RESEARCH ON VELOCITY DE-ALIASING METHOD FOR GROUND-BASED MILLIMETER WAVE CLOUD RADAR

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1. BACKGROUND

Millimeter wave radar is the new equipment of observing cloud, because it owns relatively short wavelength which is much more close to the diameters of small particles. It is suitable for detecting non-precipitation cloud and weak precipitation cloud, it has high sensitivity and resolution to obtain some important clouds parameters, such as radial velocity. Compared to the normal centimeter wave weather radar, millimeter wave radar's wavelength is shorter and the maximum unambiguous velocity is smaller, which more likely causes the velocity aliasing and severely limits the quality of velocity data. With the development and application of the ground-based millimeter wave radar, it's a urgent need to alleviate the problem of cloud radar velocity ambiguity.

2. DATA PRE-PROCESSING

Ground-based millimeter wave cloud radar usually uses three different scanning modes: plane position indicator (PPI), range height indicator (RHI) and time height indicator (THI). Taking into account the noise and data missing includes in the velocity product will influence the effect of velocity de-aliasing, put forward to pre-process the velocity data using noise separation method, k-neighborhood frequency method, fast median filtering method, and interpolation method.

3. VELOCITY DE-ALIASING

This research proposes corresponding methods aiming at velocity de-aliasing for the three scanning modes of ground-based millimeter wave radar, involving automated two-dimensional multi-pass velocity de-aliasing algorithm used in PPI, automated two-dimensional continuous extrapolation velocity de-aliasing algorithm used in RHI and THI. Fig1 showed the detailed process of velocity de-aliasing algorithm.

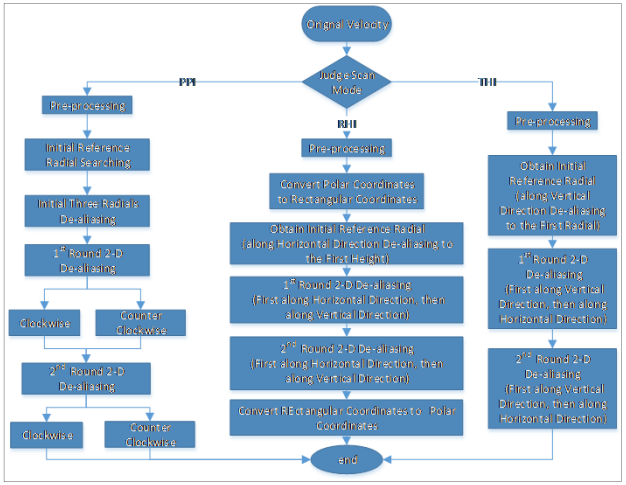

Fig1 Diagram of Velocity De-aliasing

4. VERIFICATION

Verification data collected from a ground-based Ka band magnetron radar locates on Chengdu university of information technology. The main system parameters of this radar are shown in table 1. The cases were chosen to test the algorithms in a variety of different environments. Fig2~5 presented an example of velocity de-aliasing under three scanning modes (PPI/RHI/THI) respectively. It can be seen from these figures that velocity de-aliasing algorithm performs well when velocity field is continuous, after de-aliasing there is only one zero velocity line in the scanning area while there are multiple zero velocity lines in original velocity because of velocity aliasing; and the positive and negative velocity region is located at the each side of zero velocity line; and after de-aliasing the maximum velocity can be up to 8m/s while in the original velocity it is only 3.225m/s.

Working Frequency	35GHz	**Wavelength**	8.6mm	**Beam Width**	0.2°
Pulse Width	0.5us	**Range Resolution**	37.5m	**Range Bin No.**	1280
PRF	1500Hz	**Max Velocity**	3.225m/s		

Table1 Main system parameters of data acquisition radar

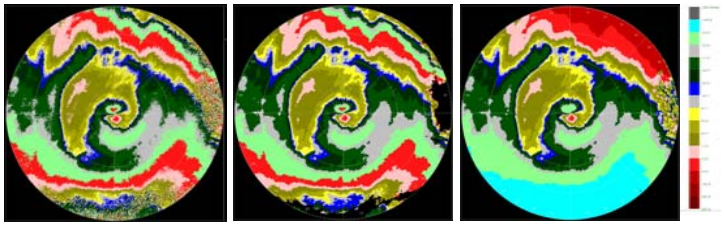

Fig2 PPI Velocity
Elevation：10º
Showed Max Range：12km
Left：
original Velocity
Middle：
Pre-proceed Velocity
Right：
De-aliasing Velocity

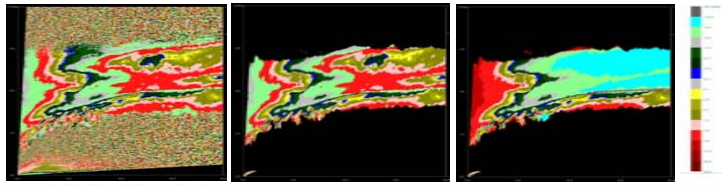

Fig3 RHI Velocity
Azimuth：330º
Elevation：2~85º
Showed Max Range：24km
Showed Max Height：12km
Left：
original Velocity
Middle：
Pre-proceed Velocity
Right：
De-aliasing Velocity

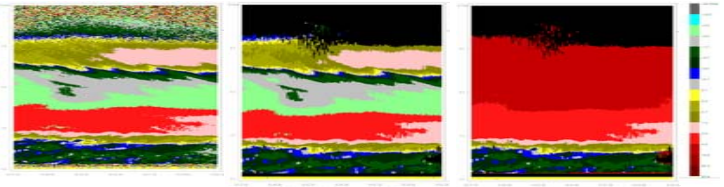

Fig4 THI Velocity
Elevation: 90º
Max Range：12km
Left：
original Velocity
Middle：
Pre-proceed Velocity
Right：
De-aliasing Velocity

5. SUMMARY AND FUTURE WORK

De-aliasing performance of two-dimensional continuous extrapolation method is fine under condition of velocity data being continuous and there is only one layer cloud, and the multiple velocity aliasing problem can also be solved. However, it's still a challenge to process velocity aliasing data with jumping spot or area and multilayered cloud, in the future can combine with the wind data of other detection equipment (such as sounding data and wind profile radar data) to solve the problem of velocity aliasing under these conditions.

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