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Tracking and Analysis of IRNSS Satellites by Using IRNSS Receiver in STK Simulation

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***Abstract*—This paper deals with the study of availability of IRNSS satellites in the space segment over its coverage area from the user location (SET-JU Campus). The objective of this paper is to analyze the visibility gap of the IRNSS satellites with respect to a user position to show that twenty four bar seven there is no interruption in service provided by the IRNSS satellites over Indian geo-graphical boundary. All seven satellites are observed over a period of twenty four hours and are mapped in terms of distance, speed, angle with respect to time. By using two line element file of the satellites in Satellite Tool Kit software the visibility gap, elevation of the satellites are mapped.**

***Index Terms*— Indian regional navigational satellite system (IRNSS), Indian space research organization (ISRO), Visibility gap, Geo-stationary satellites, Geo-synchronous satellites.**

I. INTRODUCTION

Ref. [2] Till the date, GPS satellites are used to provide tracking and navigational service to the users in India but now Indian Space Research organization is developing its own tracking and navigation system which is independent of GPS satellites. Ref. [6]IRNSS consist of seven satellites in its constellation namely IRNSS-1A, IRNSS- 1B, IRNSS – 1C, IRNSS – 1D, IRNSS – 1E, IRNSS – 1F and IRNSS – 1G in which three are geostationary and other four are geosynchronous placed approximately at 36000 kilometers altitude above earth surface, and two satellites on the ground as stand by in addition to ground stations. Ref. [6] In this scenario all seven satellites are launched and placed in their respective orbits as considered. Ref. [1]Services obtained by these satellites are Standard Positioning Service (SPS), which can be accessed by all the users and Restricted Service (RS) which is only for the authorized users. Position accuracy of the IRNSS will to be 10m on land and 20m in ocean within 1500km around Indian boundary. The IRNSS base station consists of IRNSS Space Craft Control Centre (ISCC) and IRNSS Navigation Centre (INS) units will provide the information about the position, speed and time of the IRNSS satellites by using the signals received by the ground station antenna from both IRNSS and GPS satellites. The SPS and RS service are provided by using L5 band (176.45 MHz) and S band (2495.028 MHz). Navigation signals are transmitted through S band frequency (2-4 GHz) and the coverage area and signal strength of the navigation is maintained by broadcasting through phased array antenna. The IRNSS ground station antenna will be able to receive the

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IRNSS signal especially in L band. Ref. [1][2] In this case the receiving antenna which is place at school of engineering and technology, Jain university will cover 0 Degree – 360 Degrees in azimuth and the elevation angle is fixed at 5 Degrees from the ground.
Ref. [4]The 2D and 3D view of the IRNSS satellite movement and their coverage area with respect to the user receiver are observed by simulating it in satellite tool kit.

