Modified CEMIC Scheme for New Service Signals

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Overview

- NVS-01 is now transmitting interoperable service signal in L1 band.
- Study on multiplexing additional new service signals in L1-band with the existing NavIC **S**ynthesized **B**inary **O**ffset **C**arrier (SBOC) signal to transmit it through common payload hardware chain is considered.
- The composite signal must have constant envelope to operate the transponder at saturation with maximum efficiency.
- Congestion in L1-band in terms of other GNSS signals is higher than other RNSS bands.
  - It further poses difficulty in coordination of the centre frequency of the new service signal.
- *For maintaining interoperability, change in the modulation and frequency of NavIC SBOC signal in L1-band will not be permitted/desirable.*
- The data and pilot component of NavIC L1-band signal (SBOC) are multi-level in nature.
  - It posses additional challenge in terms of multiplexing operations.

Hence, a suitable Modified **C**onstant **E**nvelope **M**ultiplexing with **I**ntermodulation **C**onstruction (CEMIC) method is devised to incorporate:

- *Multi-frequency signals (to exploit frequency diversity) for minimization of inter- and intra-system interference.*
- *Multi-level signals for supporting backward compatibility (receiver transparency) to the existing SBOC signal in NavIC L1-Band.*

Proposed Method: MCEMIC Scheme

- Proposed MCEMIC has highest multiplexing efficiency and currently the state-of-the-art scheme for single frequency BCS signal[$].
- The same is extended for multi-level & single/multi-frequency signals multiplexing scheme.
- MCEMIC is a waveform Domain Processing for generating constant envelope signal.
- Targeted to provide flexibility in allocating power sharing between signals.
- Using a new centre frequency (*constraint to have some discrete values due to existing SBOC signal design*) to provide frequency diversity.

Proposed method can be generalized to incorporate additional signals in L1-band.

[$] Bhadouria Vijay Singh, Upadhyay Dhaval, Majithiya Parimal, & Bera Subhash Chandra (2022); Modified CEMIC scheme for multiplexing signals over single frequency band. *NAVIGATION, 69*(3). https://doi.org/10.33012/navi.528

MCEMIC : Case Study

Case Study: NavIC L1 Band Signals				
Signal Name	**Power Sharing (%)**	**Phasing**	**Relative frequency Offset (MHz) [@]**	**Modulation Type**
SBOC- Data	18.3[$]	90°[$]	0	MBOC (6,1,1/11)
SBOC- Pilot	24.7[$]	0°[$]	0	
New Service Signals	7.9	0°	18.414	BPSK (2)
	7.9	0°	18.414	
	23.7	90°	18.414	
IM Components	17.5	0°/90°	18.414	-

[$] Relative power sharing and phasing is preserved for the NavIC SBOC signal.

[@] Frequency Offset is with respect to the frequency of 1575.42 MHz.

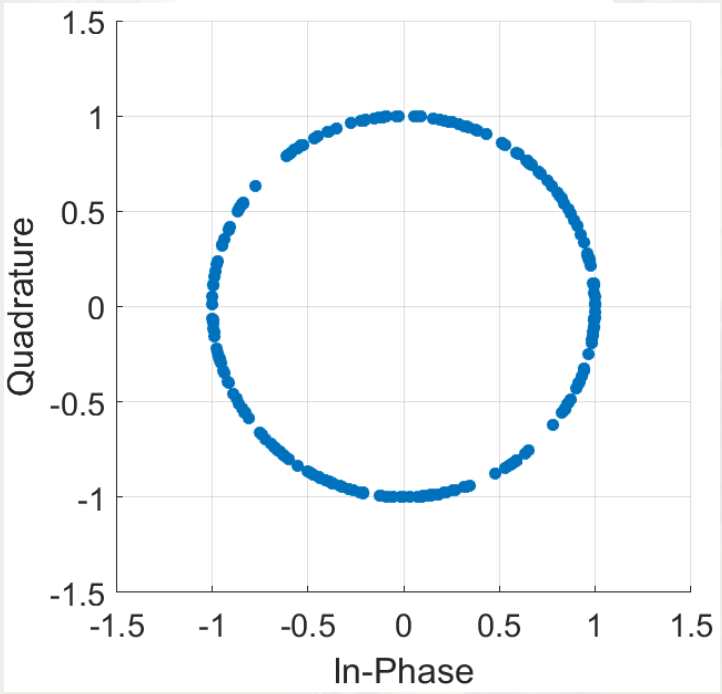
Note:

- ***Signals are to be generated at a sampling rate of 147.312 Msps***

MCEMIC Performance

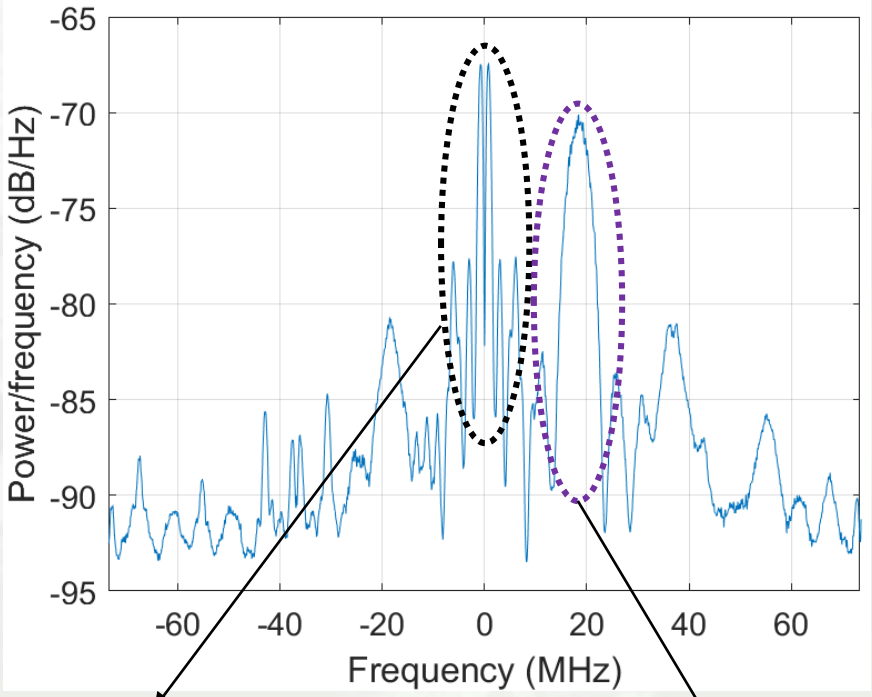
LUT based Scheme Performance

Constellation Points



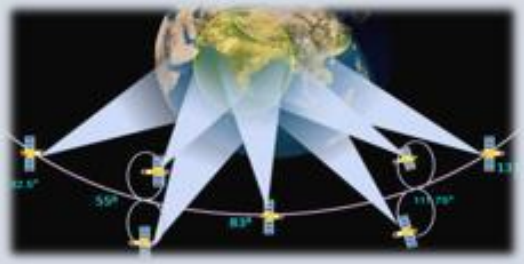
256 point constellation

Power Spectral Density



SBOC signal

New Service Signal








Thank You

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