Analysing the Effectiveness of Wavelet Transform for Mitigating C/A Code Multipath at GPS Reference Stations

Thilantha L. Dammalage[a], Chalermchon Satirapod[b] and Seishiro Kibe[a]

[a]School of Engineering and Technology
Asian Institute of Technology, Thailand
st105206@ait.ac.th, kibe@ait.ac.th

[b]Department of Survey Engineering
Faculty of Engineering
Chulalongkorn University, Thailand
chalermchon.s@chula.ac.th

ABSTRACT

Differential correction (DGPS) technique is one of the most popular and comparatively accurate techniques to enhance the GPS positioning accuracies by minimizing most of the common mode errors as a collective process. Further, several DGPS processing techniques can also be found, for instance, single differencing and double differencing which are very recurrent in practice. Irrespective of the processing technique that is used in DGPS, the ultimate accuracy of the user location depends on the amount of non-common mode errors, which effect at the point of observation and the reference. Of the latter, the dominant mode has been identified to be the multipath error. Therefore, several researchers have proposed different strategies and approaches to minimize the effect of multipath from final position estimation. Out of which, the wavelets transformation has higher potential for the precise extraction of the multipath error; however, the accuracy is highly depending on the proper selection of the wavelet family and the level of decomposition.

In this experiment, C/A code DGPS observations were performed at three precisely known ground controls, assuming two GPS receivers as permanent reference stations and one as user GPS receiver. Four segments of 24-hour continuous static observations were performed by introducing four different multipath environments at one reference GPS receiver using different types of artificial signal reflectors. Making use of the known configuration of the GPS receivers and the reflector the additional pseudo-range multipath were precisely calculated for each segment of observations. Later, different wavelet families and decomposition levels were introduced to extract the multipath from pseudo-range residuals. By comparing the calculated and extracted multipath errors, the best wavelet and the level of decomposition were recognized. Furthermore, the C/A code DGPS positioning accuracies before and after multipath correction were also presented.

Key Words: Multipath, Wavelet analysis, GPS permanent reference station