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DETERMINING THE COORDINATES AND LOCATION UNKNOWN SOURCES RADIATION EMW METHOD FUZZY THREE SPHERES AND FUZZY TORI

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ABSTRACT: This paper presents a method for determining the coordinates of the location of the unknown source of radiation EMW, determine its coordinates method three spheres, or in 3D space, the results of measurement RMS (root mean square) unknown and presumed sources of radiation on the basis of which they determined the coordinates of the observed sources EMW. A program was developed in MATLAB based on which it is carried out simulations for determining the location and coordinates of origin EMW. A fuzzy 3-sphere are constructed as a part of fuzzy complex projective spaces, by modifying the Laplacians. This way leaves only states which corresponding to fuzzy spheres the construction of a fuzzy circle gives as the way to use fuzzy tori.
Keywords: RMS (root mean square), radiation EMW, fuzzy 3-sphere

1. INTRODUCTION

In paper we are solving the problem of locating sources of EMW, seismic signals or sound source, occurs in a number of different human needs. The methods in this paper will be analyzed relating to the settlement of determining the location of origin EMW in two-dimensional space, but with certain approximations can be applied to determine the location of sources in three-dimensional space. Of course, such procedures may be applied to determine the location of the seismic source excitation (SP) or the sound source to the two-dimensional, and in three-dimensional space.

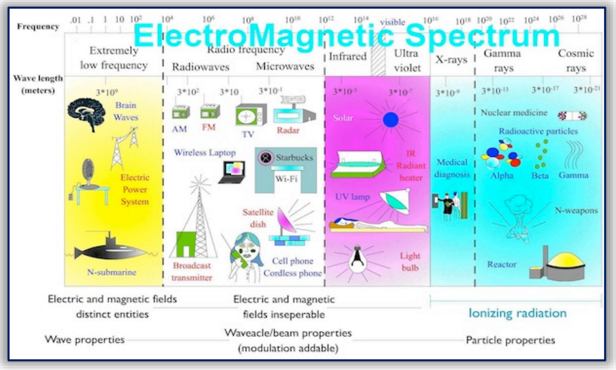

Figure 1. Electromagnetic spectrum

The electromagnetic spectrum is organized by frequency. Generally, lower frequency radiation is on the left, and higher frequency radiation is on the right. See above graphic on Figure 1. [7]

The properties of electromagnetism change at different frequencies and electric and magnetic fields behave differently according with the spectrum. A material that is transparent to visible light can be opaque to infrared light, but then again transparent to radio frequency radiation (e.g., glass). Chrome is highly reflective to all of these frequencies, but nearly invisible to IR cameras because it reflects much more heat energy than it emits. So how do you measure the temperature of a chromed device if you cannot attach temperature sensors (thermocouples) to it?

To solve the problem of locating sources EMW or seismic signals require at least three sensors, which can be placed in a different relative position we use a sensors. It can be meters EM fields, if it is a source of EMW, geo-sensor microphones or if it is a source of SP or the sound source, respectively.

In this paper, the layout of the three-meter EM fields, which are placed at the apex of an equilateral triangle (or about such an arrangement, which is conditioned buildings on the site where the measurement was carried out). In this case was used Spectrum Analyzer in parallel with a PC Lap-Top with AD card, which is used in parallel with the measuring instrument registers the signal spectrum or other parameter signals that can be applied to the control panel of Analyzer. Their parameters are expressed in power [dBm] or [Wats], avoltage expressed in [dBmV] or [Volts]. On this spectrum analyzer, there is significant internal memory capacity (64 GB and larger), which allows storage of over 1000 measurement settings and 1000 test results that can later be used in further analyses.

In this measurement can be used also and Antenna Analyzer or other parameters of the meter EM field, which can be used to detect the location of an unknown radiation source EMW.

To support the analytical method calculated location sources EMW, we are made numerous of measurement in real conditions and simulation on a computer. This program has been done in MATLAB.

