A GENERAL PLATFORM FOR MILLIMETER WAVE SYNTHETIC APERTURE RADIOMETER

Qingxia Li, Fei Hu, Wei Guo, Ke Chen, Liang Lang, Jing Zhang, Yaoting Zhu, Zuyin Zhang
Huazhong University of Science & Technology, Wuhan, 430074, China
Qingxia_li@hust.edu.cn

1. INTRODUCTION

For passive microwave remote sensing from space, in order to provide high spatial resolution without requiring the very large and massive scanning antenna of a real-aperture system, microwave synthetic aperture radiometers are proposed for both low frequency band such as L-band [1] and high frequency band such as millimeter wave band [2].

However, there are more error sources such as antenna error, baseline error, and channel error in synthetic aperture radiometer, which degrade the system performance, and more complex calibration system is required. At millimeter wave band, the synthetic aperture radiometer is more sensitive to errors because of shorter wavelength.

To evaluate the error effects on synthetic aperture radiometer performance, calibration performance, and to provide a tool for improving design of synthetic aperture radiometers, a general array receiving platform for millimeter wave synthetic aperture radiometer is developed at Huazhong University of Science & Technology, Wuhan, China.

2. THE GENERAL PLATFORM FOR MILLIMETER WAVE SYNTHETIC APERTURE RADIOMETER

This platform consists of two parts: hardware and software, as shown in Fig. 1.

The hardware includes antenna array, receiving channel array, and A/D (analog to digital converter) array. A/D is located at IF stage, so that the platform can experiment with different configurations. At present, the hardware is working at 8mm wave band.

The software is a simulation program, which include a complete chain simulation from scene emission, transmission through atmosphere, array receiving, correlation, image reconstruction (inversion), image processing, and display. It contains five main blocks: scene and atmosphere block, antenna array block, receiving channel array block, synthetic aperture processing block, and image processing block.

The software has a flexible and open structure. It organizes models and algorithms by model and algorithm libraries. Currently, there are four model libraries: scene and atmosphere model library, antenna array model library, receiving channel array model library; and one algorithm library: image reconstruction algorithm library. Different models and algorithms can be chosen from libraries for flexible combination simulation. New models and algorithms can be easily added to the system without need to change the program structure.

When simulating, one can set parameters, choose appropriate models, algorithms from the libraries according to simulating requirements. When experimenting, the hardware is working jointly with synthetic aperture processing block to generate an image of a scene.
3. EXPERIMENT RESULTS

The experiment results with this platform to view the sun and buildings are given. The platform outputs good images when error correction is made, whereas it outputs degraded images when errors are not corrected. This means the platform can evaluate the error influence on synthetic aperture radiometer and calibration performance. Thus it can be used as a tool for improving design of synthetic aperture radiometers.

4. CONCLUSION

A general platform for millimeter wave synthetic aperture radiometer is introduced in this paper. The platform consists of hardware and software, and has a flexible and open structure. The platform is suitable for simulation of synthetic aperture radiometer performance, algorithm performance, error influence on radiometer performance, and calibration performance, especially at high frequency band, e.g. millimeter wave band. With the receiving array hardware, this platform can conduct experiments of 8mm synthetic aperture radiometer. If replacing 8mm receiving array with other frequency receiving array, this system can conduct experiments at other frequency bands.

5. REFERENCE


Qingxia Li received the B.S., M.S., and Ph.D. degree in Electronic Science and Technology from Huazhong University of Science and Technology, Wuhan, China, in 1987, 1990, 1999, respectively.
He is presently a professor in the Department of Electronics and Information Engineering, Huazhong University of Science and Technology, Wuhan, China. His research interests include passive microwave remote sensing, microwave detection, and digital signal processing.