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Multi-frequency Interferometry on Synthetic Aperture Sonar Images

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Interferometric processing on synthetic aperture sonar (SAS) images can provide accurate bathymetric maps with very high spatial resolution. Often, bathymetric precision is limited by two-pi phase ambiguities in the interferogram. Several phase-unwrapping algorithms exist, but they all depend on some type of continuity throughout the interferogram.
The locations of the phase ambiguities are dependent on the carrier frequency of the transmitted signal. Dividing the frequency band into multiple sub-bands provides multiple interferograms, each with a unique carrier frequency and thus differing ambiguity positions.
In this paper, we investigate how to take advantage of sub-band interferograms to reduce phase ambiguities at the expense of accuracy. This is performed by using the phase differences between the individual sub-band interferograms. We also present a method were we use the differences in sub-band interferograms to eliminate the phase ambiguities in both the original interferogram, and in the sub-band interferograms themselves. Both methods are tested on simulated data and field data collected by the HUGIN autonomous underwater vehicle carrying the Kongsberg HISAS 1030.