Faster Coarse Acquisition Process in IRNSS using FFT

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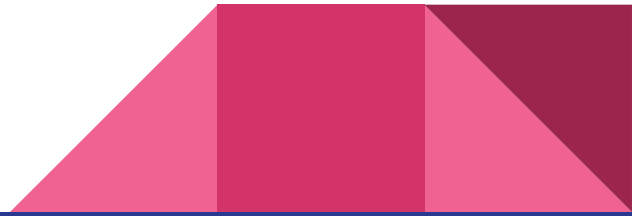
IRNSS

IRNSS (Indian Regional Navigation Satellite System) or now known as NavIC (Navigation within Indian Constellation) is an indigenous satellite navigation system consisting of 7 satellites, 4 geosynchronous and 3 geostationary.

Data received from the satellites contains the acquisition data and tracking data.

Coarse acquisition is performed to find a ‘*coarse*’ estimate of the doppler frequency and the code phase shift. It also provides the ID of the satellite which generated that particular data.



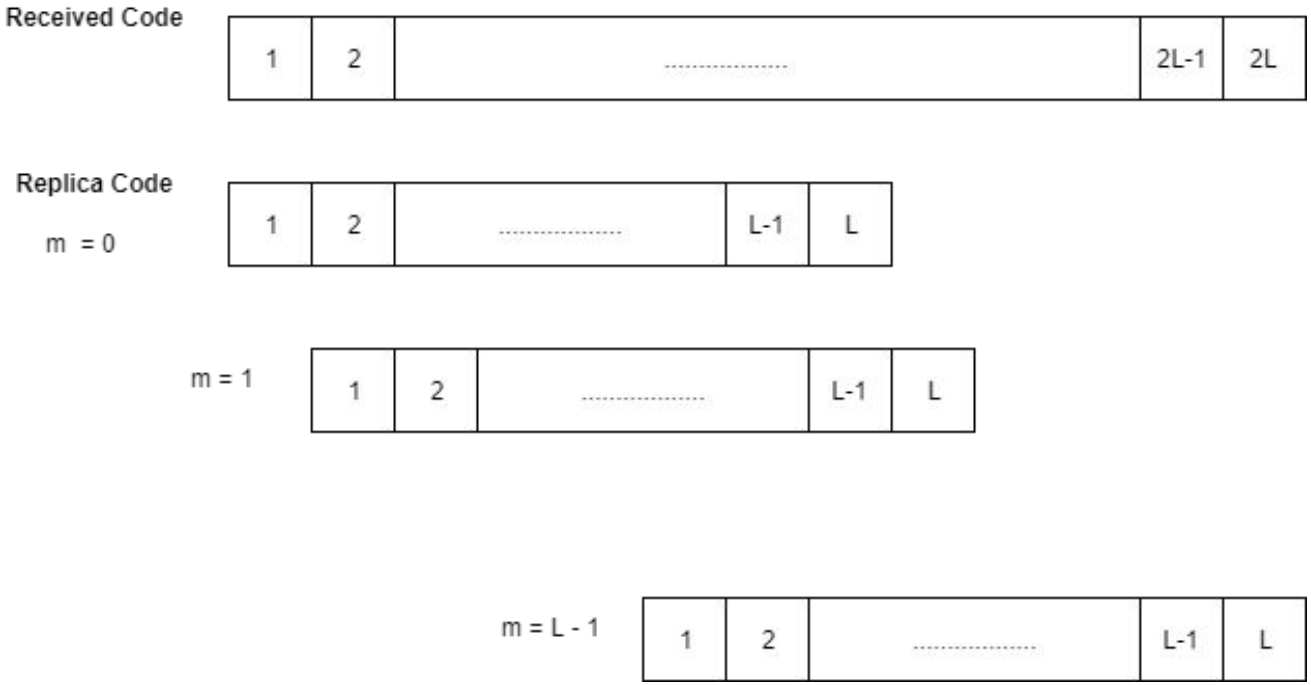
Coarse Acquisition Codes

- The CA Codes are unique for each satellite.
- The cross-correlation of the CA codes is very *low*.
- The auto-correlation of the CA codes is very *high*.
- Even if the codes are shifted by one bit the autocorrelation drops to a very low value.

