37 -- 2017-03-04 05:01:37
Session 2A Paper 4
Fridman, Sergey V.: NorthWest Research Associates
Nickisch, L.J.: NorthWest Research Associates
Hausman, Mark: NorthWest Research Associates

Assimilation of HF Measurements of Unknown Sources for Improved HF Geolocation in the Presence of Traveling Ionospheric Disturbances

We describe development of new HF data assimilation capabilities for our ionospheric inversion algorithm called GPSII (GPS Ionospheric Inversion). Previously existing capabilities of this algorithm (Fridman et al., 2015) included assimilation tools for data related to HF propagation channels. Measurements of propagation delay, angle-of-arrival (AoA), and the ionosphere-induced Doppler from any number of known HF propagation links can be assimilated by the model. The HF links may be established by channel probes (one way links) as well as by over-the-horizon radars (two way links). End points of such propagation links were assumed to be known.

Presently we are extending the assimilative model to accommodate data from one-way and/or two-way propagation links associated with sources or radar targets with unknown locations and velocities. Time series of data from such unknown reference points (URP) has the potential to improve performance of the model in the presence traveling ionospheric disturbances. URP data from radar targets typically contain time series of AoA, propagation delay, and Doppler measurements. URP data from unknown HF transmitters are typically represented by time series of AoA measurements. In order to utilize the URP data we extended GPSII algorithm with the capability to perform Kalman filter estimation of geographical coordinates and velocity vectors of unknown targets. Thus, the algorithm simultaneously estimates the state of the ionosphere and the coordinates of URPs.

We demonstrate operation of the new algorithm using time series of transponder returns collected by an over the horizon radar. The transponders are treated as unknown targets, so that GPSII geolocation of the targets can be compared to the truth. We observe that assimilation of URP data helps to substantially mitigate adverse effects of traveling ionospheric disturbances on estimation of target position and velocity.

References

Fridman, Sergey V., L. J. Nickisch, Mark Hausman, George Zunich (2015), “Assimilative model for ionospheric dynamics employing delay, Doppler, and direction of arrival measurements from multiple HF channels”, Radio Sci., 51, doi:10.1002/2015RS005890.