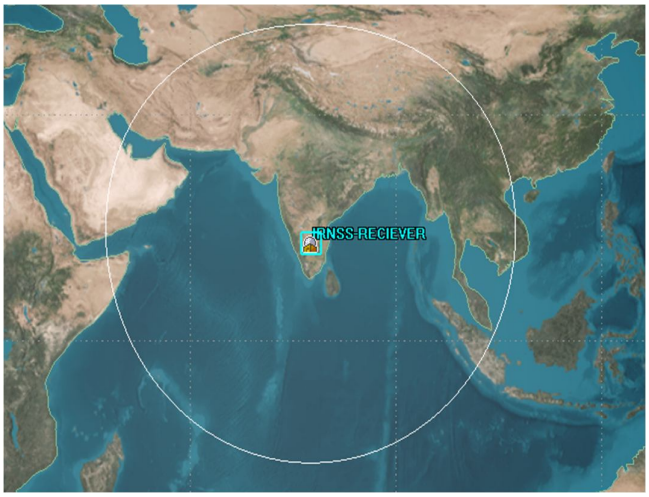

Figure1. Indian Service Area

II. METHODOLOGY

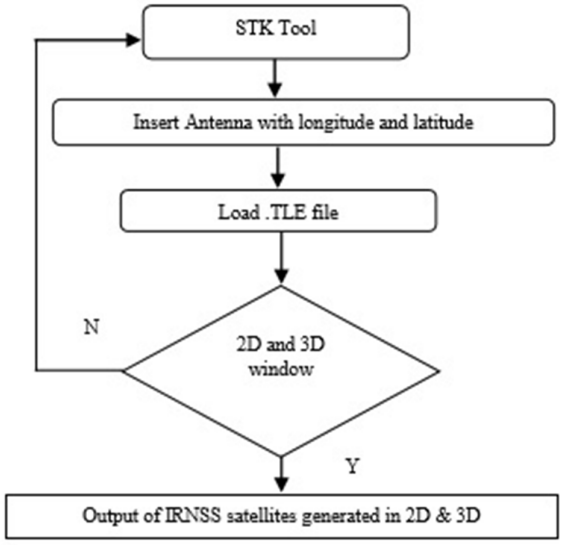

Figure2. Flowchart To Analyze And Track The IRNSS Satellites

Ref. [4] Satellite Tool Kit software is used to simulate the IRNSS satellites and it can calculate the altitude and position of the satellite with respect to the user location. With the help of this tool kit the speed, elevation, angle and the visibility of the satellites can also be measured with respect to time. In this case the receiver is placed at the SET-JU campus, the latitude and longitude details of the receiver and the data from IRNSS satellite are uploaded in the STK platform in the form of two line element sets. Ref. [2] The satellites

data are generated by North American Aerospace Defense Command agency and are provides in the form of two line element sets. These .tle files are used to map and analyze the satellites in 2D and 3D form.

III. RESULTS AND DISCUSSION

For a period of one week all seven IRNSS satellites are tracked and their visibility gap with respect to time is plotted. The 2D and 3D orbiting path of the IRNSS satellites with respect to the receiver is shown is the Fig. 3 and Fig. 4 respectively. The Fig.5 shows the visibility gap of IRNSS satellites. Fig. 6 shows the graph of angle and distance of the satellite from the IRNSS receiver with respect to time. Fig. 7 gives the data of the IRNSS satellite travelling speed and angle with respect to time and FIG. 8 is the graph of elevation angle and altitude of the satellite with respect to time and Fig. 9 gives the information about the elevation angle of the satellites.