Existing Approach

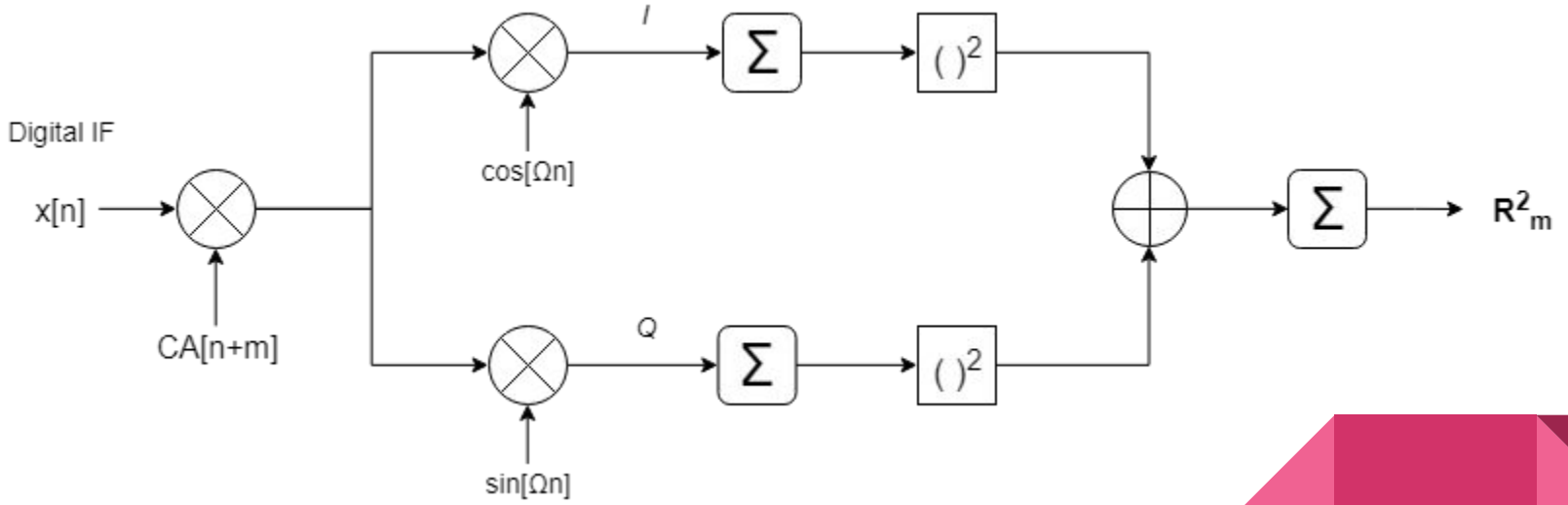
Serial Search Algorithm

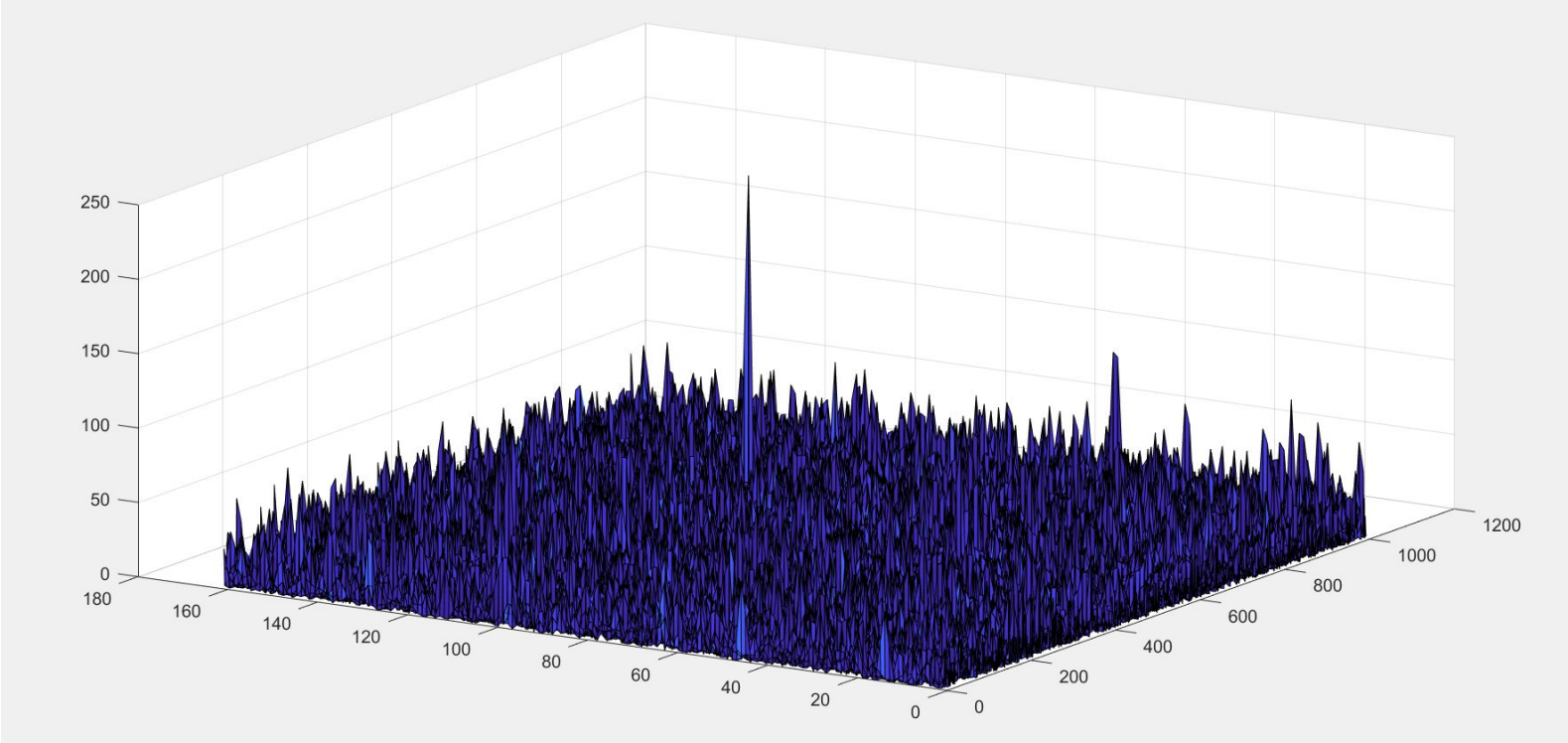
- Received code is extended to at least twice the length and the replica code is correlated by shifting one bit at a time.



Serial search algorithm

Non - Coherent Time Domain Correlator





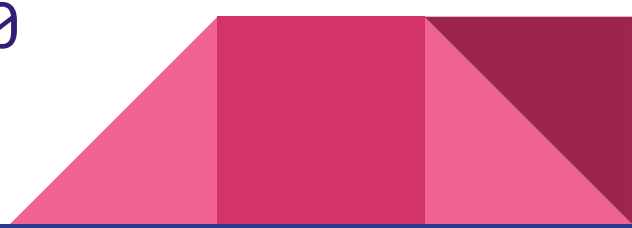
Correlation Matrix for Satellite no. 4 using time-domain correlation

