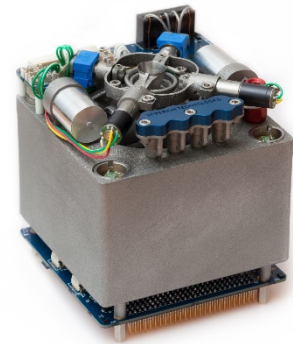


PM200 – High thrust propulsion for CubeSats

2017 Clean Space Industry Days



HYPERION TECHNOLOGIES

OCTOBER 26TH, 2017



Hyperion Technologies

- Delft (NL) based, founded in 2013
- Development of subsystems and components for small satellites
- Best-in-class performance
- Use of COTS components where available and possible
- Beside propulsion currently available:
 - Star Trackers, Reaction Wheels, Magnetorquers, integrated ADCS units, Sun Sensors, Imagers, Payload processors, OBC, GNSS module, Data acquisition units, ...



Propulsion Development

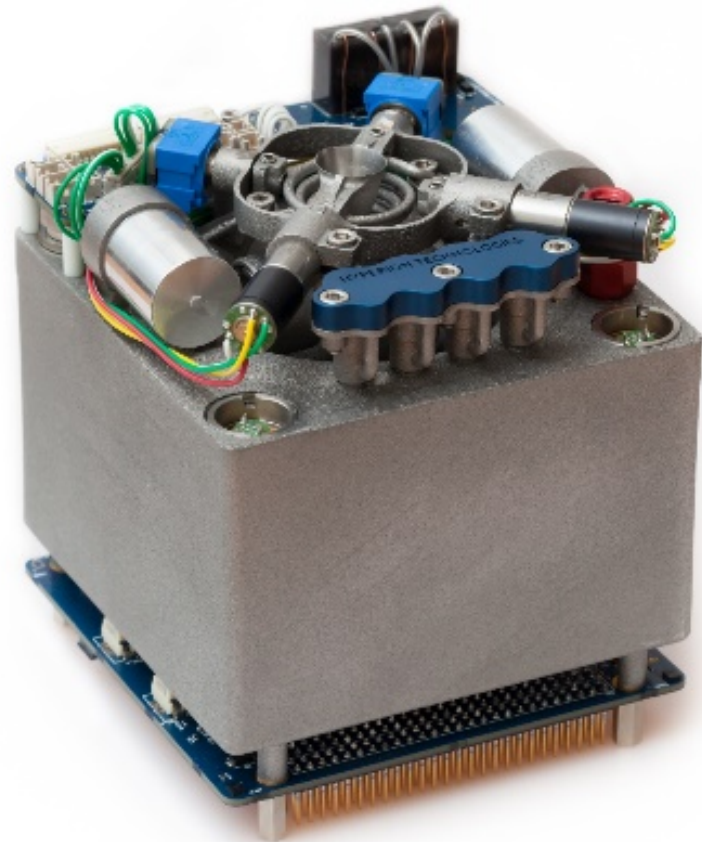
Needs for small satellite / CubeSat missions:

- Low barrier to entry (=> low cost!)
- Quick manoeuvres 0.5 N thrust
 - Immediate feedback
 - Responsive avoidance manoeuvres
 - Low impact on payload utilization
 - “Time is money”
- High delta V 230 m/s (3U sat)
- Low power < 6 W



PM200 Propulsion Module

- 90% 3D printed
- Intended for 3 -12U satellites
- 1U total volume
- 0.5 N Bipropellant thruster
- 315 g propellant storage
- Spark ignition
- Regenerative cooling



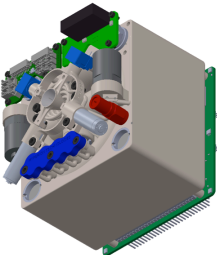
N₂O / Propene propellants

- Bi-propellant combustion
- High Isp: > 285 s (=> 1.5x Hydrazine monoprop.)
- Self pressurizing (=> low complexity system)
- Abundant and inexpensive
- Absolutely non-toxic
- No storage life limitations
- Simple and safe operations (=> low barrier to entry)
- Double as cold gas propellants for lower impulse bits

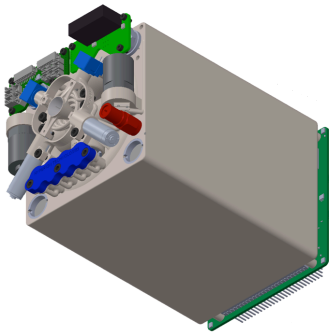


Scalability

- Scaling components are additively manufactured
- Up to 8U-size modules manufacturable in monolithic structure
- Increased effective storage density with scaled up systems



