Magnetotelluric method is an electromagnetic induction method which studies the distribution of the electrical conductivity in the Earth by analyzing natural variations of the Earth's electromagnetic field of the external origin. A wide frequency range of the natural sources of the magnetotelluric field makes it possible to study the Earth's conductivity from near-surface structures down to depths of the upper mantle. Dependence on weak natural fields, however, causes the method to fail in case of data contaminated by electromagnetic disturbances of cultural origin. This thesis summarizes basic principles of the statistical magnetotelluric data processing in the frequency domain, and shows the recent progress of the processing due to the application of robust statistical methods as well as due to employing reference data from remote stations. In some cases, the measurements are disturbed excessively, and even advanced statistics method fail in processing the data. In some of these cases a more thorough analysis of the noise field in terms of its directional and source characteristics may be useful. We present an example of simultaneous recordings of two magnetotelluric stations from the West Bohemian seismo-active region and show that the noise field is dominated by two types of strong electric disturbances with different polarizations. Under a simplified approximation where a direct current dipole on the surface of a uniform half-space is assumed to be the source of the observed disturbances, we formulate an inverse problem for the position, azimuth and input current of that dipole. The inverse problem is solved by the Monte Carlo method with the standard Gibbs's sampling algorithm as an engine. The solution indicates two focused areas of the noise sources. Identification of these sources with particular industrial facilities is difficult, however, and employing a spatially inhomogeneous resistivity distribution in the crust of the studied area will be necessary.