2. METHOD FOR THE LOCATIONS OF THE EMW

Determining the location of the radiation source EMW, seismic or acoustic wave shown in detail work [1] wherein the cutting method shown three circles and ellipses three methods, for whose display are used RMS power or voltage signal mean square value power symbols over RMS (Eng. Root mean square).

The sequence analysis method based on locating sources of radiation measurement EMW mean-square value power symbols over RMS. In this paper, the methods of application of section three spheres of EM waves, which can be displayed spheres or fronts of these waves and by three circles, respectively.

2.1. Methods for locations of EMW - method three spheres

If this expression instead of a sphere show a front wave, where the wave has a maximum value, then the analysis is simplified, because the sphere, we can replace with the circle with the center of the sensor. Calculated coordinate origin EMW can perform, if we assume that generate three hypothetical EMW with sources in sensors. Location (point) where they meet all three rounds represents the location sources EMW. This point is, in fact, the point of intersection of all three rounds, and all three spheres. This approach to determining the source location EMW, which we marked with M (x, y) is good if we analyze the problem in one plane or M (x, y, and z) and if we analyze the problem in the area illustrated in Figure 2.

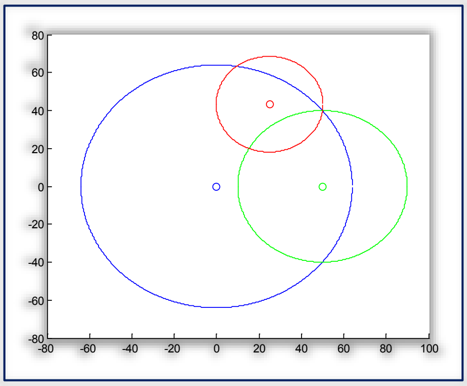

Figure 2. Figure Illustration fronts EMW based on the sensors S_1, S_2 and S_3

In the special case, if the sensors are placed at the apex of an equilateral triangle and if the source of the EMW is the center of gravity of the triangle, then all three circles intersect at point source location EMW, i.e.the point M (x, y). Thus, section fronts generated EM waves defines by point M (x, y) in which we have the source of radiation. Method section three spheres, or in the case of a simplified method of the intersection of three circles constructed with centers in sensors, it is possible to determine the location of the source of EM waves.

Let is the Figure 2, Sensor S_1 set at the origin, so its coordinates S_1 (x=0, y=0)and sensors S_2 and S_3some are placed in the other two peaks of an equilateral triangle with coordinates S_2(c,0) and S_3(p,q). The point where they meet (cut) all three rounds (spheres), whose cross-sections of the circle represents the location sources EMW or ST in pointM (x, y).

In this case, the distance from the pointM (x, y) to sensors - meter fieldS_1, S_2 and S_3 marked with r_1, r_2 and r_3, respectively, which are formed of an equilateral triangle.

From the triangleS_1 S_2 S_3, the Pythagorean theorem we get the equation circle,

$$x^2 + y^2 = r_1^2;\ (c-x)^2 + y^2 = r_2^2;\ \ (x-p)^2 + (y-q)^2 = r_3^2 \tag{1}$$

where is

$$p = c/2, p^2 + q^2 = c^2, q = \sqrt{3} \cdot c/2. \quad (2)$$

These circles are presented in Figure 2 and intersect at a pointM (x, y).

In these relations the size of the amount of secondary power P_1, P_2 and P_3sensors, or RMS power, which is measured in three different directions in relation with the source of EMW are inversely proportional to the square of the distance from sensor to the source:

$$P_1 \equiv \frac{1}{r_1^2} \qquad P_2 \equiv \frac{1}{r_2^2}\ P_3 \equiv \frac{1}{r_3^2} \quad (3)$$

Based on the differences radius vector, we can determine the condition of the intersecting circles observed that fronts EMW:

$$r_1^2 - r_2^2 = 4b_1 \,;\; r_1^2 - r_3^2 = 4b_2 \,;\; r_3^2 - r_2^2 = 4b_3 \quad (4)$$

