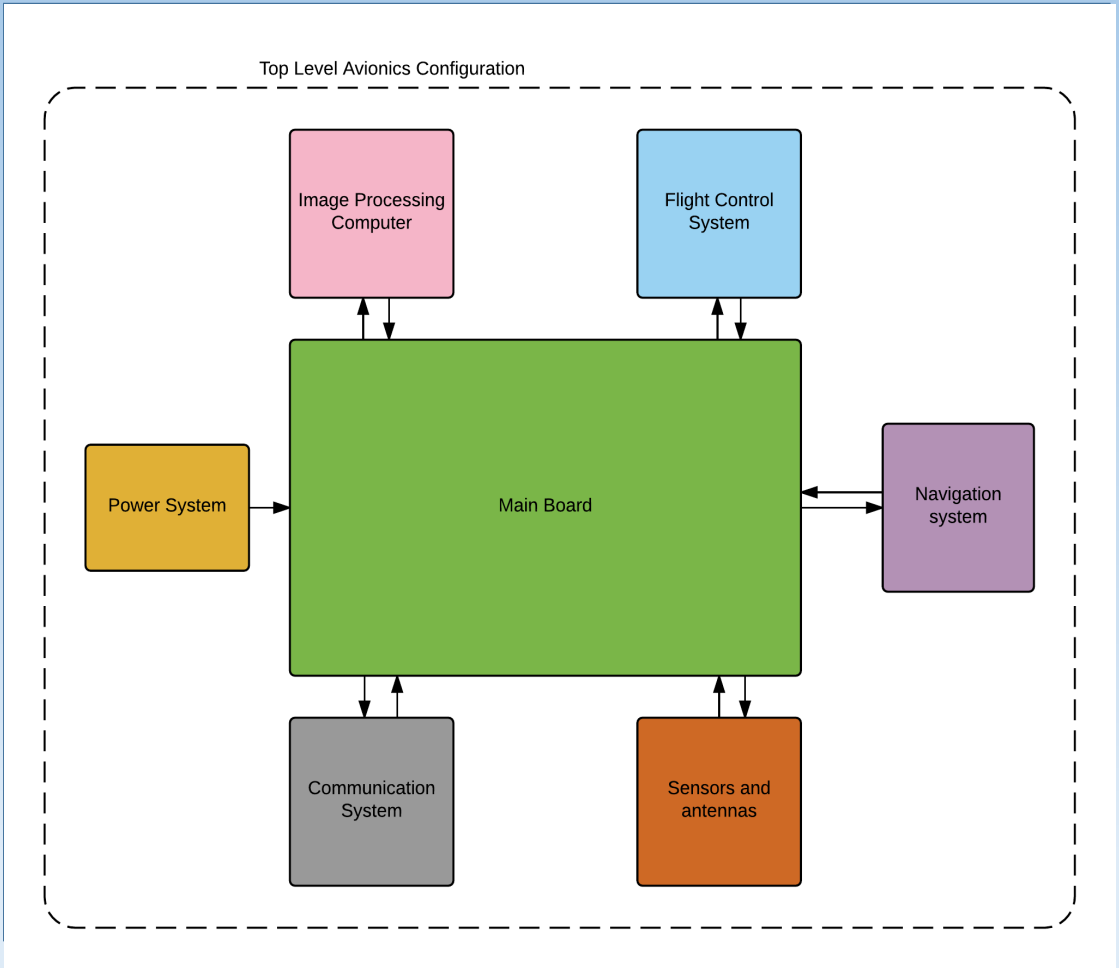
Winch design



Details:

- 27,782 N clamp utilizing 3-track grey disc encoder for control of payload descent rate
- 3mm 6X19+FC steel winch cable capable of withstanding up to 498Kg load
- Hydraulic clamping piston system
- Wireless electronic tension release clamp
- Nema34 hi speed 3Nm stepper motor for winch cable retraction

