1. Understanding ISCE Output Files and Formats

If you ran the lab 3.1 or labs 4–7, you will have a directory containing many output files. These files are the outputs at various stages of the workflow, and can be explored with mdx.py to gain insight into their characteristics: dimensions, intrinsic feature characteristics, noise characteristics, and other aspects. Each of these files is either a “flat” binary file containing numbers that represent the images with no other formatting information, or an XML metadata file describing the attributes of a corresponding image. In all cases, the binary data file has the form <prefix>.<extension> and its corresponding XML metadata file has the form <prefix>.<extension>.xml. The file extensions and their implication as to the data type stored in the file and function in the ISCE workflow is given in the following table.

File Extension	Datatype	Description	ISCE outputs.
.raw	Byte, two channel	Byte samples for I and Q channels. (BIP format)	Used to store raw radar echoes.
.slc	complex64, single channel	Complex floating point data, 8 bytes per sample, 4 for real and 4 for imaginary	Used to store SLCs. Short for single look complex image.
.int	complex64, single channel	same as .slc	Used to store complex valued interferograms. Short for interferogram.
.amp	float32, two channels	One line of first amplitude channel, followed by one line of channel 2. (BIL format)	Used to store amplitude files. Short for amplitude.
.cor	float32, two channels	One line of amplitude, followed by one line of coherence (BIL format)	Used to store coherence files. Short for correlation.
.unw	float32, two channels	One line of amplitude followed by one line of unwrapped phase in radians (BIL format)	Used to store unwrapped phase files. Short for unwrapped.
.mph	complex64, one channel	same as .slc	Used for simulated data to clearly indicate that the contents do not contain real radar observations.

			Short for magnitude/phase.
.flat	complex64, one channel	same as .slc	Used to store interferograms whose topography phase component has been removed. Short for flattened.
.mht	float32, two channels	One line of amplitude, followed by one line of data (BIL format)	Used for simulate data to clearly indicate that the contents do not contain real radar observations. Short for magnitude/height.
.geo	Variable	Depending on the basename of the file	.geo is used to indicate that the file contains geocoded data.
.rdr	float32, one channel	Depending on the file basename	This extension is used to indicate geometry parameters like lat,lon, z etc. in radar coordinates.

As an example, let's look at a ".int" file. Change your directory to the outputs of Lab 3.1.

```
> cd ~/data/lab3/alos/20070612_20090802
> ls *.int *.int.xml
resampImage.int  resampImage.int.xml  resampOnlyImage.int
resampOnlyImage.int.xml
```

`resampImage.int` is a binary file containing a floating point representation of complex numbers: 4 bytes for the real part followed by 4 bytes for the imaginary part. Using the unix `more` or `less` commands, you can examine some of the metadata fields. For example we see in `resampImage.int.xml` some of the fields:

```
      <property name="DATA_TYPE">
          <value>CFLOAT</value>
      </property>
      <property name="IMAGE_TYPE">
          <value>cpx</value>
      </property>
...
      <property name="NUMBER_BANDS">
          <value>1</value>
      </property>
...
      <property name="WIDTH">
          <value>5194</value>
      </property>
      <property name="LENGTH">
          <value>5529</value>
```

```
    </property>
    <property name="SCHEME">
        <value>BIP</value>
    </property>
```

These attributes state that the file data types are complex floating point numbers, that the file is BIP (band interleaved by pixel) with only 1 band, and has the number of samples across ("WIDTH") of 5194 pixels and number of samples down ("LENGTH") of 5529 pixels, making for an image with 28,717,626 complex pixels, with each pixel being 8 bytes. So the total size of the binary data file should be 229,741,008 bytes. And indeed that is the file's size:

```
> ls -l resampImage.int
-rw-rw-r-- 1 ubuntu ubuntu 229741008 Jul 25 19:02 resampImage.int
```

Feel free to explore other files and formats. The `.amp` file is an unusual format for instance, being a 2-band BIP file with each of the image amplitudes in the two bands. For `insarApp.py`, the final product is a `.geo` file, which is a geocoded version of an interferogram or other derived product. The band interleaving scheme for `.geo` files varies depending on how the data were derived. `topophase.flat.geo` is a complex 1-band BIP file like the `.int` file, as is `filt_topophase.flat.geo`. If an unwrapping filter had been applied to the interferogram, however, the file would be BIL (band interleaved by line) with two bands.