

Spectral Characteristics of Discharge Phenomena in Artificial Thunderclouds

Intended for the Session Topics "Lightning Physics or Lightning Detection Technologies"

Alexander G. Temnikov, Olga S. Belova, Leonid L. Chernenskiy (National Research University "Moscow Power Engineering Institute", 14 Krasnokazarmennaya str., Moscow, 111250, Russia; TemnikovAG@mpei.ru)

Lightning detection systems designed for lightning stroke place and lightning current parameters determination works on the base of registering of electromagnetic radiation of lightning discharge. One of the characteristic problems of such systems is separation of the intracloud discharges and the ground discharges. It is supposed that intracloud discharges have a spectrum with the higher frequencies. However, question about threshold frequency value has not been solved nowadays. That could leads to significant errors in determination of the lightning stroke place and its parameters. Establishment of connections between the parameters and the spectral characteristics of discharge current impulses and its electromagnetic radiation is actual problem too.

Application of the artificial clouds of charged water aerosol (artificial thunderclouds) capable to initiate discharges inside clouds and between cloud and ground allows be well on the solving of such problem. Results of analysis of characteristics of discharge from artificial thundercloud and electromagnetic radiation (displacement current) created by them in near field are presented. Two kinds of wavelets ("Mexican Hat" and "Morle") have been used for experimental data processing. In such case signal has analysed in frequency and time field simultaneously.

Wavelet spectrum "Mexican Hat" has shown more high frequencies for discharge current and its displacement current on the plane antenna than wavelet spectrum "Morle". For both wavelets, it was found that maximal intensities in spectral content of the discharge current and displacement current signals are observed during the period of current rise at the final stage of discharge from artificial thundercloud. Upper limit of characteristic frequency range for the discharge current was near 30-40 MHz, and for the antenna signal – near 60-70 MHz approximately. However, it was established that significant part of the wavelet spectrograms for electromagnetic radiation has shown separate range of frequencies of some hundreds MHz. Probably such high frequencies correspond to the discharge processes inside artificial thundercloud and near its boundaries.

It was established correlation between the discharge current parameters and the parameters of its electromagnetic radiation and wavelet characteristic frequencies. The last gives possibility to connect the spectral characteristics of electromagnetic radiation registered by antenna and the lightning current parameters.

Comparison of received result with results of wavelet analysis of electromagnetic radiation signals registered during the different stages of lightning by other authors is carried out.