Payload Isolation for Microgravity Research on sRLVs

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Abstract
The Vibration Isolation Platform (VIP) from Controlled Dynamics Inc. provides a sustained microgravity environment to sensitive payloads flying on suborbital Reusable Launch Vehicles (sRLVs).

Approach
During launch, re-entry, and landing, the research payload is mechanically secured to the vehicle. During parabolic coast, the research payload is automatically released on a 6-DOF free-floating platform. The payload is caged to follow the low-frequency inertial motion of the host vehicle, but otherwise left undisturbed to float freely in the sway space of the VIP. A "µg OK" discrete signal is provided to the payload when the acceleration environment is acceptable for conducting microgravity research.

Key Features
The VIP uses a combination of non-contact isolation and active stabilization to minimize the acceleration environment for microgravity research on sRLVs.

Active stabilization attenuates payload-induced disturbances as well as any disturbances translated through a payload umbilical. The active stabilization system itself is self-contained on the platform, requiring no umbilical and no mechanical contact between vehicle and platform.

Completely autonomous, the VIP automatically releases, stabilizes, and recaptures the free-floating platform during the appropriate phases of flight. A turntable is included for axial spin cancellation on spinning tube rockets or crewed sRLVs that may maneuver during coast. The turntable cancels up to 75º/sec inertial rates of the host vehicle.

Applicable to any research payload, the VIP is tightly packaged in the mounting structure, leaving the majority of the vehicle's payload volume and mass allocation for the research experiment.

Applicable to any sRLV, crewed or not, the VIP provides component-level isolation of the research payload itself without imposing any unusual constraints on the host vehicle.

The VIP technology demonstration prototype is sized to fit within a fraction of the payload allocation on any available sRLV platform. The isolation characteristics are tuned for each vehicle to provide the best possible isolation within the flight constraints of that vehicle and flight profile.

Performance
The VIP system is tuned and the isolation performance is predicted using measured flight data from the vehicles during parabolic coast.

Performance predictions based upon measured data from UP Aerospace SpaceLoft® flights will be presented.

Using the measured flight environment in the Destiny lab on the International Space Station, the VIP is shown to attenuate the 4.3mg-rms ambient environment down to <8µg-rms on the isolated platform.

Timeline
The VIP technology demonstration prototype will finish TRL-6 ground testing in August 2013. It will be available for sRLV flight opportunities immediately thereafter.

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