



NavIC Simulators for Academic and Research Institutions

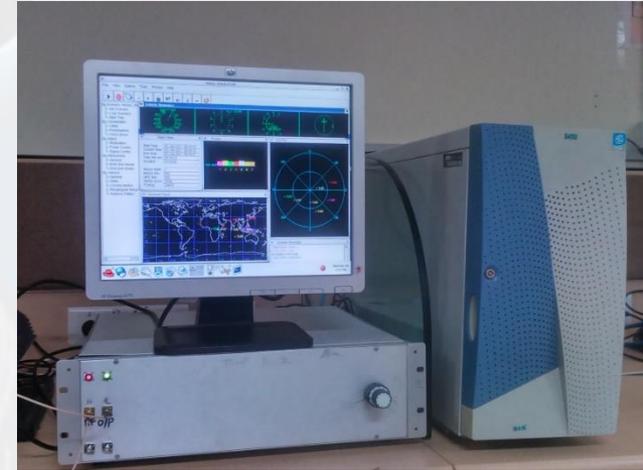
Dr. Mohanchur Sarkar
Space Applications Centre (ISRO), India

- ❖ A NavIC simulator provides an **Effective** and **Efficient** means to test NavIC receivers and the systems that rely on them.
- ❖ A NavIC Simulator emulates the environment of a NavIC receiver on a dynamic platform by modeling vehicle and satellite motion, signal characteristics, atmospheric and other effects, causing the receiver to actually navigate according to the parameters of the test scenario.
- ❖ A NavIC receiver will process the **simulated signals** in **exactly the same way** as it would those from **actual NavIC satellites**.
- ❖ In that way, a NavIC Simulator **mimics the NavIC constellation** and provides the signals, which are actually supposed to be available from the satellites **in a live condition**.

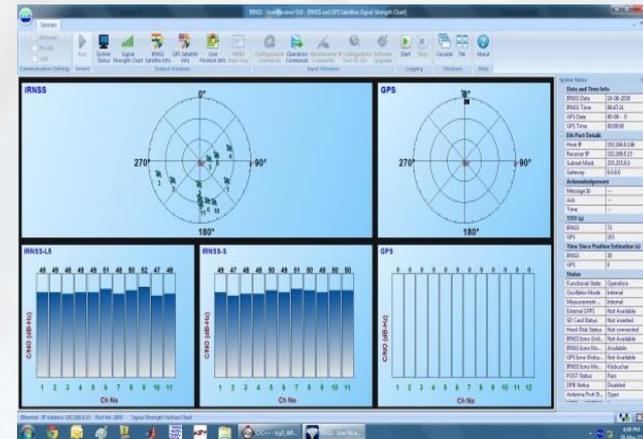
- ❖ **To develop User Receiver before the NavIC Constellation is formed**
- ❖ **Unknown Knowledge in Live Sky Test**
- ❖ **Repeatability**
- ❖ **Controllability**
- ❖ **Accuracy**
- ❖ **Capability**
- ❖ **Commercial Viability (To test NavIC Receivers under high Receiver Dynamics like Receivers used in Launch Vehicles and High Dynamics Condition)**

In-House NavIC Simulator is capable to simulate

- ❖ 22 Channel L5 and S Band NavIC Signal Generation
- ❖ Supporting 11 NavIC Satellites
- ❖ Navigation Message Generation with FEC & Interleaving as per ICD
- ❖ User selectable modulation: SPS-BPSK, BOC(5,2)-pilot & data or CASM.
- ❖ User Defined Constellation Parameters, Satellite Selectivity
- ❖ User Selectable Simulation Time, and Receiver Location
- ❖ Ionospheric Effects using Klobuchar Model and Grid based Model
- ❖ Satellite Clock errors, Satellite Perturbation, Troposphere Effects
- ❖ Signal Power Variation with resolution of 0.1 dB
- ❖ Receiver Antenna Model, User Dynamics
- ❖ Successfully tested with In-House NavIC Receiver & M/S Accord Receiver with an average RSS error ≈ 0.5 m



Indigenous NavIC L5 & S Band Simulator



Accord Receiver GUI with NavIC Simulator

Indigenously Developed NavIC Simulators

❑ NavIC L1 SPS Simulator

- ❖ The 8 Channel NavIC L1 Simulator generates the NavIC L1 signals with the newly proposed IZ4 Code Sequence, SBOC Modulation, BCH, LDPC and Newly proposed Navigation Messages supporting the facility to simulate all impairments and receiver dynamics.
- ❖ Before the launch of NavIC L1 satellites this 8 channel NavIC Simulator is used to design and develop Indigenous Multi Channel NavIC L1 Receivers.



NavIC L1 Simulator & Receiver Testing

❑ *All these NavIC Simulators have been developed in Space Applications Centre (ISRO), Ahmedabad, India.*

Indigenous NavIC Simulators provided to Academic & Research Institutions

- ❖ As the use of NavIC applications will increase, there will be a huge demand of NavIC Receivers.
- ❖ Many Indian Academic & Research Institutions will be involved in research in navigation technology.
- ❖ Many Indian Industries large or medium will have to be involved in the development of NavIC Receivers.
- ❖ For any Academic & Research Institution or Industry willing for research in NavIC technology or NavIC Receivers, there will be need for NavIC Simulators
- ❖ NavIC Simulator is absolutely needed during the complete development cycle starting from conceptualization to the final testing and verification of the developed NavIC Receivers.
- ❖ Commercially available Navigation Simulators are very costly and will consume a significant proportion of the budget needed for Receiver development.



**Engineers trained in Data Patterns,
Chennai With the provided
Indigenous NavIC Simulator**

- ❑ ISRO planned to provide indigenous NavIC Simulator to Academic and Research Institutions and Indian Industries for the proliferation of NavIC
- ❑ ISRO has provided Indigenously developed NavIC Simulator to Indian Industry (M/S Data Patterns, Chennai) for the mass manufacturing of NavIC Receivers.

- ❑ Indigenous NavIC Simulator delivered to Indian Academic Institution like Indian Institute of Space Science & Technology (IIST), Trivandrum using which students are doing research and navigation receivers are developed.
- ❑ There is an independent initiative from (Ministry of Information Technology, India) where a consortium of Indian Institute of Technology (IIT Chennai, IIT Bombay, IIT Jodhpur and Research Institutions SAMEER) is developing NavIC Receivers.
- ❑ Indigenous NavIC Simulator have also been given to Research Institution (SAMEER & IIT, Mumbai) using which NavIC Receivers are being developed.



Indigenous NavIC Simulator delivered to IIST, Trivandrum And demonstration to Director, IIST and Professors working in Navigation

