ESTIMATION OF THE SPECTRAL COMPOSITION OF THE SIGNAL BY THE ANTENNA COMPOSED OF MULTIPLE SATELLITES

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One of the most effective methods of analyzing the characteristics of dynamics of wave processes on the basis of experimental data in a variety of physical systems are methods of spectral analysis of time series and related methods for estimating the space-time spectra using discrete antenna arrays. Such an analysis is used in problems of radio and acoustic location of objects, in the study of wave processes by the remote methods in the atmosphere and ocean, as well as in various problems of astronomy, astrophysics and space physics. One of the main elements of this approach is a stationary antenna array, consisting of a small number of point nodes, which contain sensors that measure the time-varying physical parameter, which is the wave process indicator. Any physical parameter can be an indicator, such as strength of magnetic and electric fields, a temperature and pressure in the environment, etc.

Usually assumes that a discrete antenna array has a set of some properties with high precision. Distances between lattice sites are known with highest accuracy. Also assumes that the signals at nodes of the antenna array are measured synchronously with the highest possible precision. Accuracy of finding the angular position signals sources define the error in synchronization measurements. The maximum distance between the lattice sites is called the aperture, and determines the angular resolution of the antenna array. However, in reality, due to the presence of noise in the environment and various random errors which are perceive as noise, the problem of estimating the wavelengths and their directions at a fixed frequency is complicated and solved by using the procedures of spectral estimation [1,2].

Problem occurs in many modern tasks when it is necessary to process data sets from sensors that are not constitute components of the antenna array in the original sense and continuously moving in space relative to each other. For example, satellite systems of remote measurement, which compiled of individual satellites, equipped with the same devices. Because of different parameters of individual orbits of each satellite, the distance between them is constantly changing, which leads to changing Doppler shifts, which vary for different pairs of lattice sites. Nowadays there are a lot of satellites at the Earth orbit with similar observational programs and the type of used sensors, for example, meteorological satellites of NOAA and Meteor type geostationary satellites GOES, METEOSAT, etc. However, there is no method to combine data from various satellites in an interferometric data set, which would make it possible to investigate not only the frequency spectra of the waves in the surrounding space but the spatial characteristics of the waves in the form of space-time spectra.

In this paper we propose the way of representing the dynamic antenna array which nodes represent different satellites, as well as a method of estimation of space-time spectra, that allows using data from this lattice. Special transformation of source data can eliminate inhomogeneous Doppler shift in the individual nodes of the dynamic lattice, which moving relative to each other with constant velocities. It is also offered an implementation of computational procedure for the case of discrete time series and the ability to process data in real time.

Refrences

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