1U propulsion on 3U satellite: 230 m/s



2U propulsion on 6U satellite: 300 m/s



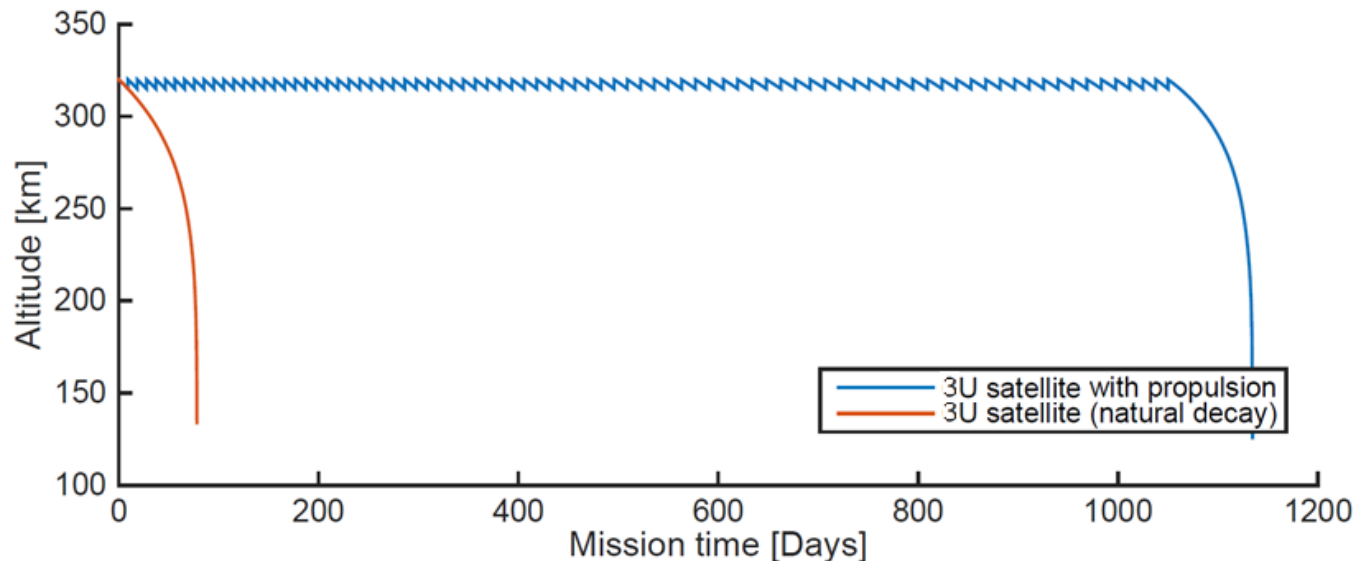
Orbit Control System

- Flight proven heritage components
- Orbit determination and maneuver controller built in
- Direct maneuver feedback
- Closed loop TVC heading-hold during firing



Performance Example

- Orbit transfers:
 - from 400 km circular to 830km circular*
- Lifetime extension*:



Mission life is extended by a factor of 13x, COSPAR atmospheric model, Launch in 2017
*4kg satellite with 1U PM200 propulsion module included



Space Debris Mitigation

1. No new debris:
 - End-of-life deorbit manoeuvre
 - Particle free exhaust
 - Enabler for long lifetime mission at very low altitudes
2. Debris avoidance:
 - Responsive manoeuvre capability
3. Debris removal
 - Enabler for active debris removal / inspection mission on small satellites

