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EVALUATION OF THE TOPSAR PERFORMANCE BY USING PASSIVE AND ACTIVE CALIBRATORS

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This paper presents the preliminary analysis of the C-band cross-track interferometric data (XTI) acquired during the MAC Europe 1991 campaign over the Matera test site, in Southern Italy. 23 passive calibrators (Corner Reflector, CR) and 3 active calibrators (Active Radar Calibrator, ARC) were deployed over an area characterized by homogeneous background (Fig. 1). Contemporaneously to the flight, a ground truth data collection campaign was carried out (*CO.RI.S.T.A.*, 1991).

The DC-8 NASA airplane was equipped with the JPL AIRSAR, which had been modified at the Ames Research Center to accommodate two C-band antennas designed and developed by the CO.RI.S.T.A. Consortium and to receive the two channels by using the existing hardware (TOPSAR, *Zebker et al.*, 1992).

The research activity has been focused on the development of motion compensation algorithms, in order to improve the height measurement accuracy of the TOPSAR system. Moreover, we intend to derive the system impulse response by comparing and integrating a theoretical model, the available ancillary data, and the CR's phase history.

In the following we present a status report of our research, which has been mainly devoted to compute a reference function for azimuth compression, that accounts for phase errors due to the airplane dynamics. In this work, after the characterization of the doppler histories of the CRs and the ARCs, we carry out a correlation between the attitude data and the phase of the range-compressed calibrators. Experimental results show a satisfactory correspondence between the airplane dynamics described in the ancillary data and the one reconstructed from the phase history of the calibrators (shown in Fig. 2). At this stage we are able to derive a range-dependent azimuth reference function which compensates also velocity and attitude perturbations. In order to validate this procedure, we perform an

C-2

image quality analysis for several calibrators, evaluating their one-dimensional 3dB resolutions, ISLR (Integrated Sidelobe Ratio), PSLR (Peak Sidelobe Ratio) and SCR (Signal-to-Clutter Ratio) (*JPL SIR-C Team et al.* 1990), and consequently an estimate of their radar cross section. A preliminary comparison of numerical results with theoretical performance, ground truth and anechoic chamber data is encouraging, and allows a refinement of the azimuth filter.

Then, the raw data gathered by the two antennas are processed separately and combined to form an interferogram. The reconstructed airplane dynamics is also used to derive the baseline time variation, that is necessary for the 2π phase unwrapping procedure. To this end we have developed a computer code based on a two-dimensional algorithm which uses the calibrators as ground control points, both to solve the first 2π ambiguity and to overcome decorrelation problems when possible.

Finally, the computed terrain elevation is compared with the 1:25000 scale contour levels of the Italian Istituto Geografico Militare (IGM), in order to assess the height accuracy of the system and to evaluate the improvement consequent to a more sophisticated interferometric processing.

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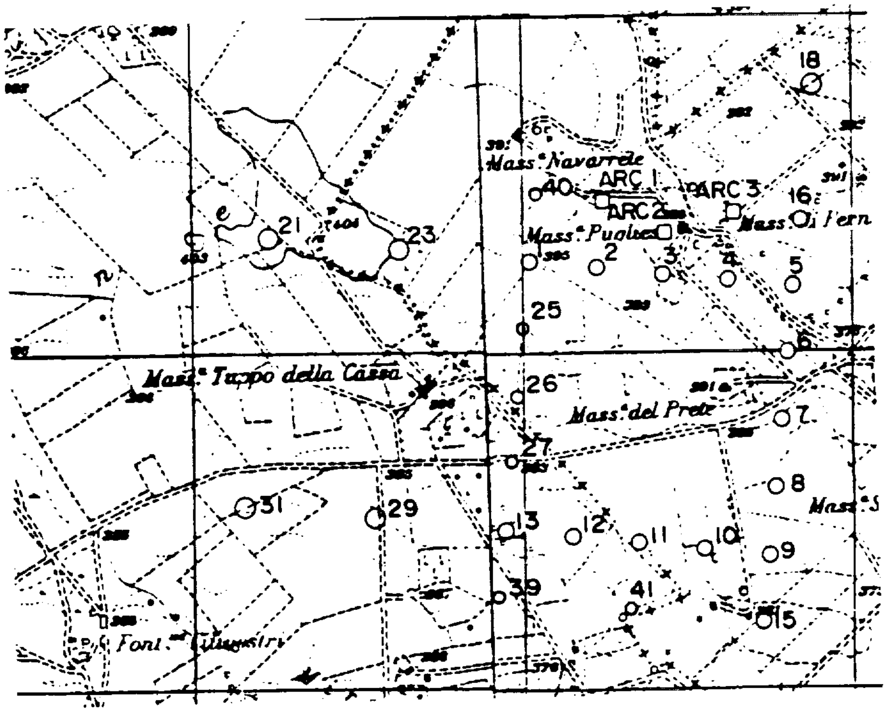

Fig. 1. Location of CRs and ARCs in the test site.

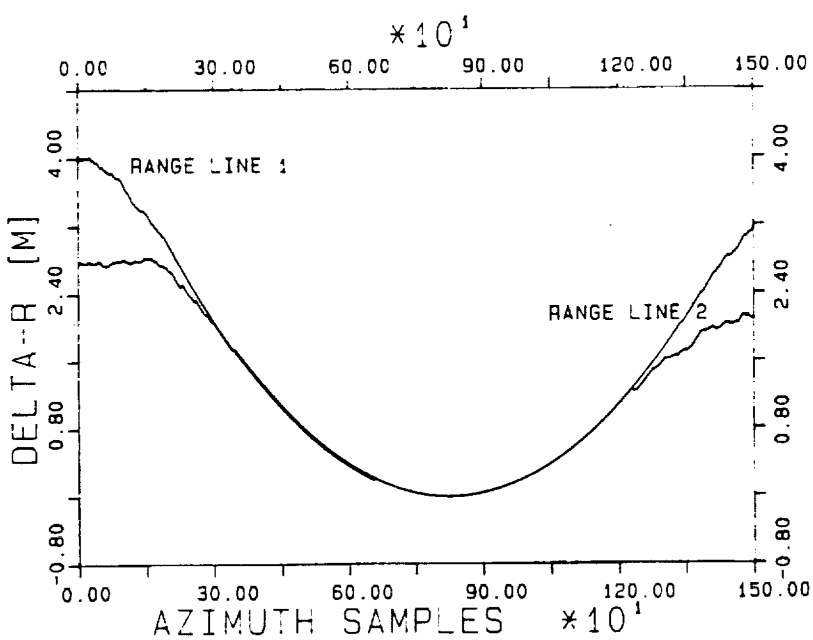

Fig. 2. Differences of the airplane-CR distance along two adjacent range bins in the range-compressed data.