Avionics



Details: Choice of COTS products to meet the needs for autonomy with safety as an important factor in product decisions

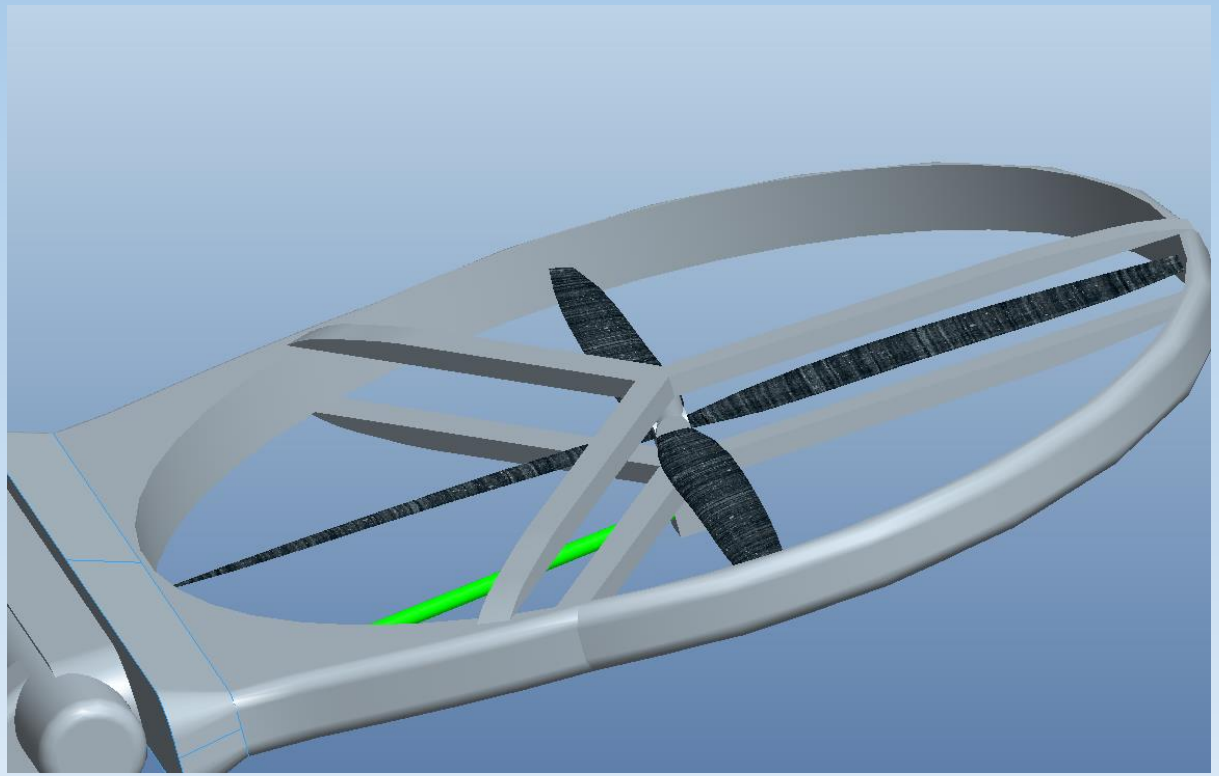
Main systems include:

- WePilot 300 Autopilot system
- Honeywell EGPWS
- PowerFLARM TCAS system
- A171 Rugged image processing PC
- CM100 Dual stabilized Gimbal Camera
- RG-442 Nickel Cadmium Battery

Estimated Cost of Avionics: $150,000

With the COTS avionics systems, the UAV will be able to navigate tough terrain with 3D databases, knowledge of nearby aircraft, the ability to see and recognise the drop off zone and back up navigation in the event a system fails.

