TIDDBIT HYPERSONICS



3D modeling of hypersonic wakes



Traveling ionospheric disturbances (TID) occur when tremendous energy is deposited into the atmosphere, creating gravity waves that propagate into the ionosphere and become mechanical and electromagnetic signatures of the energy source. Hypersonic objects traveling at altitudes around 40 km can produce TIDs at altitudes around 40 km can produce TIDs at altitudes upwards of 150 km. Accurate, real-time analysis of these TID signatures would enable defense agencies to detect hypersonic movers, deduce their properties, and ultimately address both established and emerging challenges in national defense.

INTRODUCING TIDDBIT

Orion Space Solutions (Orion) has developed a unique Doppler radar system called TID Detector Built in Texas, or TIDDBIT, that is designed to observe and measure the propagation properties of TIDs. TIDDBIT can capture data of gravity waves propagating from rapidly moving point sources such as hypersonic objects. In near real-time, models using TIDDBIT data can reconstruct the iso-ionic contours in the ionosphere — displaying the wavelength, amplitude, speed and period of hypersonic movers' TID signatures as they form — to show the wave structure as a function of time. Analysis of ionospheric signatures could be used to locate hypersonic vehicles, similar to how a water wake can be observed and traced to the boat originating the disturbance.

WHAT'S NEXT: TRIDENT

Orion is developing a next-generation sensor called the TRaveling-Ionospheric Disturbance Evaluation Tri-wave (TRIDENT). Built on TIDDBIT technology, Trident will be an operational system that delivers three types of data:

- Characterize TIDs with
 unprecedented accuracy to
 include wave period, phase speed,
 horizontal and vertical wavelengths
 and propagation direction
- Characterize the vertical structure of the ionosphere, much like an ionosonde
- Observe mid-latitude spread-F
 caused by ionospheric irregularities

Capabilities like TRIDENT that are developed from TIDDBIT will improve the accuracy of forecasting over-the-horizonradar performance and ionospheric impacts on systems such as satellites and high-frequency communication systems. And with the ability to detect and characterize hypersonic vehicles from their ionospheric waves, Orion's novel instrumentation and modeling solution will be the keystone for future early warning systems supporting national defense readiness.



TID PROPERTIES

TIDDBIT measures all properties of TIDs such as horizontal wavelength, azimuth, period and horizontal phase speed. The entire wave field can be reconstructed in 4D for more detailed exploitation.



TIDDBIT

CONOPS of the TIDDBIT system detecting objects moving at hypersonic speeds.





HYPERSONIC TID

Reconstruction of the iso-ionic contours in the ionosphere showing the wave structure of the TID from a hypersonic rocket launch off Wallops Island, Virginia.