Gravitational Perturbation Measurements in Martian Orbit

Rahul Ravikumar [1], Abhay Egoor [2], Krishna Teja Penamakuru [3]
Sanjay Srikanth Nekkanti [4], Vishal Latha Balakumar [5]

1,2,3,4,5 Dhruva Space Private Limited

Overview: The P30 platform is a 300 x 300 x 300 mm structure which has a modular internal configuration that was tested successfully and allows for between 9U and 12U volume within an optimized, modular structure. The proposed design will include multiple 2U CubeSats deployed from the P30 to conduct gravitational field measurements in Low Martian Orbit and perturbations due to Phobos and Deimos (Martian moons). The CubeSats shall be deployed in the same orbital planes at different true anomaly and obtain the change in distance and acceleration between CubeSats to calculate the higher order harmonics of the gravitational field.

Payload: The capability to provide a customizable internal configuration for the Payload and additional space than generally available on a similar CubeSat platform is unique to the P30 structure and can be utilized for a wide range of applications. The P30 platform can accommodate upto 3 CubeSats of the 2U form factor that can be deposited into circular orbits around the Martian moons with 2 Cubesats in an orbital plane and third CubeSat with P30 in another plane. The spacecraft can perform a thorough differential modelling of the gravitational perturbation due to the moons.

The P30 'parent' spacecraft will allow for distributed correlation of the data that is then transmitted from the 'children' satellites for downlinking using a Disruption Tolerant Network (DTN). This system of satellites can assist the guidance and navigation of future orbiters and landers and provide a better profile of the gravitational environment.

Mission Design: The platform will be designed to have a nominal mission lifetime of 3 years. The structure will include 3-axis attitude stabilization using magnetorquer coils. The inter-satellite link using the DTN system will be developed to enable autonomous data transmission between the 'children' and 'parent' spacecraft, to be downlinked to the ground station with minimal latency.

Furthermore, the 2U CubeSats will be developed based on the necessary application and integrated within the P30 platform. The P30 structure will be updated to include a deployment system for orbit insertion of the 2U CubeSats. Further research will be conducted into control of the internal thermal environment and communication capabilities with respect to interplanetary missions.