For those conditions can be calculated coordinates of the point-sectional circle, which represent sections of spherical EM wave sources and given to the following terms:

$$x = \frac{1}{2c}\left(r_1^2 - r_2^2\right) + \frac{c}{2} \quad (5)$$

respectively

$$x = \left(q_1 - q_2\right) + \frac{c}{2} \quad (6)$$

$$y = \frac{\sqrt{3}}{3}\left[-x + c + \frac{1}{c}\left(r_1^2 - r_3^2\right)\right] \quad (7)$$

respectively

$$y = \frac{\sqrt{3}}{3} \cdot \left[\frac{c}{2} + q_1 + q_2 - 2q_3\right] \quad (8)$$

In fact, in order to obtain equations for a given processbased on (1), (2) and (4) we obtain a system of linear equations, where each equation represents a straight line. Cross-section of these lines, which are approximated circle, giving the coordinates of pointsM (x, y), which gives the location of the observed origin EM radiation or other source oscillation, if we measure the RMS.

2.2. Procedures and results of measurement intensity of field broadcasting transmitter's methods for locations of EMW - method three spheres

Determine the location of origin EMW experimentally was done at several locations and at different sources EMW power and different frequencies in the field of broadcast FM transmitter.

The results of measurements of electromagnetic signals, or mean-square value power symbols over RMS (Eng. Root mean square)[4] one of observed FM transmitter, which operates at a frequency f_{FM} = 103.6 MHz, are shown in Table 1.

Table 1. Mean Square signal strength

Measures wheelbarrow	Mean Square signal strength										≈ P_{sr}
H_0 [pW]	635	643	685	619	580	685	631	676	721	....	728.73
H_5 [nW]	15.55	18.01	18.24	19.57	18.01	19.57	21.87	21.82	23.84	…	20.64
S_{01} [pW]	350.5	388.1	444.6	345.0	296.5	639.1	797.0	387.7	431.7	…	432.32
S_{02} [nW]	24.02	26.10	25.77	25.12	25.61	24.02	29.66	25.28	21.00	…	24.98
S_{03} [nW]	21.27	25.73	28.73	29.29	29.66	29.47	28.91	28.36	31.22	…	28.10
S_{04} [nW]	23.56	23.87	24.02	24.33	23.11	23.56	23.26	23.41	23.71	…	21.22
S_{05} [nW]	8.25	8.41	9.40	9.20	8.97	8.91	9.30	8.91	10.66	…	9.16
S_{06} [pW]	28.18	27.30	29.43	26.56	27.30	26.44	28.83	30.43	28.73	…	28.215
S_{07} [pW]	6.50	6.30	6.20	6.20	5.90	6.30	6.20	5.90	6.50	…	6.20

Based on these measurement results RMS can be graphic and simulation program to determine the exact location of origin EMW.

Measurements can be made with different measuring sensors or gauges mean square value of the signal in countsS_1, S_2 and $S_3$when the sensors are fixed or removable. In case you are using a portable meter (sensor), such as in the measurements used, then the assumed radius between sensor and sources EMW can arbitrarily change the distanceΔS between measuring points. With the decrease of the distanceΔS increase the reliability of approximation direction, which connects the sensor and the source. For each measurement of the maximum value of RMS get one point, which belongs to the sphere or front EMW, so that, the sensor or about sources we can draw only when a sphere or a circle representing the wavefront, how we perform measurements. By connecting these points, we get about the direction lost between the sensor and the source where the mean-square value the maximum signal strength.

If measurements are carried out from the air from a height above the tallest buildings in the area of measurement, would be eliminated interference receiving EMW signal and measuring could considerably a more reliable and precisely. On that way spheres or fronts EM waves can change with linear direction. If measurements mean-square value power signal is done using three sensors from three different directions, starting from points S_1, S_2 and S_3, then the results of these measurements, as in the previous case, we can replace the three directions, respectively, that intersect at point M (x, y), which defines the location of the radiation source. Accuracy is increased when measurements are made using three sensors rather than two, although the point defined by the cross section. So three guesses noncollinearity pointsS_1, S_2 and S_3, in which the sensors are placed, which should be assumed toinclude the point M (x, y, z).