Rotors and rotor hubs

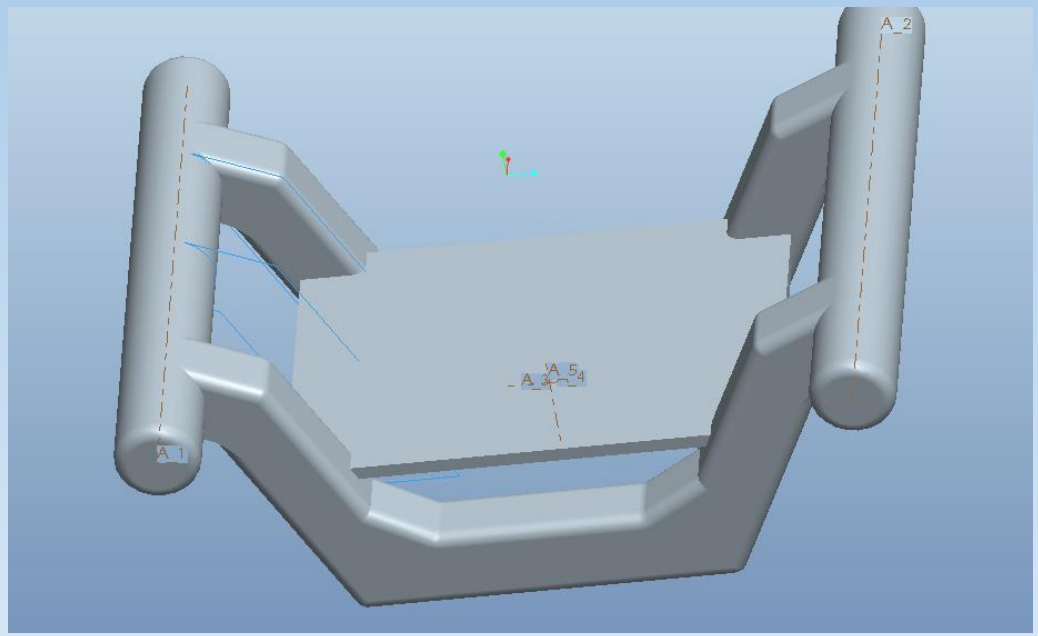


Details:

- 2X 4-blade rotors
  - -Sikorsky SC 1094 R8 airfoil
  - -Woven glass outer skin, +/- 45 ‘Green’ Nomex honeycomb core
  - -Swash plate collective control system
  - -6ft radius

- 2X rotating (lateral directional) rotor hubs
  - -Allow for yaw control
  - -Able to ‘twist’ up to 45 degree angle for transport inside C130 cargo
  - -low cost, strong and lightweight aluminium/carbon/manganese/nickel alloy altered with nanoscale intermetallic compounds (GIFT University material discovery)

