CONICAL BEAM INTERFEROMETER: FPIR CONCEPT AND DEVELOPMENT

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1. INTRODUCTION

One Dimensional **F**ull **P**olarization **I**nterferometric **R**adiometer (FPIR) is a light weight high sensitivity interferometer, differing from ESTAR-like precedent on full polarization, conical antenna beam and 2-point calibration[1]. Initially, FPIR is designed to work together with MIRAS-2, the payload of possible operational SMOS mission (SMOSops), to form a dual frequencies remote sensing system. This dual frequencies system can be used to improve the accuracy of the estimation of soil moisture and ocean salinity.

However, as a fully polarimetric interferometer, applications of FPIR are not constrained by SMOSops. Based on the FPIR principle, radiometry instrument of multiple frequency bands is more than substitute of classical radiometer and polarimeter. Benefit from its electrical scanning, full polarization and relatively simple electricities, FPIR is able to measure geographical parameters of atmosphere, land and ocean with a small satellite.

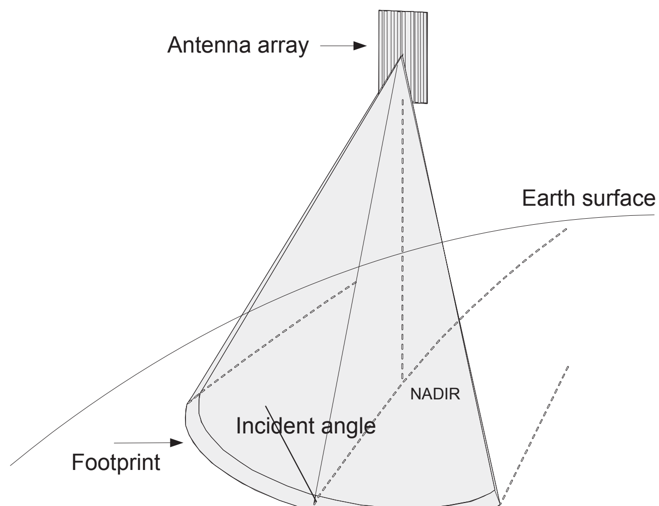

Fig. 1FPIR operation mechanism

A visible application of FPIR is an instrument combined 2 or 3 frequencies for retrieval of ocean surface wind field. Windsat has successfully demonstrated the ability to measure wind vector over ocean with the polarimetric radiometer, but the requirement of large aperture antenna presented difficulties in the antenna manufacture and mechanical rotation in orbit [2]. C plus X bands of FPIR can achieve the objectives without large aperture antenna.

2. OPERATION PRINCIPLE

FPIR concept is based on its precedent, an X-band single polarization interferometric radiometer built in 2004 [3]. Aimed on the measurement of ocean surface wind vector, FPIR is improved on dual-pol antenna, polarization switching and polarimetric information retrieval.

FPIR is composed of polarimetric antenna array, switching front-end, receiver and correlator. The antenna plane of FPIR is perpendicular to satellite orbit. Dedicated squint angle of 47° from the normal of antenna plane generates conical beam pattern and thus constant incidence angle on every pixel. The squint angle is optimized taking into account the radiometric sensitivity of the wind vector over the Earth incident angle, typically 50° to 60° for wind monitoring and 50° for FPIR. An additional horn antenna and a switch are included to provide cold reference sequentially to each receiver during the calibration procedure. To produce fully polarimetric (VV, HH, VH and HV) products, each antenna elements have to output V and H polarizations. Antenna element itself is a linear array in order to generate conical beam pattern. To reduce the mass of the instrument, each pair of V and H ports share a same receiver. The receiver is sequentially switched to V and H ports , following a sophisticated sequence. Fully polarimetric information of the footprint is finally produced after 4-step polarization switching. The operation mechanism of FPIR is depicted in Fig. 1

3. DEVELOPMENT OF KEY TECHNIQUES

Key techniques such as antenna element with two polarizations, polarization switching, light weight receiver, multi-bit correlator and the retrieval algorithm have been studied. Due to the special requirement on two polarizations, traditional waveguide antenna that has been used in ESTAR could not be applied directly to FPIR. FPIR requires a new concept of linear array. Linear horn array and dipole array are being considered. A theoretical model of the element antenna is as Fig. 2. A prototype antenna element is being built. For different antenna schemes, polarization switching sequences have been developed. For any case, a 4-step switching sequence is applicable to cover all the polarization state. A breadboard of the receiver has been built, the noise figure is less than 2dB seeing from the antenna port.

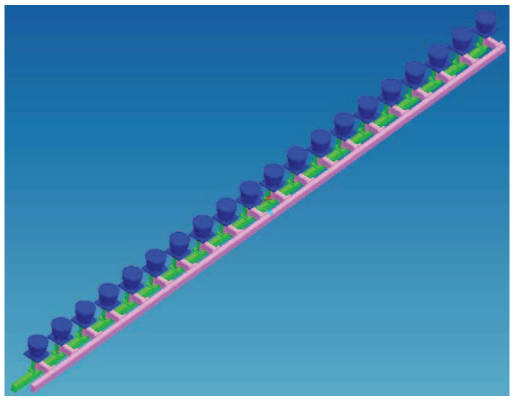

Fig. 2 element antenna with linear horn array

4. CONCLUSION

FPIR concept is presented in detail. Breadboards of key parts are being built. Simulations and parameters of real parts are well matched each other. Preliminary result demonstrates that FPIR concept is feasible for space applications.

5. REFERENCES

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