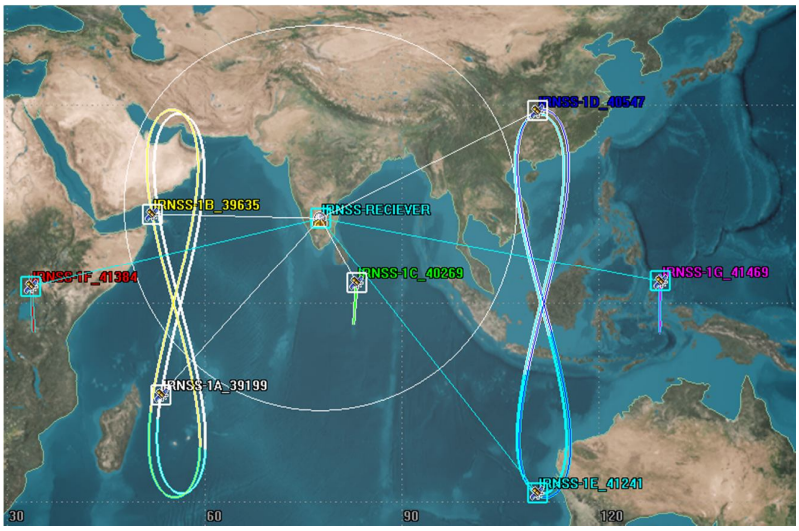

Figure3. Tracking Of IRNSS Satellites With Respect To IRNSS Receiver

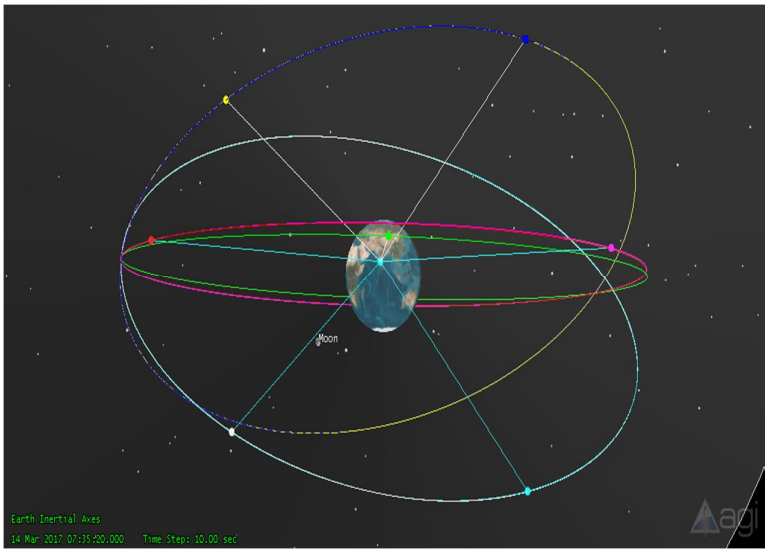

Figure4. Constellation Of IRNSS Satellites

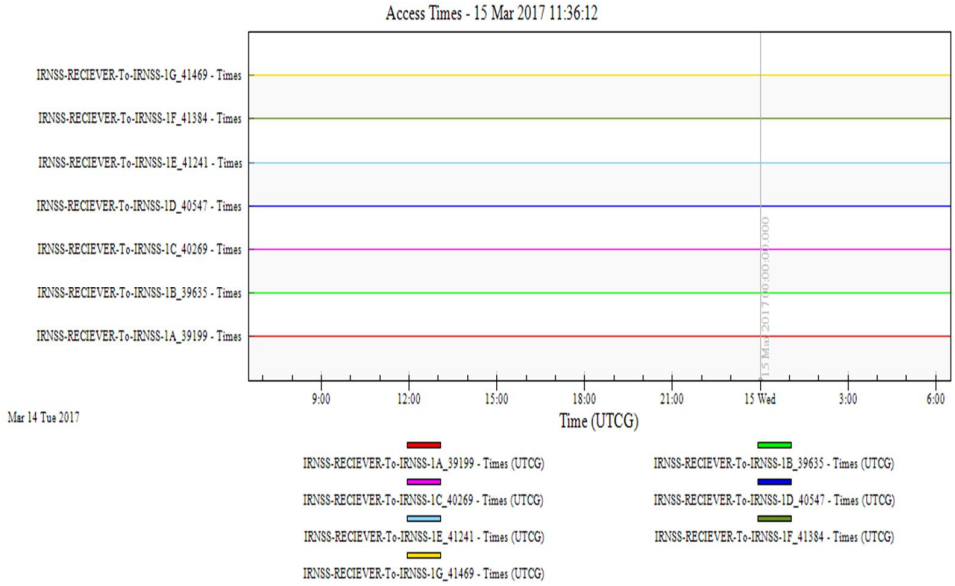

Figure5. Visibility Gap Analysis Of IRNSS Satellites

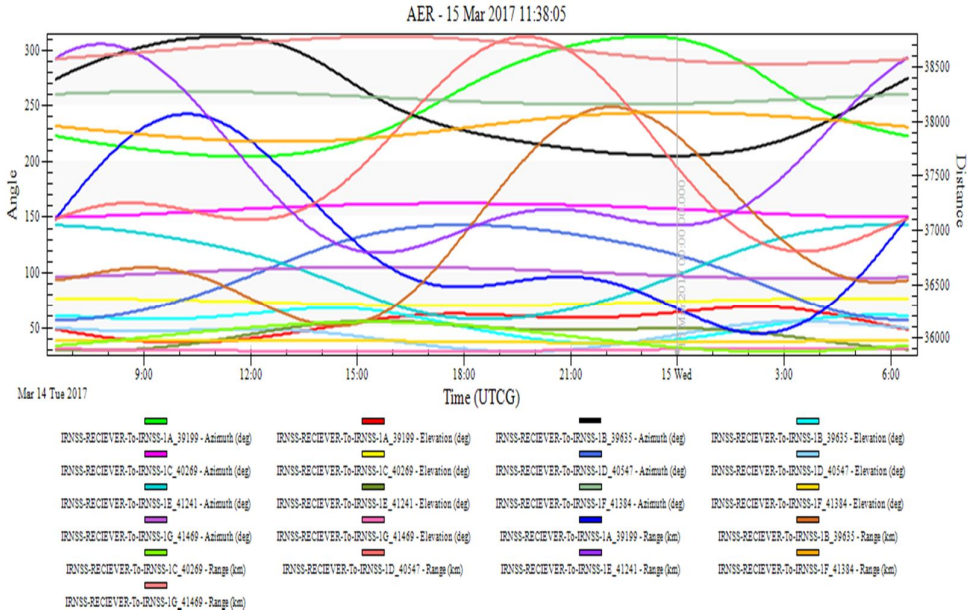

Figure6. IRNSS satellites Angle and distance with respect to time

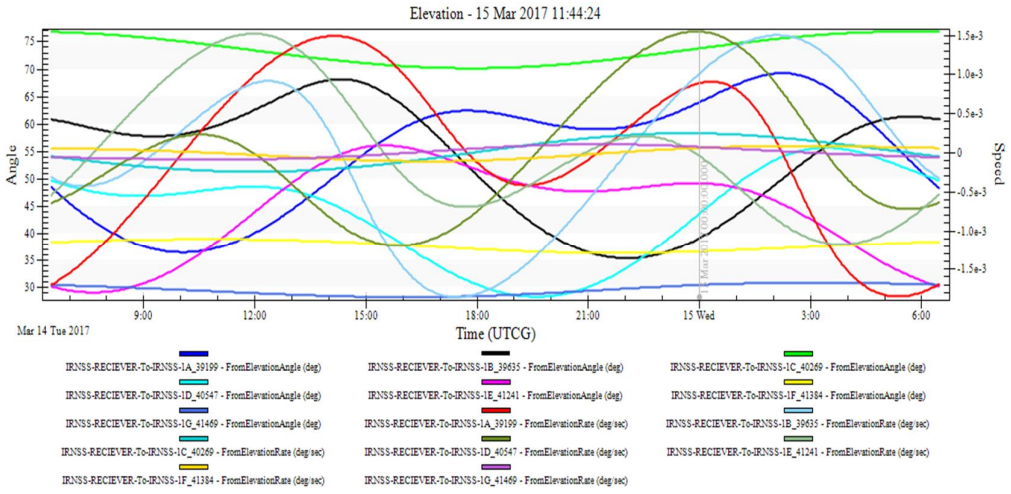

Figure7. IRNSS satellites angle and speed with respect to time

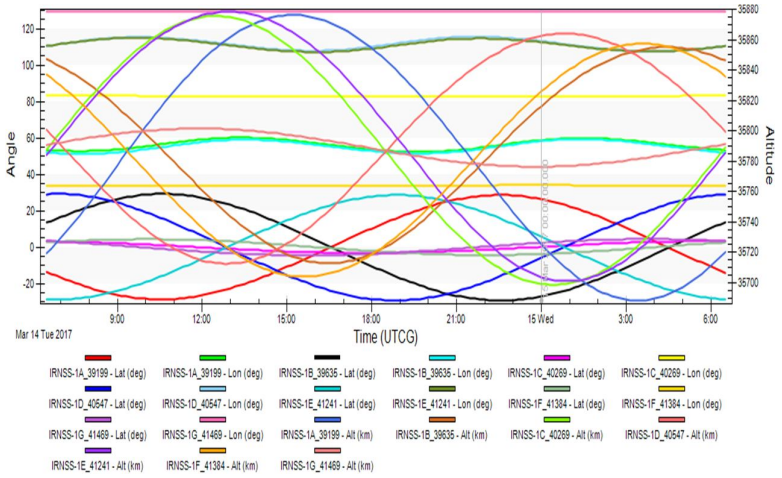

Figure8. IRNSS satellites angle and altitude with respect to time

