Module 4 – Range Cell Migration Correction (RCMC)

Program to run: ‘RCMC.m’

Functions used:

Input : \module_3\range_compressed.dat

Output : \module_6\rcmc.dat

Description:

Range Cell Migration Correction (RCMC) is a defining step for Range Doppler Algorithm and is a very important step in SAR image generation. The signal energy from a point target follows a trajectory in the two dimensional SAR data, these signals are migrated back to a constant range cell called range migration correction. This part of the module is performed on the range compressed data and is done in range-doppler domain (azimuth FFT domain). Range compressed data ‘range_compressed.dat’ is read from module 3 and the output ‘rcmc.dat’ is written to module 6 where it will be put to use.

Explanation:

RCMC:

Due to variation of range between the radar and a target, all the reflected signals from that target doesn’t come in the same range bin and follow a hyperbolic trend in azimuth direction called Range Cell Migration (RCM). To compress signal energy in azimuth direction we need to align signal energy within a single range bin where range bin depends on the range at which point target is in the centre of antenna beam. This is done by process RCMC. RCMC is also performed in patch-wise manner. The data is converted into azimuth frequency domain (Range-Doppler domain) by applying FFT in azimuth direction. The frequency shift and offset are calculated in subsequent steps finally giving a pixel offset value. After shifting the data, it is written into a file ‘rcmc.dat’ used for azimuth compression.
The offset is calculated for each pixel to place it into correct position. As the squinted range is a function of doppler centroid frequency, so the migration for each pixel is also a function of frequency shift which depends on frequency resolution $\Delta f$. Offset is calculated for each range and azimuth bin.

$$offset = \frac{R_b}{\sqrt{1 - \left( \frac{\lambda \cdot \Delta f \cdot i}{2V_{eff}} \right)^2}} - R_b$$

Squinted range

The frequency resolution is the minimum frequency shift within a single aperture in azimuth direction.

$$\Delta f = \frac{PRF}{\text{No. of aperture line}}$$