PHASE CALIBRATION OF AN ALONG-TRACK INTERFEROMETRIC FMCW SAR

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Frequency-modulated continuous wave (FMCW) radars are appealing for implementing airborne synthetic aperture radars (SAR) because they are compact and use low-power transmitters. The Applied Physics Laboratory of University of Washington, in collaboration with Artemis Inc., has developed a miniaturized dual-receiver along-track interferometric (ATI) FMCW synthetic aperture radar (SAR) that is operated on a Cessna 172 aircraft. The system has been deployed in various nearshore ocean field experiments to provide high-resolution estimates of surface velocity. In this paper, we outline a procedure to calibrate the phase difference between the receivers in the radar and their corresponding amplitude responses. This calibration is necessary because difference frequency in an FMCW radar is equivalent to distance from the radar, so the phase difference between receiver channels introduces a range dependent phase offset in the interferograms. This phase offset can be observed as range dependent periodic ripples over the land area in the interferograms generated from the data collected using the ATI FMCW SAR. We estimate the phase difference between receivers using a lab-based calibration scheme. This scheme estimates phase differences throughout the receivers, including the digital subsystem. We present two formulations of the estimation technique: a curve-fitting formulation and a matrix formulation. Both approaches reproduce the range-dependent phase ripple seen in the ATI interferograms, and allow us to almost completely remove the range-dependent phase ripple in the post-processing for the interferograms. However, our lab-based measurements show that the phase response of the receiver is temperature dependent, and we hypothesize that this temperature dependence is the dominant source of the residual phase error in calibrated interferograms.