GEODETICALLY ACCURATE IMAGING OF POORLY MAPPED REGIONS USING MOTION-COMPENSATED ALOS DATA AND PRECISE ORBITS

Howard A. Zebker
Stanford University

Scott Hensley, Paul Rosen
Jet Propulsion Laboratory

1. INTRODUCTION

Several InSAR processing packages, free and for pay, are in common use by the science community today. The ready availability of precise orbit information for modern sensors leads to improvements in these packages that produce geodetically accurate interferograms, greatly improving the usability of the products. Placing the output pixels on known, precise grids also reduces the need for image matching and precise registration. We present our approach for generating accurate and high quality interferograms, which we demonstrate using ALOS PALSAR data. Our approach also enables the software package to process multiparameter, multichannel radar data with little change. Thus, polarimetric InSAR data are easily registered so that diversity in polarization may be incorporated into radar backscatter models.

2. APPROACH

Our approach is to use motion compensation algorithms and the precise orbits to determine exactly where output pixels are placed. Three technologies contribute greatly to our effort: First, we interpolate the satellite orbits to an accuracy of cm at a sample spacing corresponding to each radar transmit pulse. Clearly this is a limit set by orbit measurements, but we find that for ALOS the orbits appear accurate to the 10's of cm level. The extra error introduced by the interpolation is less than 1 mm. Secondly, we express the location of the satellite in a coordinate system defined with respect to the nadir location satellite at a fixed point. Finally, we use motion compensation methods to place the satellite effectively in a special, non-inertial orbit in which the azimuth reference function is particularly simple in form. The combination these makes it easy to keep track of the output pixel locations.

3. SOFTWARE ATTRIBUTES

Our intent is to develop a modular processing package that is easily modifiable by users for specialized applications, while still retaining the advantages of accurate and efficient code. We have used Fortran 90 as the coding medium because there exists free compilers that run on most platforms and allow for multithreading of the code for multicore environments. Subroutines are linked via python scripts, and a single parameter file organizes the data flow, permitting traceability and reproduceability of each data run.

4. RESULTS

We have applied our processor to ALOS PALSAR interferometric pairs over many terrain types and under several of the radar modes. In each case orbit accuracies are sufficient to produce maximal quality interferograms. We show data acquired over Greenland, North and South America, and Africa, and will describe InSAR correlation and phase shifts for these varied data sets. Data show variability related to polarization channel, with HH and VV data being remarkably similar in interferometric character. Unusual phase changes appear in cross-polarized data when compared to co-polarized data in many regions, especially when there is significant penetration of data into the medium—ice is the best example of this. The geodetic accuracy of the final products is to the accuracy of our digital elevation model data, which we obtain from SRTM. Throughput can be as low as one minute for a full ALOS scene when run on a desktop, eight core (US$5000) computer.