Multiposition Bistatic Radar System Using Radio Signals of Geostationary Satellites for Hydrometeors Parameters Determination

Igor MYTSENKO, Dmytro KHALAMEYDA

Radar Department, Institute of Radiophysics and Electronics of National Academy of Science of Ukraine, 61085, Kharkov, Ukraine, 12 Akademica Proskury Str.

khalameyda@ire.kharkov.ua

Abstract— **The method using geostationary satellites to determine hydrometeors parameters and to diagnose hazardous occurrences, such us: showers, hail formations, lightings, turbulences, etc are presented. The advantage of the multiposition bistatic radar system is a capability of detecting small objects (turbulences) owning to a sharp increase in the value of Radar cross-section of objects close to base line and its environmental safety.**

I. INTRODUCTION

Nowadays an increasingly considerable interest in bistatic radars has been aroused in the radio engineering community [1, 2]. The advantage of these systems is that they are capable of detecting small-sized objects owing to an increasing their radar cross-section as they traverse the baseline. But the shortcoming of the systems is the difficulty of locating objects position. The bistatical radars can detect the signals reflected from an object when a transmitter direct signal is of great intensity. As a result, interference signal occurs in at a receiver input. The Doppler frequency signal can be obtained by amplitude detection.

One of the primary requirements for the apparatus being developed and used is its environmental safety. The bistatic systems offer an opportunity to install a transmitter at a point where they have no impact on a human being and the environment and allow receiving signals in some advantageous positions [3].

The aim of this article is to study the possibility of creating of multiposition bistatical Radar system using radiosignals of geostationary satellites for determination of hydrometeor parameters and diagnosing of hazardous weather conditions over great arias.

II. METHOD OF RESEARCH

The geometrical parameters of radiowave propagation path are shown in Fig. 1. The coordinate system XOY lies in a horizontal plane. The detection area of such systems is along the baseline and is defined as an area where a significant increase in the object's bistatical radar scattering cross-section occurs. It is limited by a minimal magnitude of bistatical angle $\beta_{\min} = 150°$ [4].

The received interference signal amplitude is modulated by Doppler frequency F [4]:

$$F(t) = -\frac{1}{\lambda}\frac{dr(t)}{dt} = -\frac{1}{\lambda}\frac{dr[r_1(t) + r_2(t)]}{dt} = -\frac{1}{\lambda}[V_1(t) + V_2(t)], \quad (1)$$

where:

- λ is the wavelength;
- t is the actual time;
- $r(t) = r_1(t) + r_2(t)$ is total distance.

For the radar system (Fig. 1) distances $r_1(t)$ and $r_2(t)$ are the vector magnitudes $\bar{r}_1(t)$ and $\bar{r}_2(t)$; V_1 and V_2 are the vectors projections of an object velocity $\bar{V}$ onto the vectors $\bar{r}_1(t)$ and $\bar{r}_2(t)$ respectively.

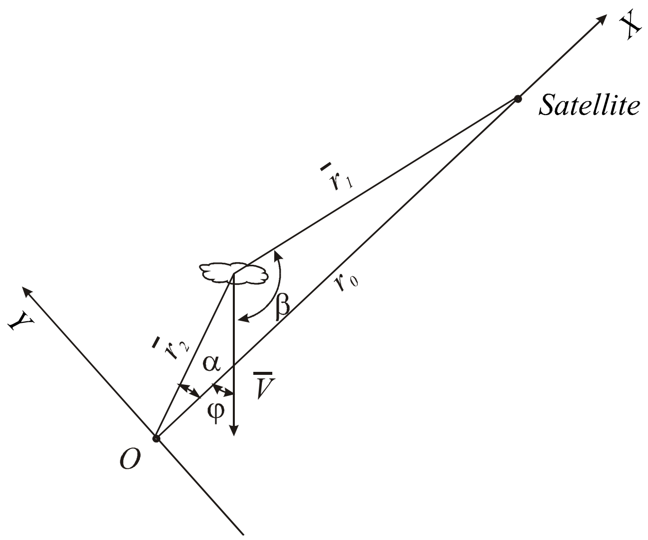

Fig. 1 Geometrical parameters of propagation path: r_0- baseline length; r_1 - distance from the satellite to an object; r_2 - distance between an object to the receiving antenna; α - azimuth; β - angle between directions from an object toward receiving and transmitting antennas; $\bar{V}$- vector of object movement velocity ; φ- inclination angle of base line trajectory

It follows from (1) that the Doppler frequency is positive and its magnitude decreases as the object approaches the baseline. When the traverses the baseline the Doppler frequency is equal to zero because vectors V_1 and V_2 are