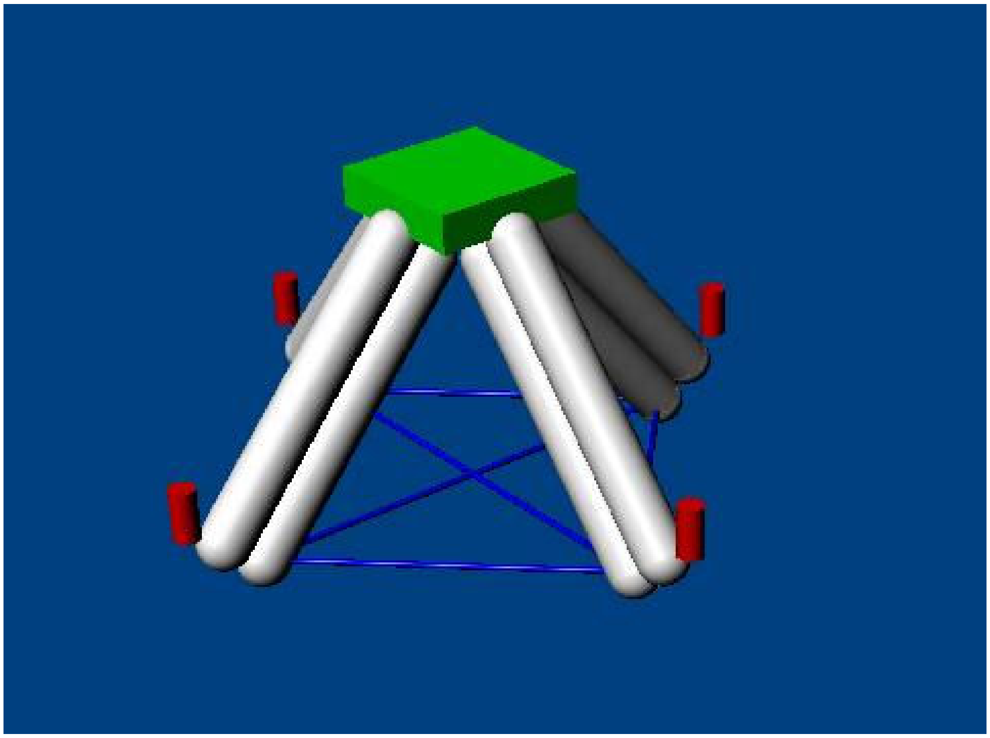
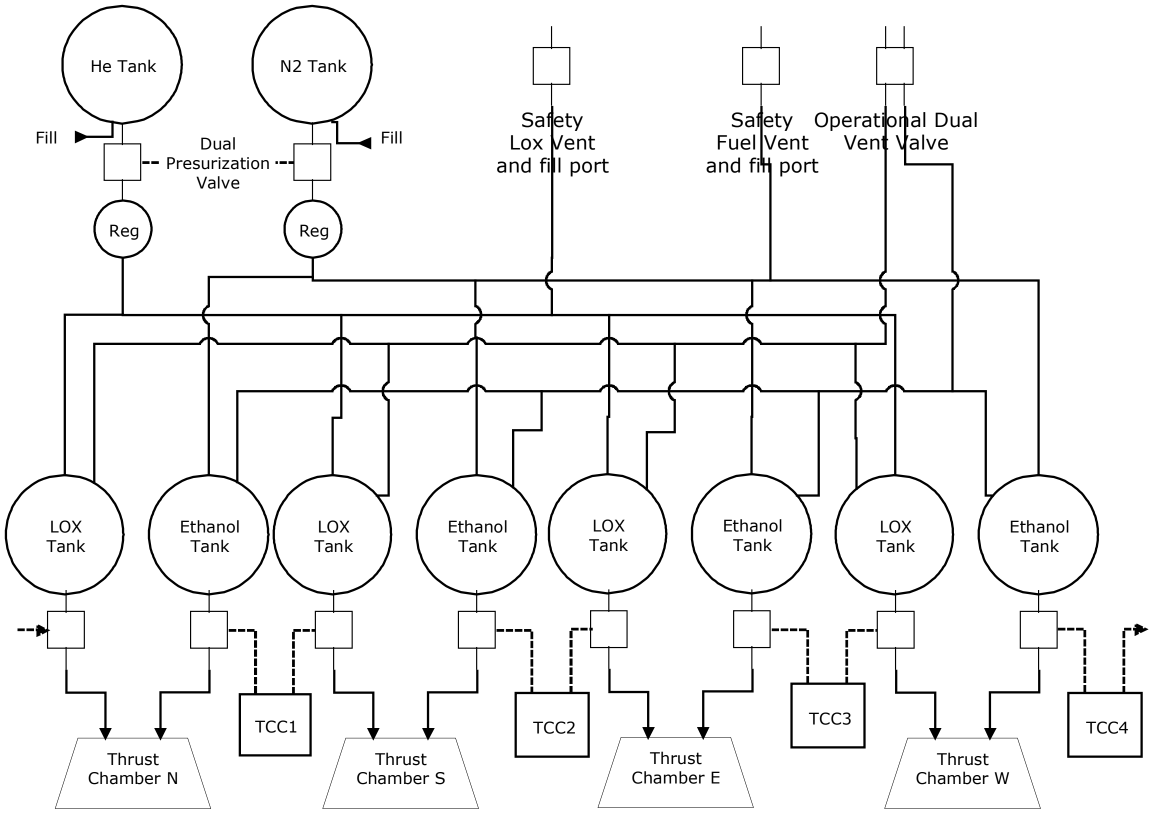


