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Rainfall Noise Modeling for Sensing the Atmosphere by Microwaves

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Considering precipitation measurements established methods currently used face difficulties especially in urban and mountainous areas. Therefore microwave point-to-point links, e.g. with already established commercial links, may help in obtaining additional weather information in regions where other methods provide poor accuracy or lack availability at all.
The PROCEMA (Regional Precipitation Observation by Cellular Network Microwave Attenuation and Application to Water Resources Management) project aims at the development of structures using commercial microwave links for the purpose of supplementary measurements of the atmospheric state.
This publication presents the modeling of additional channel noise signals in microwave communication links due to hydrometeor movement in rainfall using a numerical model for both the scatterer distribution and their interaction with microwaves in rain fields. The raindrops are generated dynamically and on-the-fly with raindrops falling according to a model of terminal velocity. The simulation volume is populated with rain applying the Marshall-Palmer drop size distribution (DSD) depending on the rain rate.
The raindrop replenishment process may be varied in time utilizing any statistic needed. Raindrops are characterized by their radius according to the DSD and the relative permittivity of water depending on both frequency and temperature.
In the modeling an incoming plane wave is scattered by all drops in the simulation volume. The electromagnetic wave interacts with drops modeled as spheres using analytical formulas for Mie scattering.
The resulting signal noise is recorded in phase and amplitude for further processing and analysis. The signal includes polarization information in all three spatial dimensions where only the co- and crosspolarized (transverse to the propagation direction) are observable in real measurements.
Ongoing simulations show a significant influence of the rain rate on the Doppler spectrum of the received signal. This is supposed to be directly correlated to the velocity distribution of the rain resulting from the corresponding DSD.
In near future results obtained from the simulation described above will be compared to measurement results obtained in the PROCEMA project. It is foreseen to use real distrometer data as input for the parametrized rain production process.