

## Back-projection Processor

Using the “alosraw.dat” ALOS1 PALSAR raw radar data provided, write a back-projection processor to focus the data. There is a second file “alos.position” with the relevant earth-fixed position and velocity vectors for every transmit pulse. Also provided are two versions of a digital elevation model, “alos.dem” and its metadata file “alos.dem.rsc”, and “alos.xyz”. The latter gives the three dimensional earth-fixed position of each point in the DEM. ALOS is a new L-band data set for you, but it will help you get ready for NISAR.

- Relevant ALOS information is as follows:
  - Range of First Range Sample: 1194925.0 (m)
  - Range Sampling Frequency: 16000000.000000 (Hz)
  - Chirp Slope: -518518518518.518494 (Hz/s)
  - Pulse Length: 0.00002700 (s)
  - Wavelength: 0.23605710 (m)
  - PRF: 1655.629000 (Hz)
  - Antenna Length (along-track): 8.9 (m)
- “alosraw.dat” is a flat binary file, with no headers.
  - Number of complex samples per line: 4144
  - Number of lines: 27152
  - Complex sample format: (float32,float32)
- “alos.dem” is a digital elevation model, unsigned integer16 numbers, representing height above the ellipsoid in meters on a lat/lon grid.
  - Dimensions and geographic coordinates of corner points are in “alos.dem.rsc”
- “alos.xyz” is a flat binary file. Each element represents the x,y,z earth fixed coordinates of a lat,lon,height in “alos.dem”. The shape of the array is a triplet of float64 numbers, with (x,y,z) points per line given in the alos.dem.rsc”

The DEM is sampled roughly every 30 m. Based on the input parameters for ALOS PALSAR, how does this compare to the resolution of a full-resolution image?

Since your implementation may be not optimized, you will need to experiment with the size of the synthetic aperture and the size of the area you can process in a reasonable amount of time.

1. Write a general back-projection processor to focus the data using the raw data, satellite position/velocity information, and xyz values of lat/lon/height provided.
  - a. Select an area of 10 km x 10 km in an area with some good contrast.
  - b. Focus the data to 100 m resolution in azimuth, display an image of the result.
  - c. Steadily decrease (make finer) the resolution toward 5 m and demonstrate improvement in resolution as processing time increases. If necessary, decrease the processed area to make processing time manageable.

- d. Increase the area processed to see how much of the image you can create in a reasonable amount of time, and at what resolution.



Image of the ALOS PALSAR scene covering the area of the DEM provided.