ICG-16

Update on Signal Monitoring Receiver for NavIC with L1 Band Support

WG-B

11th October 2022, 17:00 Hrs

Rakesh Kumar Bijarniya

Rohan S Urdhwareshe

Saurabh Bhalla

Sagar Subudhi

Space Applications Centre (SAC)

Indian Space Research Organization (ISRO)

Ahmedabad

Overview

- NavIC is slated to introduce a new SPS signal in L1-band designed to be interoperable with other open signals in L1-band.

- Monitoring navigation signal data integrity and phase measurements between various signal components are of paramount importance for a satellite navigation system.

- A special class of signal monitoring receiver is developed to monitor data integrity and ranging parameters for Signal-in-Space (S-i-S).

- The receiver shall be deployed at Signal Monitoring Stations for NavIC at INC (ISRO Navigation Centre).

- The receiver firmware is also configurable for the processing of various other open GNSS signals with a variety of modulation schemes and data formats.

Proposed NavIC L1 SPS Signal

S. No.	Parameter	Specifications
1	Frequency Band	1575.42 MHz +- 12 MHz
3	Bandwidth	24 MHz
4	Modulation	Synthesized Binary Offset Carrier (SBOC) Pilot(Power: 58.18%): BOC(6,1) & BOC(1,1) Data(Power: 41.82%): BOC(6,1) BOC(1,1)
5	Ranging Codes	Primary: Interleaved Z4 (IZ4) Linear Sequence Overlay: Truncated Z4-Linear Sequence
6	Symbol Rate	100 sps
7	Frame Format	18 sec Master Frame SF1: 52 sym., SF 2: 1200 sym., SF 3: 548 sym.
8	Channel Code	SF-1: BCH(52,9) SF-2/SF-3: ½ Rate LDPC
9	Navigation Parameters	Primary Bits: 576
10	Ionospheric Messages	Grid-based Ionospheric corrections and Klobuchar model coefficients

Signal Monitoring Receiver Specifications

| Parameter	Specifications
Number of Channels	26
Signal Support	L1 SPS signal L5/S SPS Other Open GNSS signals in L5/S/L1 Band
Sensitivity	Acquisition : 32 dB-Hz C/No Tracking : 28 dB-Hz C/No
Anti-jamming Capability	Narrowband interference mitigation, Pulse blanking and notch filtering
Individual Code Phase Accuracy	Better than 10 cm (> 44 dB-Hz C/No)
Individual Carrier Phase Accuracy	Better than 10 mm (> 44 dB-Hz C/No)
Theoretical performance	Within 10 %
Timing Mode	Time Synchronization through external 1 PPS as well as reference clock
External Interface	RF Input 1-PPS Input and Output External Reference Clock (10 MHz) Data Communication Interface (USB-UART x2)
Configuration and Commanding	User-defined Channel Configuration and PRNs Signal-wise

