



## **An improved method for Multipath Hemispherical Map (MHM) based on Trend Surface Analysis**

Zhiren Wang (1,2), Wen Chen (1,2), Danan Dong (1,2), Chao Yu (1,2)

(1) Engineering Center of SHMEC for Space Information and GNSS, East China Normal University, Shanghai, China (wangwangzhiren@163.com), (2) Shanghai Key Laboratory of Multidimensional Information Processing, East China Normal University, Shanghai, China

Among various approaches developed for detecting the multipath effect in high-accuracy GNSS positioning, Only MHM (Multipath Hemispherical Map) and SF (Sidereal Filtering) can be implemented to real-time GNSS data processing. SF is based on the time repeatability of satellites which just suitable for static environment, while the spatiotemporal repeatability-based MHM is applicable not only for static environment but also for dynamic carriers with static multipath environment such as ships and airplanes, and utilizes much smaller number of parameters than ASF. However, the MHM method also has certain defects. Since the MHM take the mean of residuals from the grid as the filter value, it is more suitable when the multipath regime is medium to low frequency. Now existing research data indicate that the newly advanced Sidereal Filtering (ASF) method perform better with high frequency multipath reduction than MHM by contrast.

To solve the above problem and improve MHM's performance on high frequency multipath, we combined binary trend surface analysis method with original MHM model to effectively analyze particular spatial distribution and variation trends of multipath effect. We computed trend surfaces of the residuals within a grid by least-square procedures, and chose the best results through the moderate successive test. The enhanced MHM grid was constructed from a set of coefficients of the fitted equation instead of mean value. According to the analysis of the actual observation, the improved MHM model shows positive effect on high frequency multipath reduction, and significantly reduced the root mean square (RMS) value of the carrier residuals.

**Keywords:** Trend Surface Analysis; Multipath Hemispherical Map; high frequency multipath effect