1. Number formats in ISCE data files

ISCE files are almost universally either binary “flat files” containing image data or large arrays of processing relevant information, or ASCII text files containing logging, metadata, and other ancillary information. A “flat file” is just an unformatted sequence of binary numbers that can represent one-, two-, or n-dimensional arrays of data. The binary numbers themselves can be single bytes integers, two-byte integers, four-byte integers, or four-byte floating point numbers, depending on the data file and its application.

To further complicate matters, the numbers can be complex, that is with a real and imaginary part. Radars are coherent instruments, essentially operating at a single radio sinusoidal frequency. As such, the instrument can keep track of the magnitude and the phase of the sinusoidal signal in the received data. It is this phase information that allows us to perform interferometry - interfering the phase of one image against another. (For those rusty on complex numbers: the magnitude of a complex number is calculated from $(R*R+I*I)^{1/2}$ and the phase from $TAN^{-1}(I/R)$).

Complex numbers are typically represented in a file as “sample-interleaved” data. For example, for a 3 x 3 image, if `R` represents the real part of a sample, and `I` represents the imaginary part of a sample, then the image file would look like:

Row 1: `RIRIRI`
Row 2: `RIRIRI`
Row 3: `RIRIRI`

and represented as just a sequential unformatted list of numbers it would look like:

`RIRIRIRIRIRIRIRIRI`

Note that R and I represent different values at each sample position. Note also that the number format for the samples can be a range of possibilities. In ISCE, generally, `R` and `I` are 4-byte float numbers, such that the complex sample is an 8-byte complex quantity. But there is no reason that complex numbers could not be for instance represented as having a 2-byte real and 2-byte imaginary part.

Another aspect of these flat files is that they may contain more than one layer of data. For example typically, ISCE binds a radar image and a derived interferometric image into one file to make it convenient to match an easily recognizable geographic feature with an interferometric quantity. These files are typically line-interleaved. A 3 x 3 line interleaved example would be:

Row 1: `AAA`
Row 2 `PPP`

Row 3: `AAA`
Row 4 `PPP`
Row 5: `AAA`
Row 6: `PPP`

where again A and P represent different values at each sample. This can also be thought of as a double width file of three rows.

Row 1: `AAAPPP`
Row 2: `AAAPPP`
Row 3: `AAAPPP`

ISCE does have some file naming conventions that would aid a user in knowing what format is specified, but it is best not to rely on that. The Output File Formats discussion in the Datasets tutorial has a complete description of the naming conventions used in ISCE for flat files.

Clearly, without a metadata file describing the dimensionality and other attributes of the data file, a user would need separate documentation to interpret it. ISCE metadata files carry all the necessary attributes of the data.