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Research on X-Band Doppler Weather Radar with Dual-Linear Polarization Capability

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1 Introduction

Since Seliga et al (1976) presented the assumption of dual-linear polarization radar, the early dual-linear polarization radars were developed on the basis of conventional pulse radar. With the development of digital technology, the Doppler weather radar is becoming mature to mature, and shows more notable technical advantages. The Doppler radar features with excellent performance and complete functions, which can not only measure the location and strength of precipitation, but also provide the radial component of the wind vector and flow course of internal air stream within the precipitation.

2 Dual-linear polarimetric Doppler radar system and information processing

2.1 Information processing of dual-linear polarization Submission

The dual-linear polarization radar can be called a multi-parameter measuring system. The radar transmits the horizontal polarization and vertical polarization pulses alternatively or simultaneously, and receives the echoes, reflectivity factor Z_{HH} and Z_{HV} (e.g., horizontal, H, and vertical, V) by horizontal transmitting and the echoes, reflectivity factor Z_{VV} and Z_{VH} by vertical transmitting, thus it can measure multiple polarization parameters of hydrometeor. The Doppler radar can also evaluate the phase difference $\Phi_{DP}=\Phi_{H}-\Phi_{V}$ of horizontal and vertical polarized echoes. Besides the echo strength $Z_{(dBZ)}$ at horizontal polarization, the function of dual-linear polarization can measure differential reflectivity factor Z_{dr}, specific differential phase shift K_{dp}, linear depolarization ratio L_{drH} and L_{drV}, copolarization correlation coefficient ρ_{HV}, etc..

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2.2 Introduction to the System

Doppler dual linear polarization meteorological radar system is of full coherent PD type and features high-stability LO amplifier transmitter, low noise big dynamic digital receiver, low side lobe antenna, digital signal processing and real time picture terminal. The system can measure the intensity Z of meteorological echo and its characteristics of regional distribution in ground clutter environments, the system can also measure the radial velocity V of the scatter and velocity spectrum width W. Appliance of dual linear polarization technology results in that the radar system features powerful performance, gets more information about the shape and phase state of precipitation cloud and extracts such dual linear polarization parameters as Z_{DR}、K_{DP}.

3 Key technology of dual linear polarization

The key technology of dual linear polarization is to use high performance microwave ferrite material, compound wave-guide loading technique and high power resistant excitation control technology, so to realize the polarization switch of high speed, high power polarization conversion. The isolation of the switch is more than 30dB, the switch time is less than 5μs, power resistance is higher than 100kW. In addition, since the statistical quantity of the differential value of dual linear polarization parameters Zdr, Kdp and etc. measured for the system are all small values, so the standard of the measuring system is very high. So, the

test accuracy of the radar system is much higher than that of the common system. For example, differential reflectivity factor Zdr, accuracy of linear de-polarization ratio Ldr is 0.2dB, differential propagation phase shift accuracy is 0.2 °, these are very strict requirements to the system. Any small error in any part of the radar system will have very severe effect on the test result. Apart from the special requirements of the Doppler radar, accuracy of any part of the radar will become the core of the key technology of design and application of the dual linear polarization system. Besides, the following aspects are also very important.

4 Dual linear polarization experimental radar system

We have devised a one-channel dual linear polarization experimental system for several years on the basis of the strict system specifications and the polarization switch of high performance.

During its operation, the system has obtained many clear measured pictures about the weather process and the recognizable results about the rainfall and the snow.

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