Finally, we compare the baseline length changes before and after multipath correction to evaluate the performance of the MHM method. Figure 8 is a baseline length sequence before and after the 8-hour multipath model correction, the average baseline length (8.1024 meters) has been subtracted from the original baseline length sequence. Statistical results show that the average deviation of baseline length is close to 0 before and after multipath correction, and RMS decreases by 9.20%.

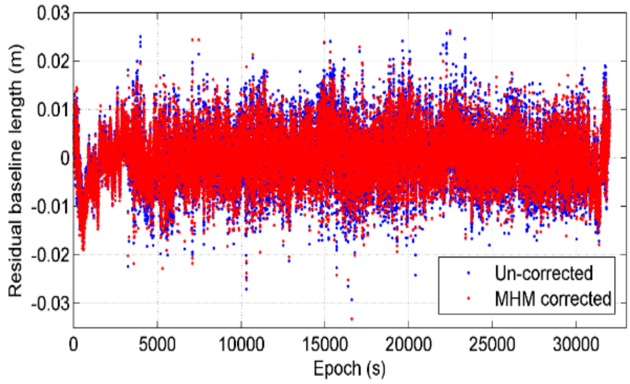

Figure 8. Residual baseline length sequence before and after multipath correction (8 hours model)

4. Conclusion

In this paper, we extend the MHM method to a dynamic ship borne environment, and validate the feasibility of MHM model for multipath correction in a dynamic ship borne environment by static and dynamic ship borne experiments. The experimental results show that in static and dynamic experiments, the RMS of observed residuals are decreased by 39.89% and 21.91% respectively, and the RMS of baseline solutions are reduced by 10.47% and 10.57% respectively.

To carry out the dynamic experiment provides a construction method of full coverage of the MHM model, according to the path of the sky map navigation trajectory of our dynamic experiment and the realization of the MHM model, we can see that only need to rotate the hull, to build the MHM model with high coverage in a short period of time.

However, MHM model is applied to the dynamic marine environment there are still some problems, such as: Determination of three-dimensional attitude is an important prerequisite for MHM multipath correction, which means that the 3D pose requires at least three antennas to the simultaneous solution of baseline, the key in the full coverage of the MHM model is to improve the performance of multipath correction.

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6. References

[1] Rao B R K, Sarma A D, and Kumar Y R. Technique to reduce multipath GPS signals. Current Science, 2006, 90(2): 207-211

[2] Satirapod C, Rizos C. Multipath mitigation by wavelet analysis for GPS base station applications. Surv Rev[J]. Survey Review, 2005, 38(295):2-10.

[3] Souza E M, Monico J F G, Polezel W G C, et al. An Effective Wavelet Method to Detect and Mitigate Low-Frequency Multipath Effects[M]. VI Hotine-Marussi Symposium on Theoretical and Computational Geodesy. Springer Berlin Heidelberg, 2008:179-184.

[4] Zhong P, Ding X L, Zheng D W, et al. Adaptive wavelet transform based on cross-validation method and its application to GPS multipath mitigation[J]. GPS Solutions, 2008, 12(2):109-117.

[5] Dong D, Wang M, Chen W, et al. Mitigation of multipath effect in GNSS short baseline positioning by the multipath hemispherical map[J]. Journal of Geodesy, 2016, 90(3):255-262.

[6] Zhong P, Ding X, Yuan L, et al. Sidereal filtering based on single differences for mitigating GPS multipath effects on short baselines[J]. Journal of Geodesy, 2010, 84(2):145-158.

[7] Zheng B, Zhou N, Ou G. Study on elimination of multipath error in PPP based on sidereal filtering[J]. Journal of Geodesy & Geodynamics, 2014, 34, 178-182.