TITAN DRAGONFLY

Add-on for Orbiter2016

Installation

Extract all files to the root of your Orbiter2016 program directory, preserving the directory structure. This should NOT overwrite anything in the standard Orbiter package.

Requirements

Launch scenarios require:
Falcon9 for Orbiter2016
https://www.orbiter-forum.com/resources/falcon9-for-orbiter2016.291/

FalconHeavy for Orbiter2016
https://www.orbiter-forum.com/resources/falconheavy-for-orbiter2016.3287/

Recommended

Titan Atmosphere
https://www.orbiter-forum.com/resources/titan-atmosphere-v1-0-0.2592/
Note: Not compatible with Orbiter2016 “Surface Elevation” at negative altitudes.
Disable Orbiter2016 “Surface Elevation” and follow installation instructions for Titan.cfg

What's In This Add-On?

The Titan Dragonfly rotorcraft lander and its EDL Capsule/Cruise Stage.
Features automatic EDL sequence, parachute deployment, etc.
Launch scenarios for Falcon9+Star48BV or FalconHeavy, post-launch scenarios.
TransX MFD planning included.

Mission

The NASA mission to send a rotorcraft lander to explore Titan.
Launch is now scheduled for 2028, arriving at Titan 2034.
More info.....
https://en.wikipedia.org/wiki/Dragonfly_(Titan_space_probe)

https://dragonfly.jhuapl.edu/

https://www.researchgate.net/publication/373256268_Dragonfly_Phase_B_Mission_Design

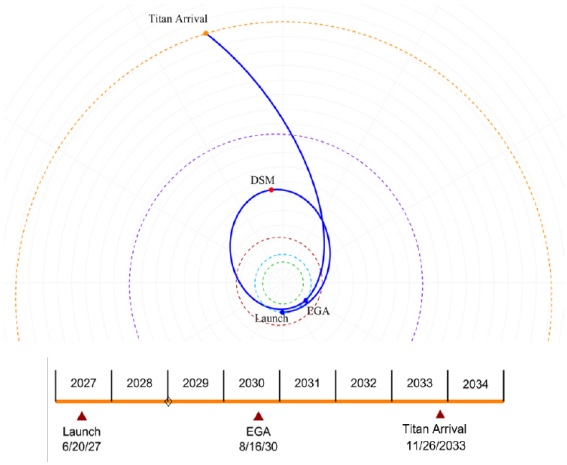
Titan Atmosphere

Using the “Titan Atmosphere” module add-on will give a close-to-nominal EDL profile, but it is not compatible with Orbiter2016 “Surface Elevation” - if you land much below “sea level” (planet mean radius) you will not be able to take-off again!
Disable Orbiter2016 “Surface Elevation” - you're not missing much on Orbiter Titan.
Using the default Orbiter atmosphere for Titan will give a more brutal decelaration for EDL.

Launch Notes

An interesting and challenging mission to fly in Orbiter!

The trajectory requires a DSM ~ 650m/s near Aphelion of the first orbit, leading to an Earth Gravity Assist to put the spacecraft on course for Titan.



Launch scenarios use the 2027 launch date, although launch has now slipped to 2028.

Launching on the Falcon9+Star48BV kick-motor is challenging since the Star48BV is a payload of the Falcon9 and must be jettisoned and ignited manually for the final burn. The Star48BV is a solid-fuel motor and will burn to depletion, giving a dV of 2180m/s .

TransX calculates burn-times and start-times differently for the Falcon9 and Star48BV. I find the best way is to set up TransX in the Star48BV(use “Inherit Plan” from Falcon9) and use Orbiter “Remote Vessel Control” for the Falcon9 main engine burn. Remember to cut Falcon9 burn when there is 2180m/s remaining, jettison Star48BV, ignite motor.

Launching on FalconHeavy is less complex!

Launch autopilots are set for 90° azimuth, 200km parking orbit.
Lift-off set for 17:40:00 on 21 June 2027.