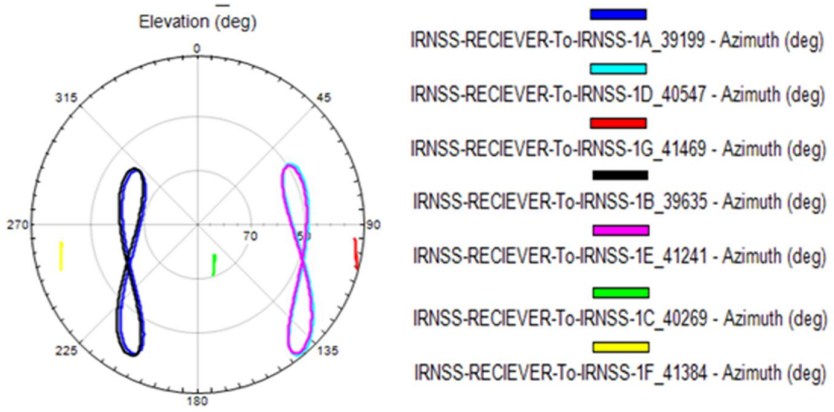

Figure9. IRNSS Satellites Elevation Angle

IV. CONCLUSION

In the result the visibility gap analysis of IRNSS satellites are simulated and plotted in 2D images, by the graph we can conclude that there is no visibility gap in the IRNSS satellites with respect to user location. So there will be no interruption in the IRNSS satellite service to user all the time and the location information provided by the IRNSS satellites will be more accurate.

V. ACKNOWLEDGMENT

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