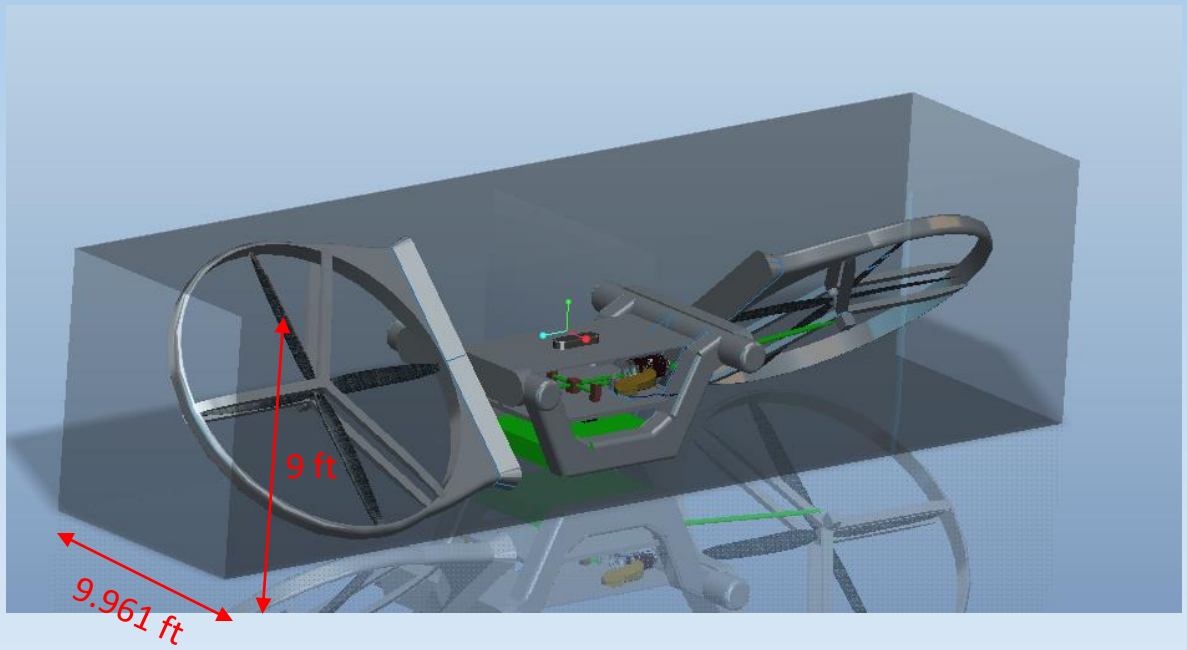
Fuselage



Details:

- low cost, strong and lightweight aluminium/carbon/manganese/nickel alloy altered with nanoscale intermetallic compounds (GIFT University material discovery)
- Hollow struts for reduced weight and fuel storage
- Simple, strong design
- Easily replaceable parts
- Few individual sections for assembly/maintenance

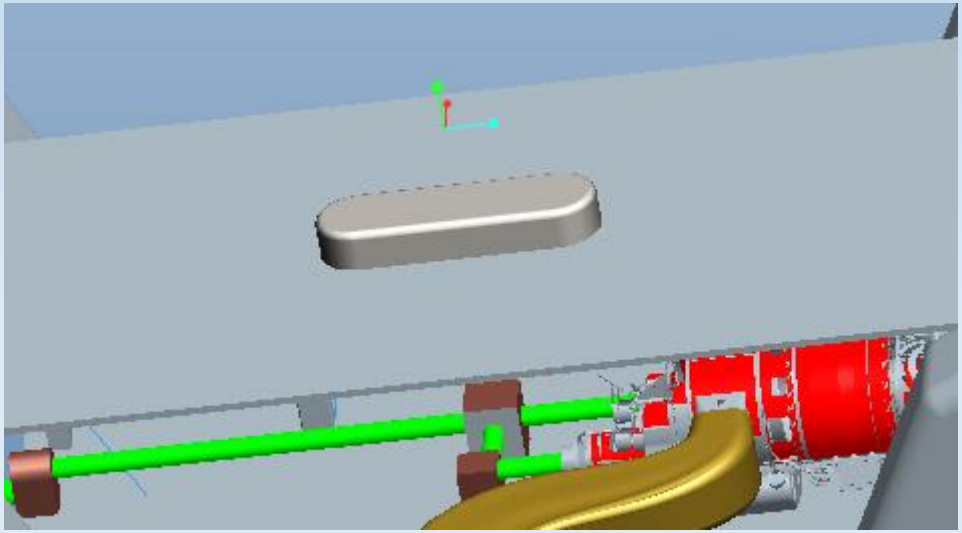
Transport



Details:

- Rotorcraft fits neatly inside C-130J cargo hold due to storage mode
  - Rotor hubs angled to 45 degrees
  - Rotors will only spin at low RPM until launch if deemed safe by pilot and crew