Theoretical Jitter Performance Comparison
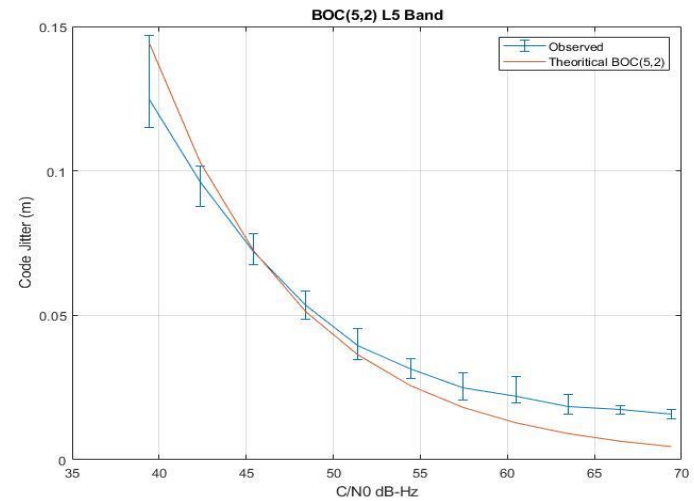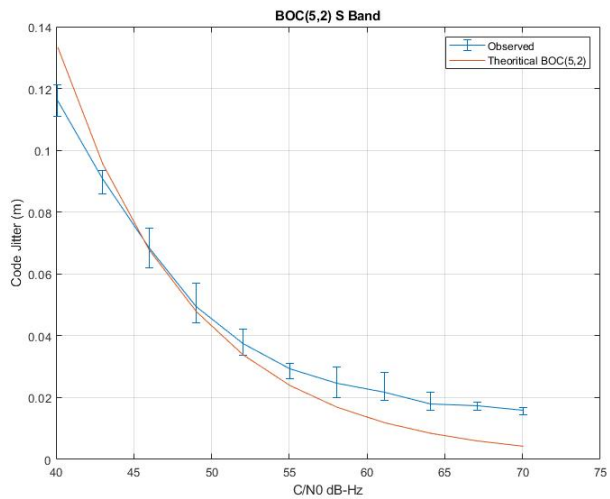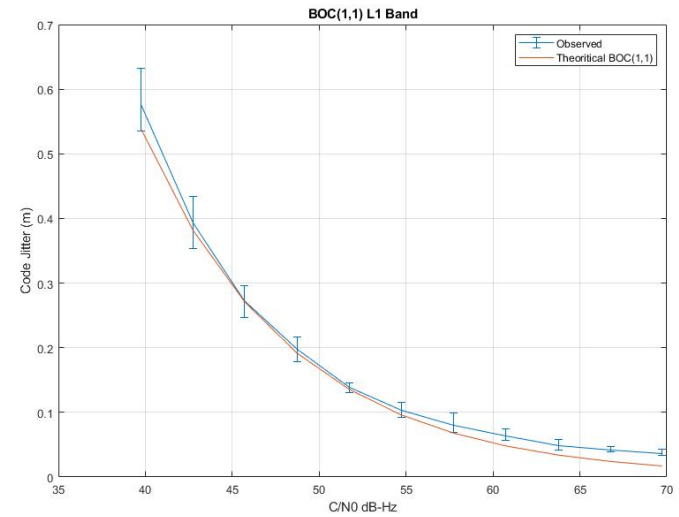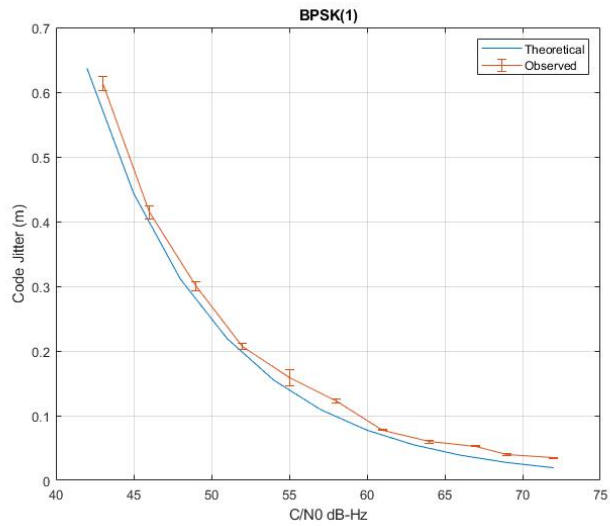
Ranging results evaluated for available NavIC signal-in-space
- Measurement noise of Receiver is within desired specifications and comparable with IRIMS (IRNSS Ranging and Integrity Monitoring Station) measurement noise.
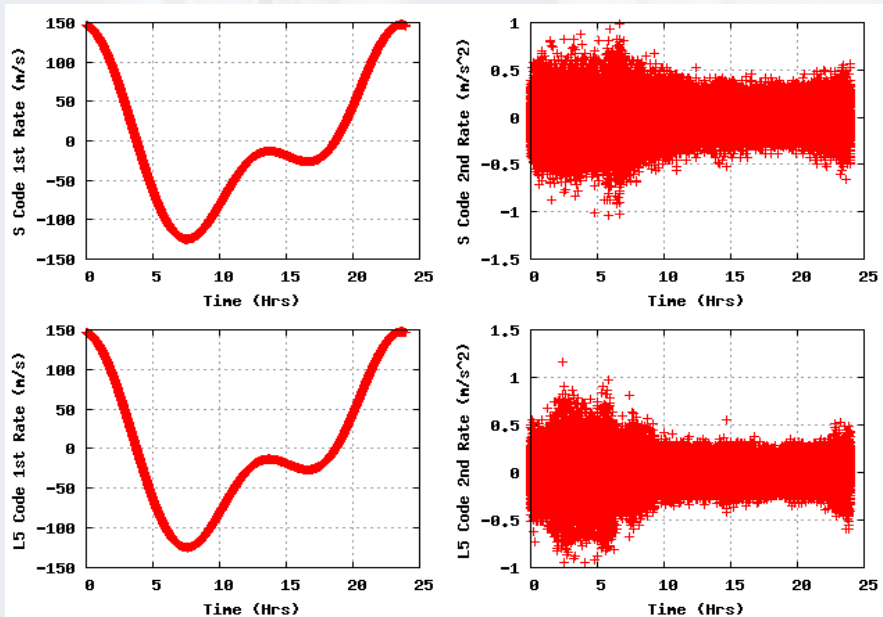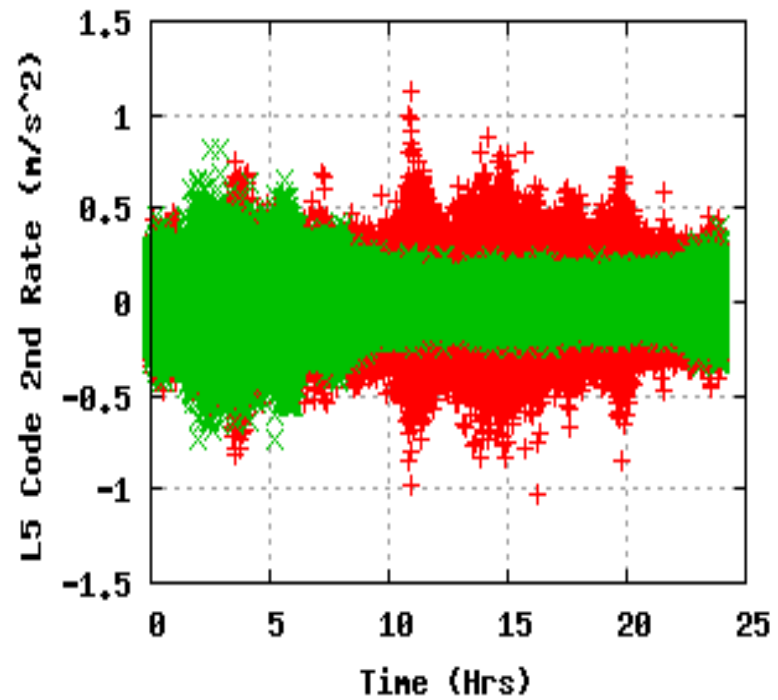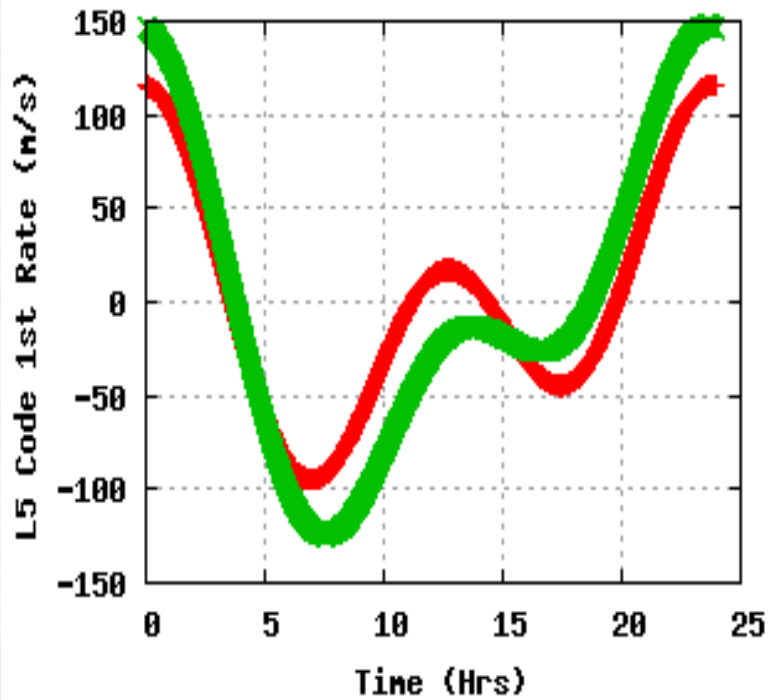