Proposed Vehicle and systems.

Empty weight ~ 300 Lbs
GLOW ~ 850 Lbs
Oxidizer LOX
Fuel 70% Ethanol 25% water.
Pressurization:
He for Lox
N2 for Fuel to 60% then blow down.

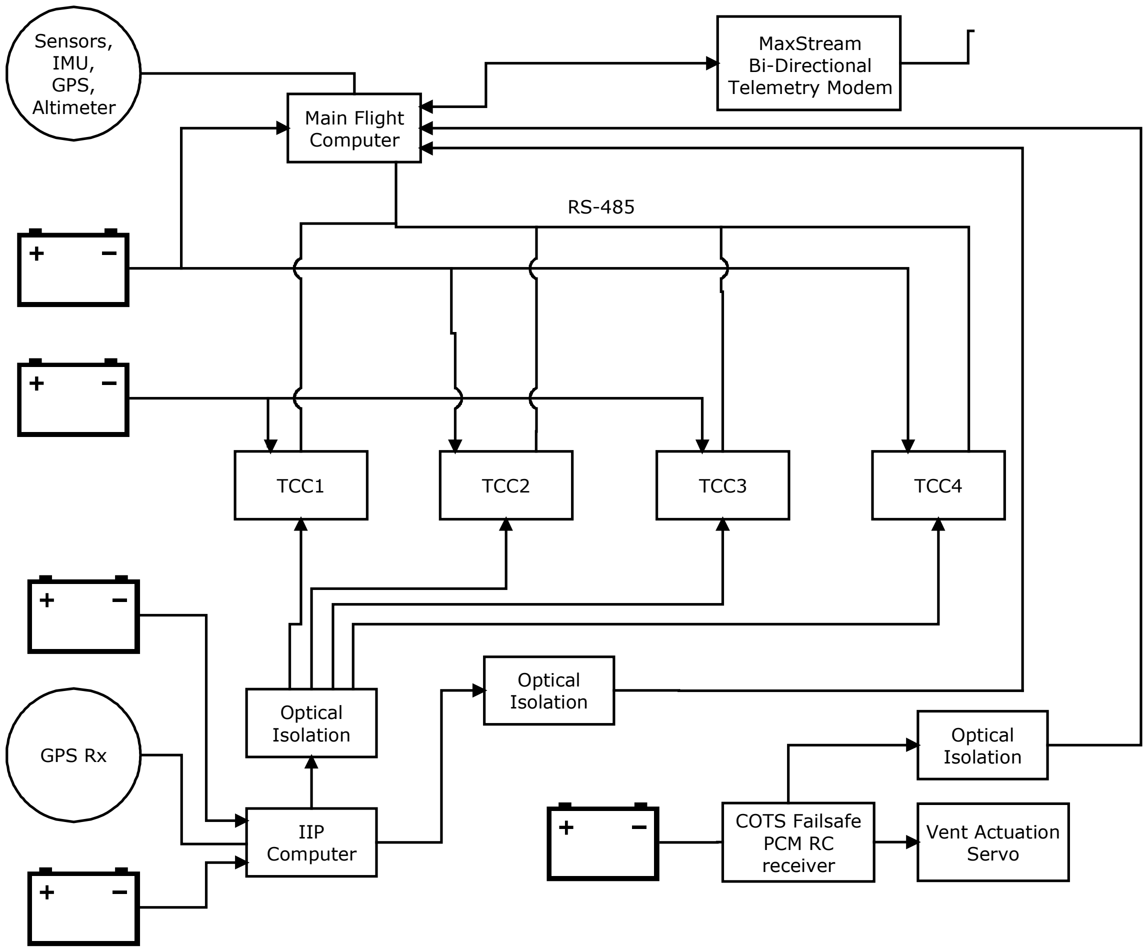
Thrust 4X 250 lb regen motors.
Tanks 8” 0.072” wall 6061 aluminum tubing.
For performance sake I may replace the fuel tank with composite Kevlar or Spectra tanks.
Payload 25Kg XPC Gold box.
This vehicle design depends on a favorable ruling on the XPC rules for AST required safety equipment. If this ruling turns out unfavorably then the vehicle will grow by ~40%



Plumbing basic concepts.
Please not that the TCC Thrust chamber computers are shown to illustrate shutdown redundancy and aren't really plumbing.

