A Virtual Wind Vector Retrieval Method based on Radar Echo Shape

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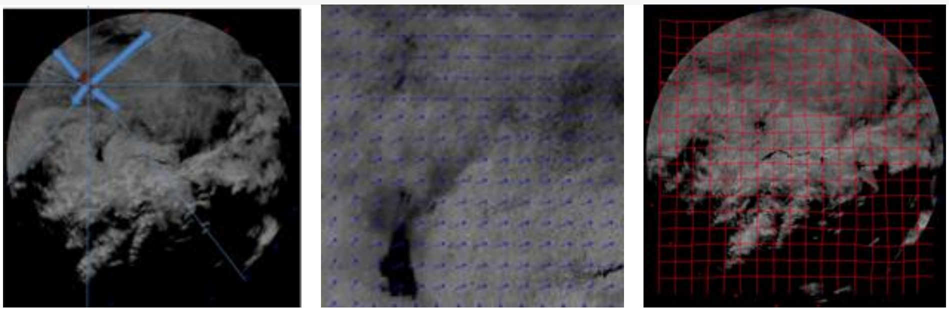
As urban flood damage has increased in recent years, interests in localized torrential rainfall are also increasing. Unlike surface rain-gauges that measure rainfall at a point, weather radars are used more effectively by observing precipitation distribution and movement trends and estimating precipitation through various algorithms in a planar or cubic way. However, existing large radars have difficulty in accurate detecting and tracking of rapidly changing local precipitation due to low spatial and temporal resolution. In order to overcome such disadvantages, there is an increasing tendency to build X-band radar networks having a relatively high spatio-temporal resolution.

In this paper, we propose a method to generate a virtual wind field mesh within a radar observation radius by direct operation on the polar coordinate system using only minimum information(Reflectivity or QPE) for real-time precipitation tracking and prediction. In addition, we propose a method to estimate the morphological distortion of the precipitation echoes in real-time using the generated virtual wind field mesh.

The proposed method first estimates the radar velocity using only SAD(sum of absolute differential) based similarity method with the minimum continuous PPIs' ray profile information(Reflectivity or QPE) that can be obtained in limited radar system or network environments. Then, two ray profiles having each the maximum value in positive and negative are extracted to calculate a global wind vector (GWV) for the whole coverage of the radar PPI. Through this process, it is possible to quickly search the entire movement of the precipitation echoes without the Doppler velocity information. The virtual wind field of Fig. 1- (b) is generated by using the inner product of the maximum visual velocity of the quadrants divided in GWV and local region on the realistic coordinate system as shown in Fig. 1- (a). Finally, the virtual wind field mesh as shown in Figure 1- (c) can be constructed by connecting the moving points of each virtual vector. Here, each distorted quadrangle in the mesh can be regarded as a square area within the radar moved by the wind field. Therefore, it is possible to estimate the movement of precipitation by applying recursively the transformation matrices after finding the matrix of each distorted quadrangle from all squares.



(a) (b) (c)

Figure 1. Configuration process of virtual wind field mesh, (a) Computing virtual vectors in the local area, (b) Virtual wind field generation result, and (c) Mash from virtual wind fields.

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