



Polarimetric Multiparameter Weather Radar

Ingo Klein, Dirk Fischer
Münster University of Applied Sciences
Faculty of Electrical Engineering and Information Technology
48565 Steinfurt, Germany

1. Abstract

Most conventional radar systems for weather observation purposes are designed for long-range applications in wide-meshed networks that make high-power transmitters and inertial parabolic dishes necessary. These aspects limit the possibilities of modulation and make the near-ground measurements less precise. With a new approach to the systems architecture, which is based on a dense network of overlapping short range phased array radar systems, like the Digital Beamforming Weather Radar (DBWR) architecture, combined with the polarimetric multiparameter intrapulse modulation of the transmitted pulse, those disadvantages can be revised.

In contrast to conventional networks of weather radar systems, the DBWR has the following advantages with its concept of operation:

- The dense network architecture with low detection ranges allows the use of low-power transmitters and results in better near-ground measurements, as well as a very high range resolution capability. Due to the much more efficient usage of the transmitted power the radiated radar emission into the environment is reduced and hereby social acceptance of this radar system near residential areas can be improved.
- The modular networking structure of the system allows an arbitrary scalable application depending on the particular environmental properties.
- The phased-array functionality of the system implicates the adjustment of the beam-direction without any mechanical movements. This allows a flexible scanning pattern with the capability to scan individual sectors, depending on the aerial properties and current weather conditions.
- The entire software-based transmitting pulse generation allows the simultaneous modulation of amplitude, phase, frequency and polarization over the complete period of the pulse length. This provides the possibility to optimize the modulation for the detection of a variety of weather conditions.
- The polarimetric transmitting pulse generation and the corresponding evaluation of the received signals allow a better classification of different weather conditions and also provides the possibility to optimize the evaluation referring to this.
- In addition to the detection of static targets or targets which move only in one direction, the interpretation of the polarimetric parameters can also be used to detect the self-rotation of targets. These parameters can be detected by the corresponding changes in the cross-polarized and co-polarized reflections. Transferred to the interpretation of volume targets with the polarimetric multiparameter intrapulse modulation, this interpretation delivers new possibilities for weather observations.

Overall, the DBWR system sets the course for a modern, scalable radar system with digital modulation technology and provides a decisive contribution to the development of future systems.