

## **Use of the SAR (Synthetic Aperture Radar ) P band for detection of the Moche and Lambayeque canal networks in the Apurlec region, Perú**

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In recent years, research attention has been devoted to the development of a new class of airborne radar systems using low frequency bands ranging from VHF/UHF to P and L ones. In this frame, the Italian Space Agency (ASI) has promoted the development of a new multi-mode and multi-band airborne radar system, which can be considered even a “proof-of-concept” for the next space-borne missions. In particular, in agreement with the ASI, the research consortium CO.RI.S.T.A. has in charge the design, development and flight validation of such a kind of system, which is the first airborne radar entirely built in Italy. The aim was to design and realize a radar system able to work in different modalities as: nadir-looking sounder at VHF band (163 MHz); side-looking imager (SAR) at P band with two channels at 450 MHz and 900 MHz. The P-band is a penetration radar. Exploiting penetration features of low frequency electromagnetic waves, dielectric discontinuities of observed scene due to inhomogeneous materials rise up and can be detected on the resulting image. Therefore buried objects or targets placed under vegetation may be detected. Penetration capabilities essentially depend on microwave frequency. Typically, penetration distance is inversely proportional to microwave frequency. The higher the frequency, the lower the penetration depth. Terrain characteristics affect penetration capabilities. Humidity acts as a shield to microwave penetration. Hence terrain with high water content are not good targets for P-band applicability. Science community, governments and space agencies have increased their interest about low frequency radar for their useful applicability in climatology, ecosystem monitoring, glaciology, archaeology. The combination of low frequency and high relative bandwidth of such a systems has a large applicability in both military and civilian applications, ranging from forestry applications, biomass measuring, archaeological and geological exploration, glaciers investigation, biomass monitoring, detection of buried targets. Its extension to non-civil application concerns sub-surface target detection and foliage penetration (FOPEN). In order to achieve the flexibility to face all the above mentioned fields of application, the CORISTA system has been designed as a multi-mode and multi-frequency radar. Multimode stands for the functionality of the system both as Sounder and Imager. In addition, P-band radar is a multi-frequency instrument, since it is designed to work in three different frequency bands, as mentioned above: lower frequency band is used in sounder operative mode, higher frequency in imager operative mode. In the Imager operative mode, low resolution and high resolution capabilities are implemented. The data collected by the radar system have been processed using a model-based microwave tomographic approach, recently developed by IREA-CNR, with the aim to enhance the interpretability of the raw-data radar images. Currently, the non-invasive SAR P band application is under evaluation for testing in the Northern Coast of Perú, in collaboration with the Museo Arqueológico Nacional Brüning. The project will aim to recognize the subsurface ancient Moche (100-700 d.C.) and Lambayeque (700–1375 d.C.) canal networks, whose water supply comes from the Canal Taymi, started to be dug by the Mochicas, still in use by local communities.