Mitigation of Ionospheric Anomaly Threat to Enable LAAS Airport Surface Movement
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Introduction
This study shows design and requirements alternatives to mitigate ionospheric anomaly threat in order to enable Local Area Augmentation System (LAAS) airport surface movement in terms of integrity and availability.

Surface Movement Simulation
- Generate all in view, all 1-SV out, all 2-SV out, etc., down to all 4-SV subset geometries
- 1 day + 5-minute updates
- 24-SV constellation (all 5V’s healthy)
- Memphis International Airport

Real-Time \( \sigma_{\text{air}} \) Inflation Simulation for Precision Approach
- CONUS CAT-I
- Ionospheric Anomaly Threat Model
- For Subset Geometry of 1-SV-Out

Data and Methods
The computed largest HPE and corresponding HPL are calculated for each subset geometry by applying worst-case GPS range errors from the ionosphere anomaly threat model for the Conterminous U.S. (CONUS). HPL is inflated by the standard deviation of vertical ionosphere gradient (\( \sigma_{\text{hor}} \)) and by \( \sigma_{\text{air}} \) from 1 to 4 \( \sigma_{\text{hor}} \). To protect integrity, airborne geometry screening is made by limiting screening HAL (Horizontal Alert Limit) and max. \( |S| \). Availability is obtained with drill-down-to 1-SV-out geometries.

Results
LG geometry screening of real-time \( \sigma_{\text{air}} \) inflation and airborne geometry screening of \( 2 \sigma_{\text{hor}} \) or more inflation allows airport surface movement enabled with sufficient availability and current integrity requirements. For other combination of \( \sigma_{\text{hor}} \), airborne geometry screening by limiting screening HAL and max. \( |S| \) is needed to get integrity.

Conclusions
If airport surface movement is defined as a separate operation, it is supported by the existing LGF geometry screening that mitigates ionosphere-anomaly threat for CAT I precision approach and by airborne geometry screening by inflating \( \sigma_{\text{hor}} \) by factor of 2 or more that mitigates multipath threats from the ground, airframe, other aircrafts, or buildings with sufficient availability and current integrity requirements under the ionospheric anomaly observed in CONUS.

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Bibliography