In the research in this area, were analyzed the case when the source of radiation outside the sensory cells.

Due to the high cost of measuring equipment,we are not conducted at the same time measurements from all three directions, rather than individually, which is sufficient for accurate calculation of coordinates (location) of the radiation source.

If we used three independent measuring system to system goniometer sources EMW, then the location of the radiation source, we can very accurately determine the moving only by measuring the maximum points mean-square value signal strength. In this way, the measuring systems, or routes of their movement slashed to point M (x, y, z) were the source of radiation.

Sensor we have been using isSpectrum Analyzer R3131 Internal memory and floppy drive with the possibility of saving over 1000 settings and over 1000 test results, here is due to the spatial frame is shown only a few display measurement range FM signal EM, Figure 3, from which you can see the measured value of the signal, which can be detected and displayed in Table 1.

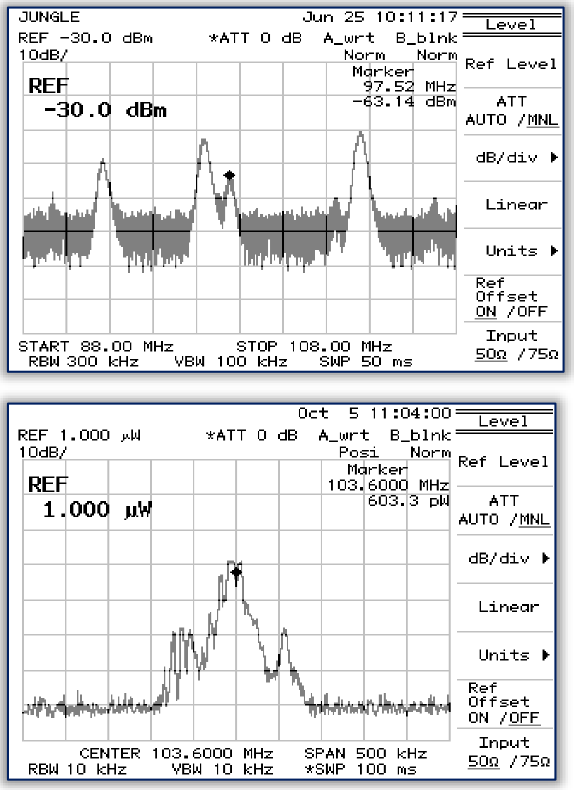

Figure 3. Display range measured signal obtained by measuring sensors Spectrum Analyzer R3131 Internal memory

The maximum value of the spectral display signal is the maximum measured mean square value signal strength. On representations of the spectrum in Figure 3 can be seen and some other parameters of the signal, which in this analysis are not necessary. Based on these measurement results, is still carried on the computer simulation in MATLAB.

3. SIMULATION DETERMINES LOCALE SOURCES EMW COMPUTER METHOD THREE SPHERE / THREE CIRCLES

Based on mean square value strength of the signals, performed in the MATLAB simulation of finding a point of section three circles, we approximated the front of electromagnetic waves, or observed spherical wave. Part of the program for the simulation determining section three spheres, or three fronts spherical EM wave is shown in Figure 4.

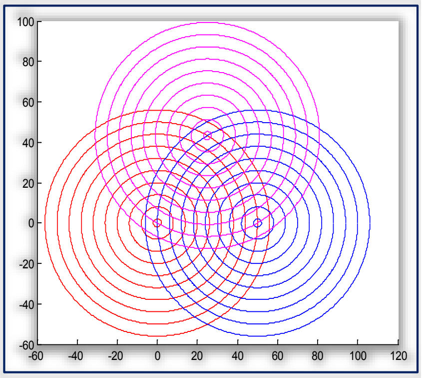

Figure 4. Part of the program for the simulation determining section three spheres, or three fronts spherical EMW waves