Code-phase measurements
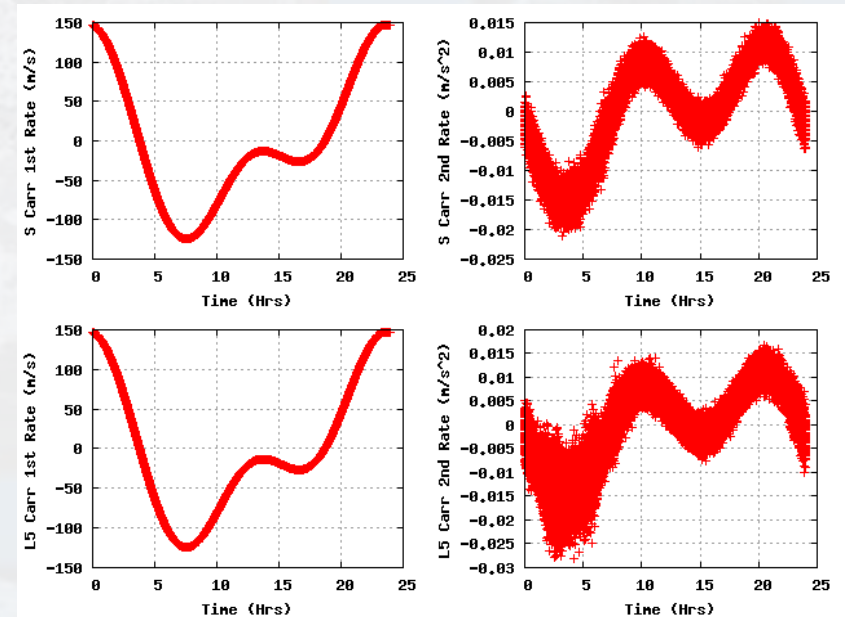
Carrier-phase measurements

• Comparison with Existing Measurements System

Conclusion

- The developed Receiver is planned to be deployed at NavIC Signal Monitoring Stations (INC) in the next phase.
- The Receiver is configurable for signals with modulations:
    - BPSK(n)
    - BOC(m,n)
    - MBOC

    Hence can be conveniently configured to cater other signal monitoring requirements.

Thank You