EDL Capsule Data and Controls

[P] Start/Stop Automatic EDL sequence.
[J] Manual jettison Cruise Stage/Heatshield/Lander (sequential)
[K] Manual deploy Drogue/Main Parachute (sequential)

Cruise Stage	320kg
Cruise Stage Fuel	400kg
Backshell	210kg
Heatshield	220kg
Lander	450kg

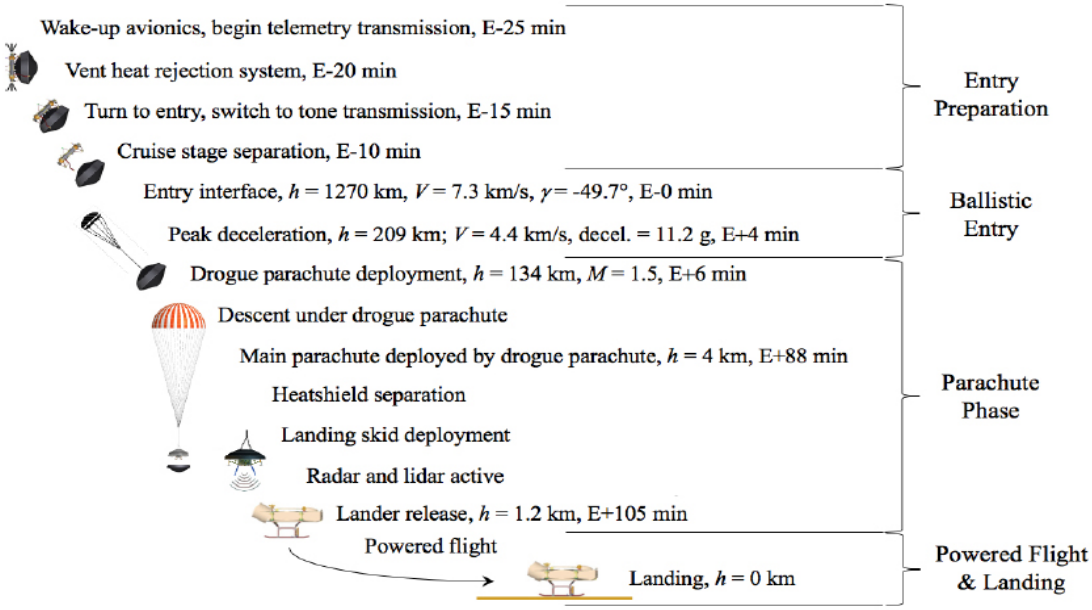
Cruise Stage RCS	20N (each) (ROT unbalanced, LIN forward/back only)
Cruise Stage Main Engine	40N (2x RCS)
Cruise Stage ISP	3000Ns/kg

IMFD “Base Approach” Parameters for Titan

Alt	1270km	(Entry Interface Altitude)
ReA	50°	(Flight Path Angle)
Ant	30°	(Anterior Angle)

Automatic EDL Sequence

7000km	Go to EDL attitude (Prograde, spin up to 2rpm)
5500km	Jettison Cruise Stage
Mach 1.5	Deploy Drogue Chute (~134km)
4.00km	Deploy Main Chute
3.80km	Jettison Heatshield
3.50km	Deploy Lander Skis
1.30km	Lower Lander
1.25km	Start Lander Rotors
1.20km	Jettison Lander (Auto Landing Sequence enabled)



Lander Data and Controls

The Titan Dragonfly lander is an eight engine rororcraft.
This is a basic “operational” simulation using a single, vectored, thruster for thrust and a 1kg propellant load simulating battery charge.
Battery charge is continuously replenished, taking aproximately 10 days to fully charge.
The lander has a range of ~30km with 50% battery charge safety margin, and a ceiling of ~12km.

[G]	Deploy Landing Skis
[M]	Deploy/Stow HGA Antenna (auto earth tracking)
[N]	Start/Stop Auto Landing Program
[V]	Auto Hover – maintain altitude and cancel horizontal velocity
[B]	Maintain Altitude - adjusts throttle to maintain altitude

Lander	449kg
Propellant	1kg (represents battery charge)

BrianJ
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