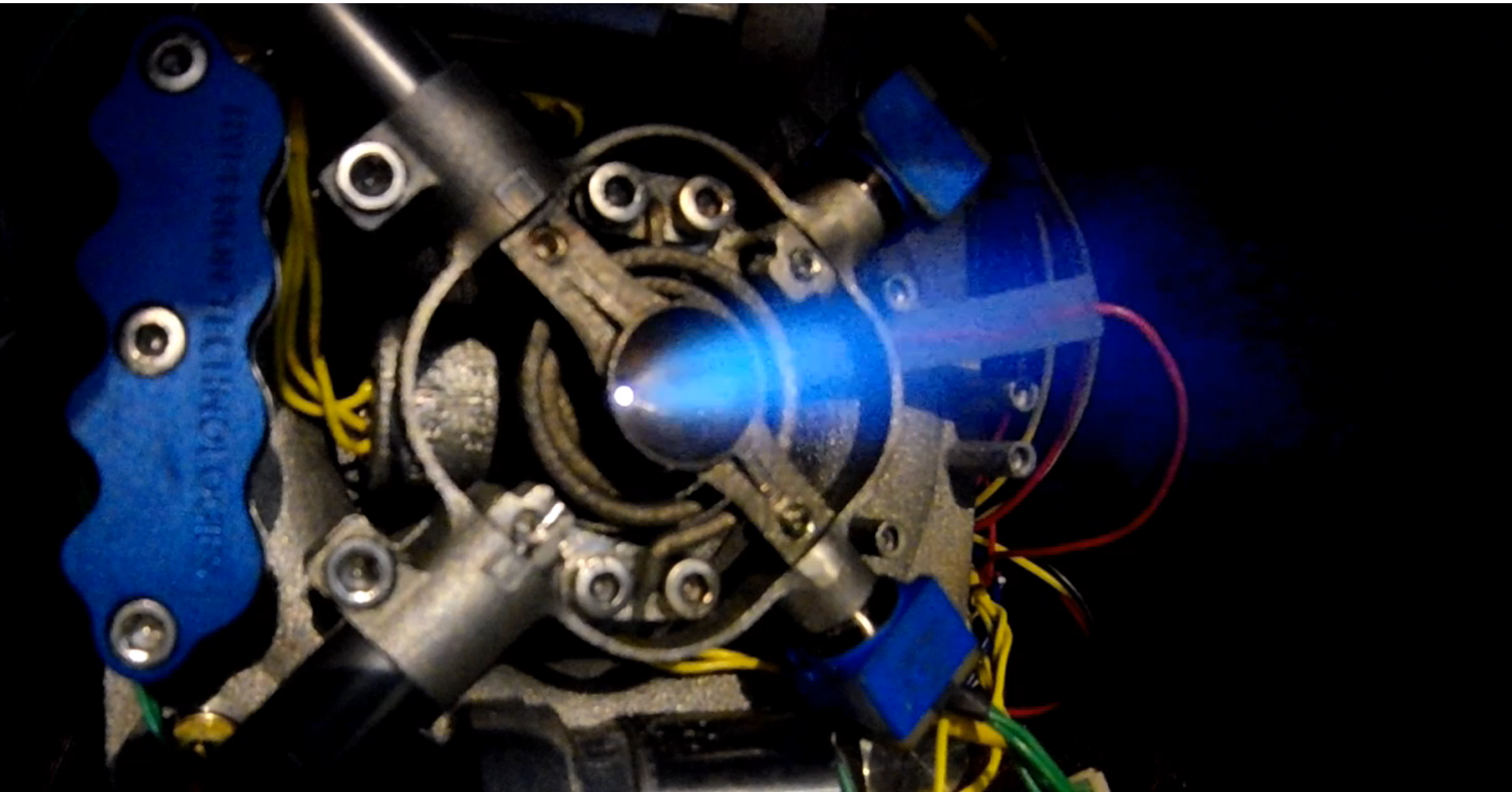


Project Status

- Fully internally funded
- Hardware functionality demonstrated
- Full environmental qualification imminent
- Basic software functionality
 - Constant updates in development
- Seeking partnership for in-orbit validation



Static firing

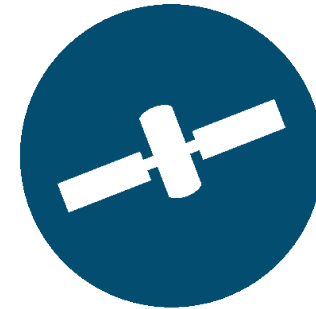
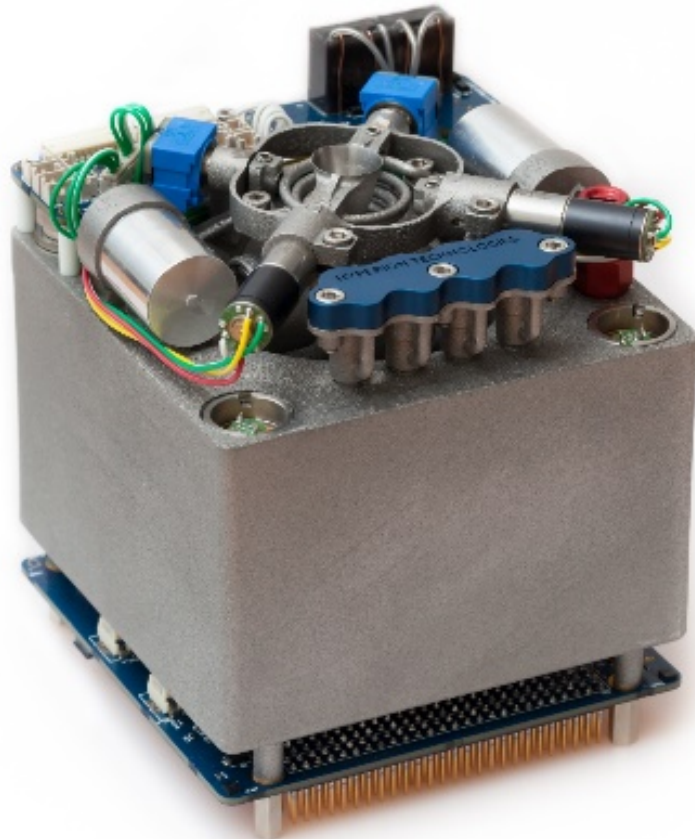


