F-SAR – DLR'S NEW MULTIFREQUENCY POLARIMETRIC AIRBORNE SAR

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1. ABSTRACT

The Microwaves and Radar Institute of the German Aerospace Center (DLR) is known for consistent work on the field of airborne synthetic aperture radar and its application. In April 2008 the 20th anniversary of the maiden flight of the well-known E-SAR system was celebrated. E-SAR was maintained well over the time. It provided valuable knowledge to the science community, especially in the past 10 years. However, it became more and more obvious that a technological renewal was inevitable. Consequently the development of a new SAR system was put on line some years ago under the name 'F-SAR'.

2. DLR'S NEW AIRBORNE SAR

F-SAR identifies the successor of the well-known E-SAR system. The system is under development at the Microwaves and Radar Institute. The development was triggered by the demand for data being simultaneously acquired at different wavelengths and polarisations as well as by the demand for very high range resolution.

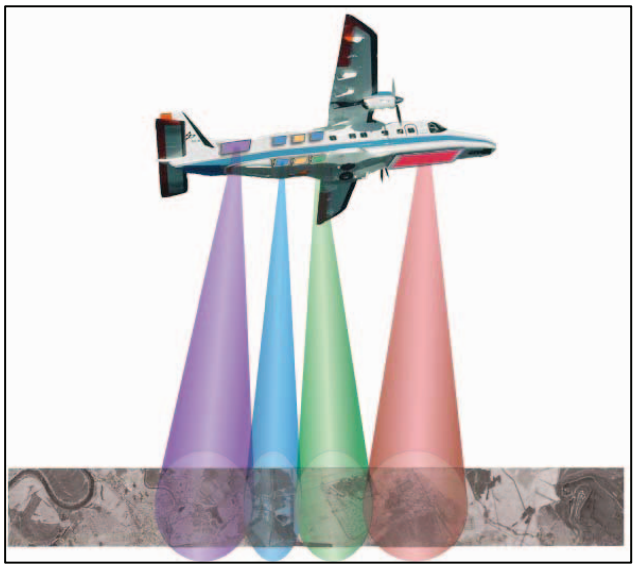

Figure 1 Artist's view: F-SAR onboard DLR DO228 acquiring data simultaneously in X-, C-, L- and P-bands (X-blue, C-green, L-purple, P-red).

E-SAR, the old system, cannot comply with these requirements due to technological limitations. F-SAR is a development utilising most modern hardware and commercial of the shelf components. As for E-SAR DLR's Dornier DO228-212 aircraft is the first choice as platform for the new system (see Fig. 1).

2.1. F-SAR general system design features

F-SAR is designed to operate in X-, C-, S-, L- and P-bands with

- simultaneous all polarimetric capability and
- single-pass polarimetric interferometric capability in X- and S-bands.

Repeat-pass Pol-InSAR is a standard measurement mode. Range resolution is determined by the available

system bandwidth. While components limit system bandwidth to 100MHz at P-band, a step-frequency approach is adopted to achieve up to 800MHz effective signal bandwidth at X-band to satisfy the requirement for very high resolution.

2.2. F-SAR instrument design overview

The F-SAR system comprises a basic system control and data acquisition sub-system to which individual RF subsystem modules are connected. System control is based on an Extended CAN bus and Ethernet concept. This gives the necessary flexibility and the degrees of freedom to configure the system optimally for carrying out the desired measurements and experiments like bistatic SAR for instance. Further, the concept makes an extension to any other RF band an easy task. Main F-SAR technical parameters are given in Table 1.

Table 1 F-SAR technical characteristics

	X	**C**	**S**	**L**	**P**
RF [GHz]	9.60	5.30	3.25	1.325	0.35
Bw [MHz]	800	400	300	150	100
PRF [KHz]	5	5	5	10	10
PT [kW]	2.50	2.20	2.20	0.90	0.90
Rg res. [m]	0,3	0,6	0,75	1,5	2,25
Az res. [m]	0,2	0,3	0,35	0,4	1,5
Rg cov [km]	12.5 (at max. bandwidth)				
Sampling	8 Bit real; 1GS/500MS selectable; max number of samples 64K per range line; 4 recording channels				
Data rate	192MByte/s max (per rec. channel)				

For regular Earth observation purposes the radar covers an off-nadir angle range of 25 to 60 degrees at altitudes of up to 6000m above sea level, which is the maximum operating altitude with the DO228 aircraft. For special use other off-nadir angle ranges, like 60 to 85 degrees for long stand-off imaging or 0 to 25 degrees for sounding or steep incidence applications, can be realised technically.

3. SUMMARY

F-SAR is in the building phase. The radar back-end, i.e. system control and data acquisition modules, the X-band front-end section and X-C-S-band up/down-converter modules are under flight test. C- and S-band front-ends have recently passed flight testing. L- and P-band sub-sections shall follow in 2009 and 2010, respectively.

In this paper we will review the system design and will give a status overview. During testing phase we have carried out a series of radar experiments with the F-SAR instrument (GMTI for traffic monitoring, bistatic SAR with TerraSAR-X). Multifrequency operation, radiometric and polarimetric calibration are on-going activities. We will reference this work and show results.