MATLAB implementation

Time taken = 150.51 seconds

Doppler frequency ~ 3 kHz

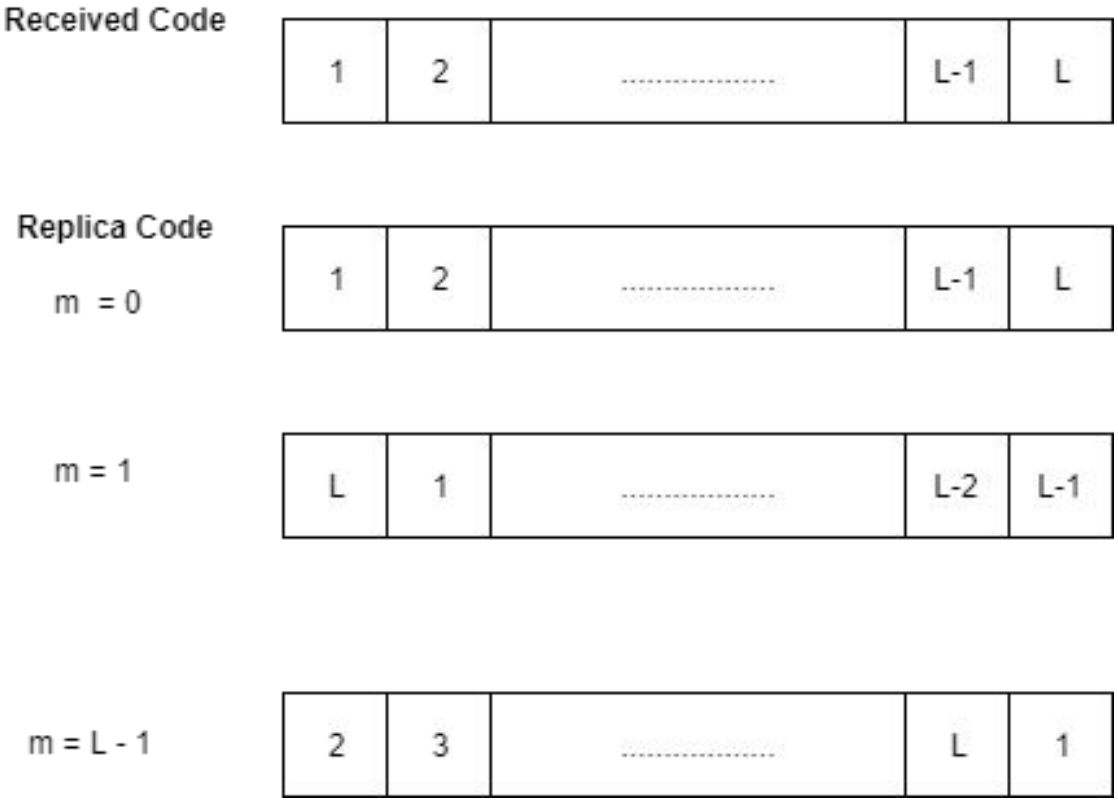
Code Phase shift ~ 2580/4000



Our Approach

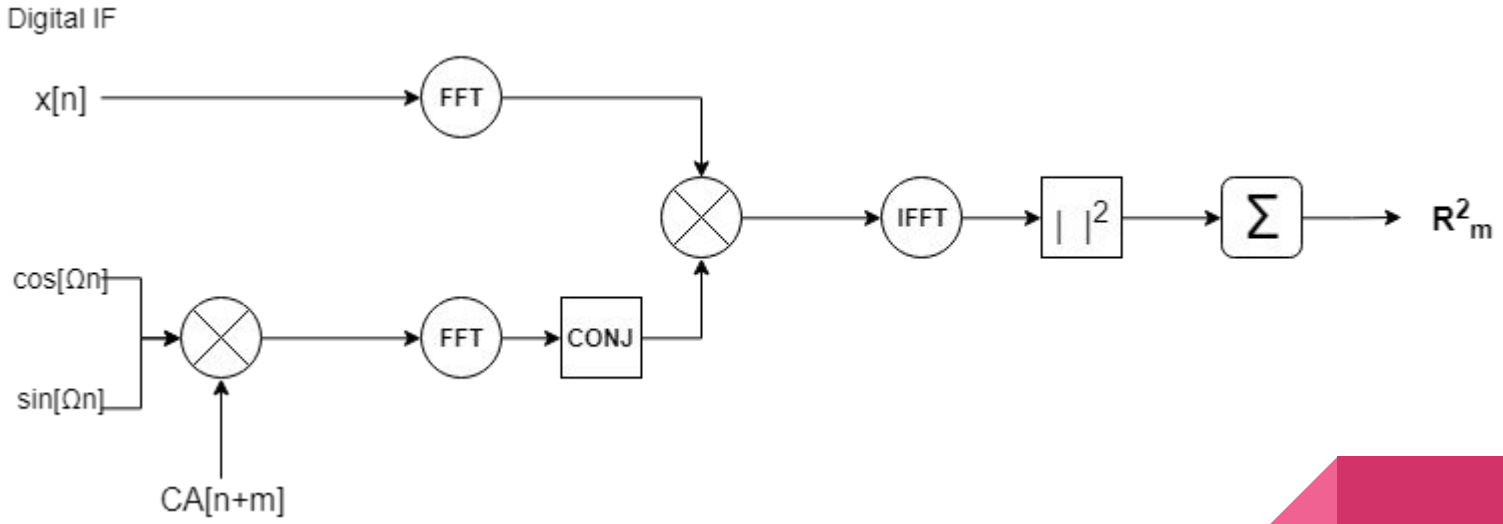
Circular Shift Search

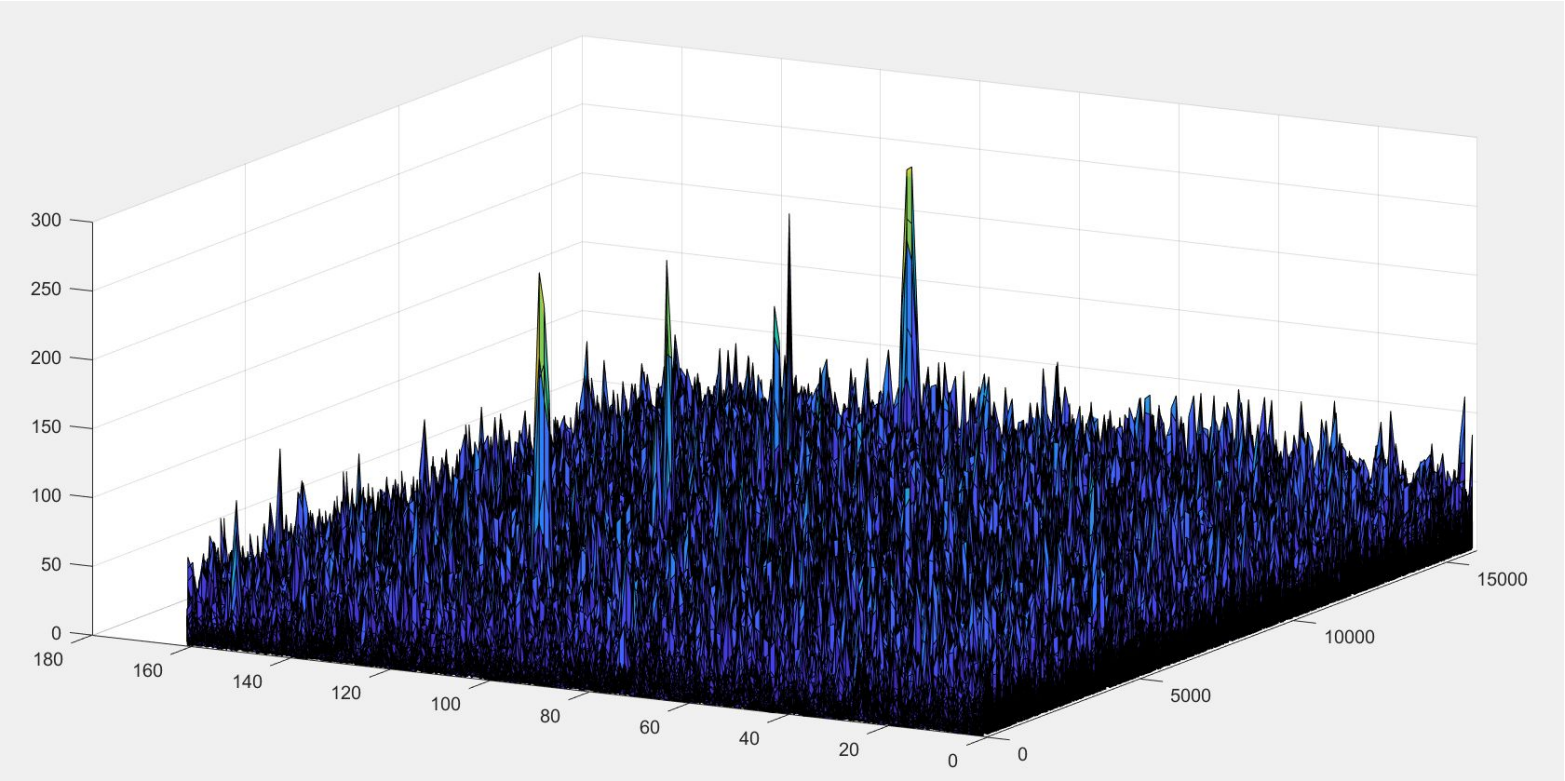
- **The replica code is circularly shifted and then correlated with the received code**
- **This resembles circular convolution of the replica code with the received code in time domain *which is equivalent to multiplication in frequency domain*.**



Circular shift algorithm

Non - Coherent Frequency Domain Correlator





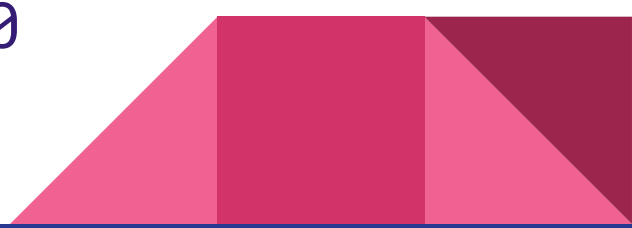
Correlation Matrix for Satellite no. 4 using frequency-domain correlation

MATLAB implementation

Time taken = 2.09 seconds

Doppler frequency ~ 3.1 kHz

Code Phase shift ~ 2580/4000



Thank you

We are open to questions