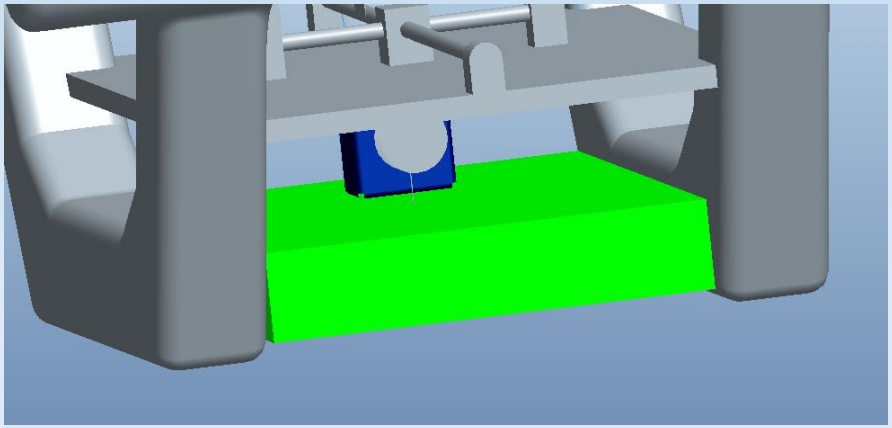
Parachute and parachute deployment



Details:

- 2x G-12E military grade parachute manufactured by Mills Manufacturing
- Payload capability from 500 to 2,200 lbs
- Rate of descend of 22.23 ft/s per parachute

