Preliminary Performance Analysis of IRNSS in Sea Environment

P. Naveen Kumar[1], R. P. Naraiah[1], KSRS. Jyothsna, T. S. N. Murthy[2] and A. D. Sarma

Chaitanya Bharathi Institute of Technology, Hyderabad, Telangana-500075.
[1]AGR Laboratory, Department of ECE, University College of Engineering, Osmania University, Hyderabad, Telangana-500007.
[2] JNTU College of Engineering, Vizianagaram, Andhra Pradesh-535003.

Global Navigation Satellite System (GNSS) is a satellite based navigation system which provides autonomous geo-spatial positioning with global coverage. To cater the navigational and precise time needs of India, Indian Regional Navigation Satellite System (IRNSS) is developed by ISRO. The IRNSS, with an operational name of NAVIC has seven satellites (3 GEO, 4 GSO) and it is operational since May 2016. It is an autonomous regional satellite navigation system which provides accurate real-time positioning and timing services. It covers the mainland of India and a region extending 1,500 km around it. The orbital position of the IRNSS satellites and the operating frequencies (L5 is 1176.45MHz and S1 is 2492.028MHz) may experience different effects in contrast to other GNSS. This is even more true with oceanic environment.

Recently, field trails to analyze the performance of IRNSS are performed at various research organizations and academic institutions in India. However, not much significant research is carried out in sea environment. There is an indeed requirement for testing in this type of environment. Hence, for typical sea environment, "Hope Island" which is 7 Kms away from Kakinada coast, Andhra Pradesh, India is chosen for carrying out the experiments. Hope Island is a small tadpole shaped Island situated off the coast of kakinada, India, in the Bay of Bengal. A preliminary experiment is conducted using an IRNSS receiver provided by SAC, ISRO, Ahmedabad,India under MoUs with Osmania University and CBIT, Hyderabad. This receiver is carried from sea coast (16° 59′ 1.94″N, 82° 17′ 3.87″E) to Hope Island (16° 58′ 57.87″N, 82° 19′ 39.88″E) in a boat, which travelled with an average speed of 15-20knots. The data is acquired along the path from sea coast to Hope Island. It took 45 mins to reach Hope Island. Along this path, 5 to 7 satellites are visible. The data from all the visisble satellites is recorded. Later, the receiver setup is placed near the shore of Hope Island and acquired the data in static conditions.

As the antenna is placed on one side of the boat, the number of visible satellites were varied from 7– 5 which has effected the GDOP values from 3.61 to 6.35. This variation in GDOP has degraded the positional accuracy of IRNSS. It is observed that, Satellite Signal Strength C/No is

varied between 50.35dBHz to 31.25dBHz throughout the path. As expected The Doppler values on S1 frequency are found to be larger than the L5 frequency and Ionospheric delay values are less in S1 as compared with L5 frequency. During this field trail, the surface water level varied nearly 1.5 meters. As the position accuracy of IRNSS is also affected by sea induced multipath, the effect of multipath error from the acquired data is estimated using Code Minus Carrier (CMC) technique. To mitigate this error, an adaptive filter such as Least Mean Square (LMS) filter is used. Our initial results indicate that in oceanic environment the performance is significantly degraded due to both multipath and sea-surface altitude variations.