Oct 26th 2017

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PM200 - High Thrust Propulsion for CubeSats



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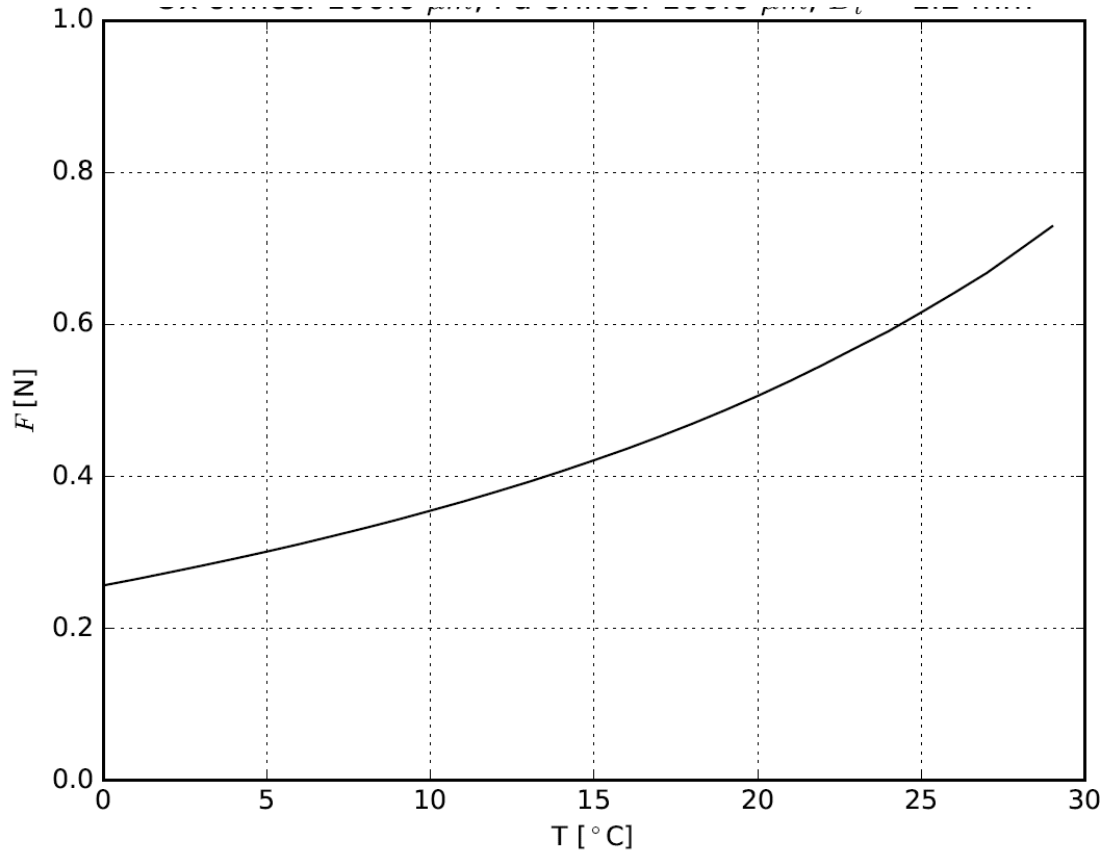
Other Mission applications

- Orbit transfers
 - from 400 km circular to 830km circular*
- Extend mission life at low altitude by a factor of 10-15*
- On demand low ΔV , high thrust for Geostationary platforms (de-tumble maneuvers etc)
- Rapid deployment of constellation, including plane changes
- Constellation maintenance
- End-of-life maneuvers

*For a 4kg satellite (propulsion included)



Thrust rating:



Thrust varies with module temperature due to self-pressurizing nature of propellants. See slide 'Results – temperature variation



Results – Temperature variation