In the section,we shown three circles like the source of radiation of electromagnetic waves, as shown in Figure 4. If the starting coordinates of the sensor in points S_1, S_2 and S_3, we predict precisely defined points on the map of the ground where measurements are made, then to the point of intersection lines with maximizing conformity mean-square values the signal strength of the radius sensor-source EMW able to determine the exact geographical coordinates or local sources. In addition, with the simulation, we can use a map or plan of the city and to some extent accurately locate and determine the geographical coordinates of the position or origin EMW on a city or a location.

```
% Program: SENSOR sphere-circle
close all
clear all
%% C = input ( 'Enter the position sensors S1 - 2c:');
............................................... .....................................
%% X = input ( 'x-coordinate of intersection point');
%% Y = input ( 'y-coordinates of intersection point');
%% P1 = input ( 'P1-power sensor S1');
%% P2 = input ( 'P2-power sensor S2');
%% P3 = input ( 'P3-power sensor S3');
C = 50%;
P = 25%;
Q = 25% * sqrt (3);
...........................................
%%% Example
% P1 = 1 * (8.0000-004)
% P2 = 1 * (1.6000-004)
% P3 = 1 * (2.2625e-004)

% R1 = sqrt (x ^ 2 + y ^ 2)
% R 2 = sqrt ((2 * C-x) ^ 2 + y ^ 2)
% R3 = sqrt ((x-2 * p) ^ 2 + (y-2 * q) ^ 2)
% R1 = sqrt (1 / P1)
% R2 = sqrt (1 / P2)
% R3 = sqrt (1 / P3)
................................................ .........

%% RMS segment display to simulate a point-section
 three spheres or three fronts EMW or three circles
% P1 = 1 * (65.9880e-012)
% P2 = 1 * (6.5863e-012)
% P3 = 1 * (145.2000e-012)
%
%% P1 = 1 * (9.9880e-009)
%% P2 = 1 * (25.0863e-012)
%% P3 = 1 * (3.2000-012)
%
%% P1 = 10000 * (24.9880e-009)
%% P2 = 10000 * (28.0863e-009)
%% P3 = 10000 * (432.0000e-012)
%% P3 = 1 * (15.0000-009)
%%% P1 = 1 * (24.9880e-009)
%%% P2 = 1 * (28.0863e-009)
%%% P3 = 1 * (0432-009).
```

Of course, there are other methods of locating sources of radiation, or the positioning of a transmitter [5], For example, by using GPS (Global Positioning System) Global Positioning System, Global Satellite Navigation System (GNSS- Global Navigation Satellite Systems), etc.

4. CONCLUSIONS

Determining the location of the unknown source of radiation EMW, especially threatening radiation sources, it is essential to timely detect the location and purpose of this source of radiation in terms of elimination of its harmful effects to living creatures and objects or finding of vessels, aircraft or other means and facilities, as well as people stray into the area or prevented from themselves provide necessary assistance in non-standard environment, and have a source of radiation that could be used to determine the location (radio, cell phone etc.).

This method of three sensors and section fronts sphere or some waves can also be used to determine the location of sound, voice, seismic ground movements due to the movement of living beings or some movable assets or location of the epicenter of an earthquake etc.

≡ A fuzzy circle and a fuzzy 3-sphere are constructed as subspaces of fuzzy complex projective spaces, of complex dimension one and three, by modifying the Laplacians on the latter so as to give unwanted states large eigen values [6];

≡ This leaves only states corresponding to fuzzy spheres in the low energy spectrum (this allows the commutative algebra of functions on the continuous sphere to be approximated to any required degree of accuracy). [2];

≡ The construction of a fuzzy circle opens the way to fuzzy tori of any dimension, thus circumventing the problem of power law corrections in possible numerical simulations on these spaces.[3]

In this study was determined by measuring the location of FM transmitters mean square value the signal strength of the radius sensor-source EMW out by three points in the intersection of three spheres, circles (front wave) or three directions. Below is an analytical method, showing the analytical equations three circles and their cross-section, which determines the location of the radiation source. Based on the results of measurements and analytical solutions, we gave a simulation point section three circles in which is the source of radiation of electromagnetic waves.

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