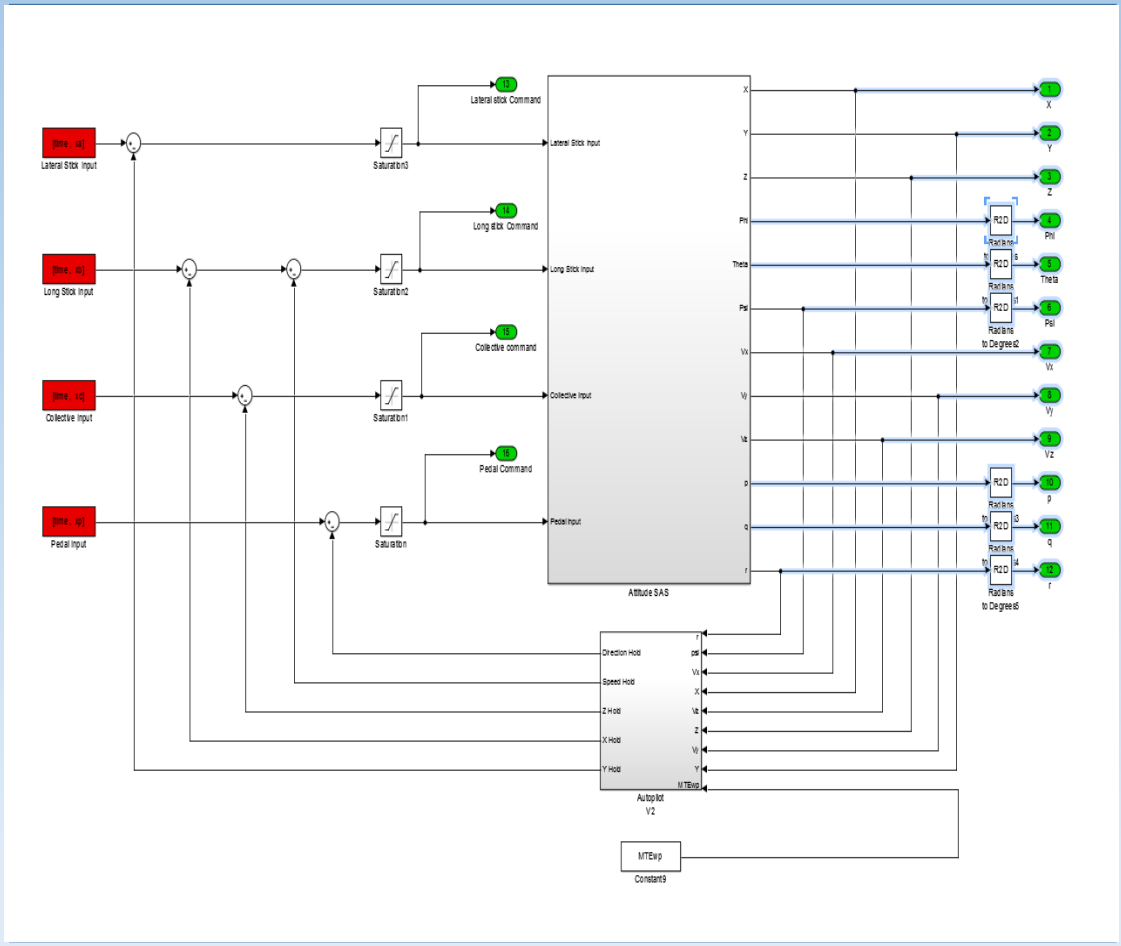
Payload configuration and storage



Details:

- Assumed to be 18 crates of bottled water weighing just over 500lbs
- Held securely inside rotorcraft fuselage until payload drop zone is reached
- Dimensions approximately 6 x 4 x 0.75 ft (L x W x H)

Control systems simulation



Details: Multi tier SAS aided control system designed in Simulink and interfaced with Flightlab model, with autopilot command through text file coordinate input.

Autopilot includes:

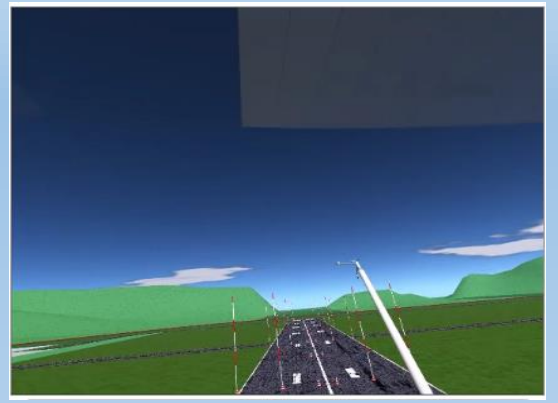
- Direction Hold (Heading Hold)
- X Coordinate Hold
- Y Coordinate Hold
- Height Hold
- Velocity Hold

Control system testing with the designed Flightlab model allowed for evaluation of design and its practicality.

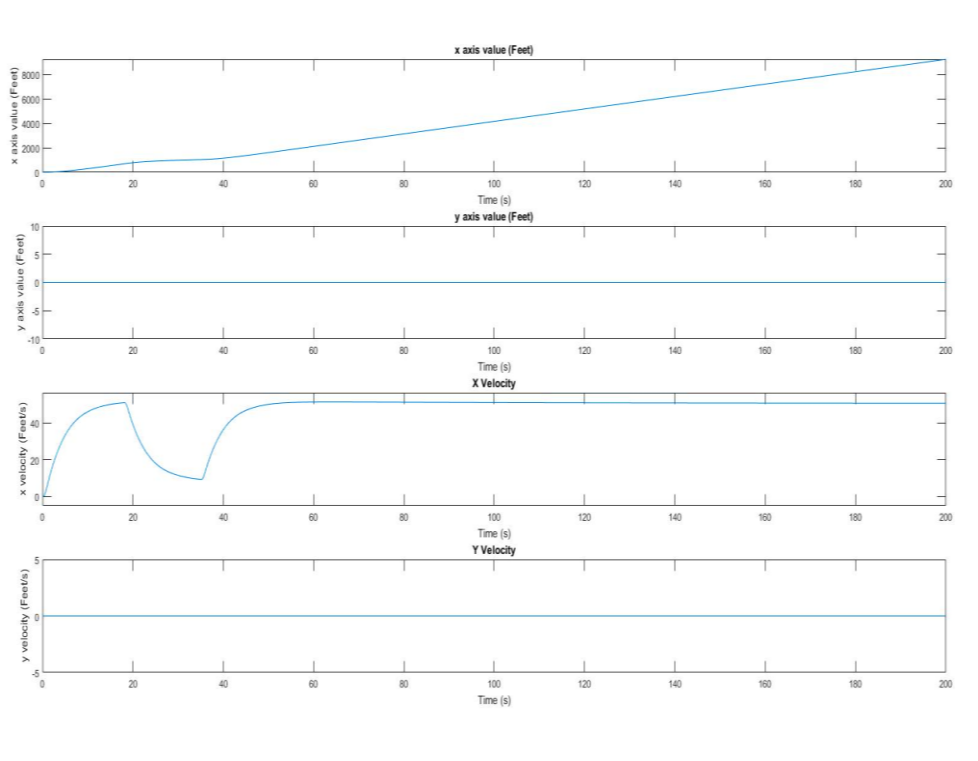
Multiple control system versions created for the 3 stages of flight; Full load, Underslung load and No load.