The safety systems for this vehicle are based on the concept of shutting it down on command. There would need to be triple failures to prevent the shutdown of all thrust chambers.

The thrust chambers can be shut down by closing the Ox, and or fuel valves.
They can also be shut down by opening the large safety vents.
The large safety vents are mounted at the peak of the pyramid, as far as possible from the thrust chambers to preserve actuation capability in the case of fire or thermal damage.



Please Note that TCC have alternating power sources.
All interfaces between safety systems and other components are one way and optically isolated.

The TCC and the IIP computer will be subject to the AST formal software qualification requirements. My intent is to not subject the main flight computer to these requirements.

The COTS off the shelf PCM RC receiver is identical to the RC equipment required by the AMA for their TurboJet waiver requirements. IF the signal is lost it will actuate the vent valves.

Thoughts on hazard analysis

On my blog I jokingly said:

"There are only two hazards, the vehicle can leaves its operational area, or parts of the vehicle can leave its operational area" While the comment was made in jest there is a grain of truth.

The vehicle was designed from the beginning to make understanding the failure modes simple. In flight there are really only two broad failures.

1. The vehicle can suffer some kind of structural failure.
2. One or more of the thrust chambers provide the incorrect thrust to keep the vehicle stable and within its operating area.

Both of these failures can have a large number of root causes, and we need to mitigate all of them.

Proposed development and testing plan(s)

GPS based IIP system.

- Formal definition of the system requirements.
- Test case development and verification with simulated GPS data.
- Flight test attached to an RC helicopter to verify real world operation.
- Limits will be set by manually carrying the box to the limit corners and commanding it to take a position. All components will be industrial temp rated and tested to the high temperature limits.

PCM RC Safety system:

- COTS off the shelf RC components.
- Valves and actuators for opening vents will be tested to 4X operating pressure.

Main Control system

- IMU, GPS , telemetry and command systems will be tested on a large RC helicopter. This will include flying the GPS IIP computer.
- All Flight expansion of the vehicle will be preceded by an identical autonomous(with RC safety pilot) flight of the helicopter.
- The only Difference between the Helicopter and XPC flight software will be the
- Inner most dynamics loop.

Full Vehicle

- The full vehicle will be tested at the FAR /MTA under the amateur rules and limits.
- If a burn time waiver is available then the full XPC flight profile can be done at FAR/MTA. If the burn time waiver is not available then the duration qualification flights will be done on a tether.
- On Time limited flights the GPS IIP computer will be supplemented with a timer system.
- If tethered flights are necessary the tether will be dual mode with both mechanical and electrical connections, If the electrical connection is lost then the system shutdown.

Number of Motors	4	
Per Motor Thrust	113.6364	250

Thrust	Kg	Lbs	number	Total Kg	Total Lbs
Payload	25	55	1	25	55
Tanks	5.212537	11.46758	8	41.70029	91.74064
Structure	22.72727	50	1	22.72727	50
Motors	3.787879	8.333333	4	15.15152	33.33333
Ignitors	1	2.2	4	4	8.8
Valves	1.2	2.64	8	9.6	21.12
Batteries	2	4.4	1	2	4.4
Avionics	2	4.4	1	2	4.4
Ptank	4.090909	9	2	8.181818	18
Regulator	4	8.8	1	4	8.8
Fuel	31.47108	69.23637	8	251.7686	553.891

			Thrust	Thrust t
Wt Full	386.1295	849.485	1000	1.1771
Wt empty	134.3609	295.594		
MR	2.873824	2.873824		
DV	1874.411	1874.411		
Hover Secs	191.0715	191.0715		

ISP	181	
Feed	250	
Fuel Density	0.8	gm/cc
TubeDia	8	
Tube length	50	
Thickness	0.072	
SphereThickness	0.125	
Tube Al Vol	90.47787	In^3
Tube Int volume	2423.611	in^3
Sphere Al volume	24.35552	in^3
Sphere Int Volume	243.727	in ^3

ISP table from Cpropep for refernence

Cp	Isp	Eff Isp	Feed
100	199	159.2	1
140	214	171.2	1
197	227	181.6	246
277	239	191.2	346
389	250	200	486
547	260	208	683

Total Al	114.8334	1881.782	cc
Al dnsity	2.77	5212.537	kg
Volume	2667.338	43709.83	cc
Tanks Fill ratio	0.9		
Fuel per tank	31471.08	gm	

Burst Calcs

Tank Yield	31000	psi
Tube burst	558	psi
Tube Safety Factor	2.232	
Sphere Burst	1937.5	psi
Sphere SF	7.75	

Total Volume All tanks	349.6787	l
PV to 60% full, blow down from there	34967.87	
Liters needed at 2200 psi	15.89448	
Number of CF wrapped cylinder	2	