Polarimetric L-Band Imaging Scatterometer (PLIS)

A consortium composed of The University of Melbourne, Airborne Research Australia (ARA)/Flinders University of South Australia, The University of Adelaide, Curtin University of Technology and The University of New South Wales

1. Introduction

The PLIS is an L-band (1.26GHz) radar from ProSensing which can measure the surface backscatters at HH, HV, VH and VV polarisations. It allows monitoring environmental variables such as soil moisture, vegetation and salinity, and additionally terrain height when used as an Interferometric SAR (InSAR).

2. Specifications

Table 1. PLIS specifications.

Radar Specification	Value
Antenna type	2x2 patch array
Antenna gain	9 dBi ± 2 dB
Cross-polarization isolation	>-20 dB over ± 15° off peak
RF output frequency	1.245-1.275 GHz +/- 1.0 MHz with 30 MHz bandwidth chirp
Peak transmit power	25 W min
Pulse Repetition Frequency (PRF)	Up to 20kHz
Pulse width	100 ns to 10 µs
Transmit polarization	Linear, H or V
Receiver polarization	Linear, H or V

3. Aircraft Configuration

The PLIS is composed of two main antennas and two auxiliary antennas tilted at an angle of 30º from the horizontal to either side of the aircraft. Both antennas are able to transmit and receive at V and H polarisation. The main antennas are installed in an under wing pod of ARA's Eco Dimona, providing a cost efficient and environmental friendly platform. The RF unit and system computer are installed inside the pod (Fig. 1). The auxiliary antennas can be installed under the adjacent under wing pod.

4. Modes

For ordinary SAR operation only the main antennas are utilized to gather radar returns. These are then processed offline using a to produce fully focused SAR imagery. In instantaneous Interferometric SAR operation both the main and auxiliary antennas are used to measure phase difference.

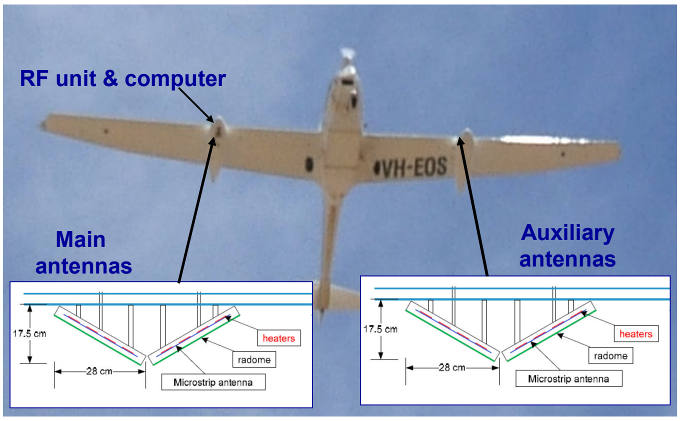

Figure 1. PLIS installation layout on the Dimona of Airborne Research Australia.

5. Performance (SAR)

The PLIS can be typically flown at any altitude between 150m and 3km, which impacts the swath achieved. In the cross-track direction, PLIS data are obtained between 15º and 45º from nadir (as a result of the antenna's 30º tilt and gain pattern). This results in two strips of high resolution PLIS data between 15º and 45º on either side of the aircraft. Table 2 lists the 15º-45º swath and ground spatial resolution of PLIS for two typical flight altitudes.

The sensitivity of the system is expressed in terms of noise-equivalent normalized radar cross section (NRCS), derived from the radar range equation. Minimum detectable NCRS at different altitudes are also listed in Table 2.

Table 2. Characteristiscs of PLIS data.

Flight Altitude (m AGL)	Swath (m)	Spatial Resolution across/along track (m)		Minimum detectable NRCS*
		15°	45°	
3000	~2000	29/0.2	10.6/0.2	-44dB
750	~600	29/0.2	10.6/0.2	-62dB

*PRF = 6750Hz, Pulse Length = 3.75µs, Vy = 45m/s

6. Applications

Radar backscatter at L-band is sensitive to soil moisture and vegetation biomass over land and to salinity over the ocean. Moreover InSAR techniques can be used to map terrain height at very high resolution and accuracy:

- Soil moisture can be derived by SAR backscatter since it affects the microwave reflectivity of the soil through the soil dielectric constant, and hence the fraction of incoming energy scattered back toward the radar;
- Vegetation biomass also influences the ratio between incoming and reflected radiation depending on the vegetation structure and water content;
- Over the ocean, the radar backscatter is mainly a function of the sea surface salinity and the surface roughness from wind and waves; and
- Microtopographic terrain relief can be performed using PLIS in interferometric mode.

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