Control systems simulation

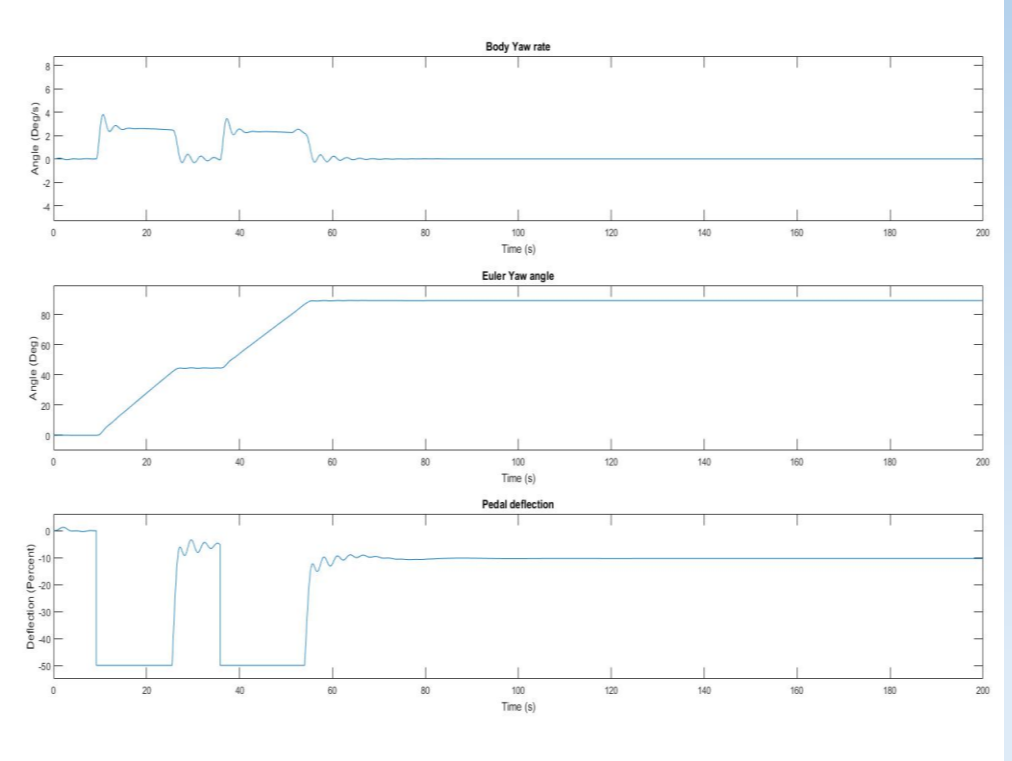
Testing of control system showed promising results for the designed model. Further testing with non linear model required to certify control system is suitable for the 3 model stages.



Flight simulator decel to dash test



Decel to Dash control system testing (showing coordinate and velocity response).



Approach to Hover control system testing (showing Directional response).