Theoretical and experimental investigations of the coherent echo spectra fine structure based on the Irkutsk Incoherent Scatter Radar data.

O.I.Berngardt

Institute of Solar-Terrestrial Physics SB RAS, Irkutsk, Russia (berng@iszf.irk.ru)

Irkutsk Incoherent Scatter (IS) radar - is a monostatic mid-latidude radar for ionospheric investigations by the radiowaves backscatter technique at frequencies of approximately 150MHz. Nowadays, one of important investigation fields carried out on the Irkutsk IS radar is the investigation of a fine structure of scattered signals - scattered signal spectra before their averaging over the sounding runs. In this paper a model of the coherent echo signals is described. The model describes the received signal as a result of scattering by a number of modulated spatial harmonics of dielectric permittivity, and is based on the radar equation for non-averaged signal, obtained earlier[1]. The characteristics of spatial and temporal modulations are determined by macroscopical parameters of the media through the dependence of dispersion relation for the given irregularities from radar range. The discreet character of the model causes the appearance of the spectra fine “comb” structure that disappears after averaging. The location of each peak in the “comb” structure is defined by the difference between spatial harmonic wave number and doubled wave number of sounding signal. The amplitude and exact shape of the peak are defined by dispersion relation for the irregularities and by the shape of sounding signal and spectral processing “window”. To describe the experimentally observed and theoretically predicted shape of the single peak in spectrum “comb” structure a "phase pattern width" parameter was suggested. The comparison shows a good agreement between the predicted by the model and experimentally observed parameters of the fine structure over the time and range. This allows us to use this model in order to improve the diagnostic abilities of the method. For instance, one of the model applications is the substantiation of the technique of improving spectral resolution that has been suggested earlier [2] and used nowadays.
The work was done under partial support of RFBR grants #03-05-64627 and #05-07-90212, and under support of “Support program for leading scientific schools of Russian Federation NSh-5071.2006.5”.

References

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