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BROADBAND SIGNAL EMMITERS IN WIRELESS COMMUNICATION SYSTEMS

The modern information communication technologies is to increase the bandwidth of radio electronic systems. The achievement of this goal is facilitated by the use of ultra-wideband signals [1, 2]. At the same time, the formation of the radiation of the electromagnetic ultra-wideband signal in the free space imposes restrictions on the design of the antenna devices used. The analysis of antenna designs for ultrashort pulsed signals showed that with the help of fractals it is possible to create a broadband antenna, significantly reducing the size of its design. Fractal is formed by dividing the figure into even smaller objects. Moreover, any of the resulting figures are divided into similar ones, which in turn are parts of the same figure. The corresponding class of antennas is called space-filling antenna (SFA). Their designs are performed on the soil of the fractals of Koch, Minkovsky (Fig. 2), Sierpinsky (Fig. 3).

The radiation on the soil of the Koch fractal (Fig. 1) is constructed as follows. Part of the segment z is divided into three equal parts. Instead of the central part, the break is presented in the form of an equilateral triangle with a side z / 3. Get a three-segment structure that creates a template, the central part of which is a triangle without a base. Subsequently, the process is repeated separately over each segment. Each step of synthesis increases the length of the line by 4/3 times. At the same time, in smaller dimensions, we obtain the same gain, and the spatial-frequency selectivity is not inferior to conventional antennas. It should also be noted that only the first 5-6 steps are effective. Framed antennas on the basis of Koch's fractal loops will increase the input impedance.

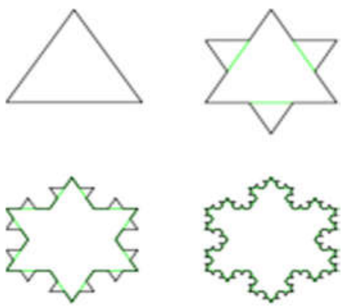

FIG. 1. Koch snowflake

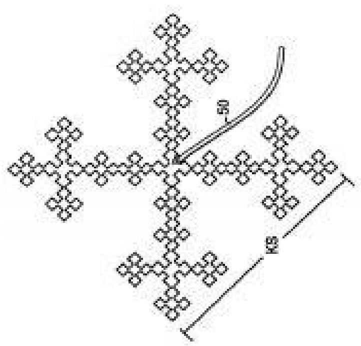

FIG. 2. Cross of Minkovsky

The radiator on the basis of the Minkovsky fractal (Fig. 2) is constructed as follows. Instead of triangles on a straight line, a meander of diminishing sizes is formed. With the first dipole of its amplification increases, the frequency range expands, and the antenna is more compact. Also, only the first 5-6 steps are effective.

The formation of the Sparinsky fractal (Fig. 3) consists of removing the central triangle of a segment with twice the height. In the formed new triangles, the central parts are again removed. The largest distribution is the fractal antenna on the soil of the Sierpinsky rectangular carpet, which is formed by removing from the initial square of the falling square-shaped segments.

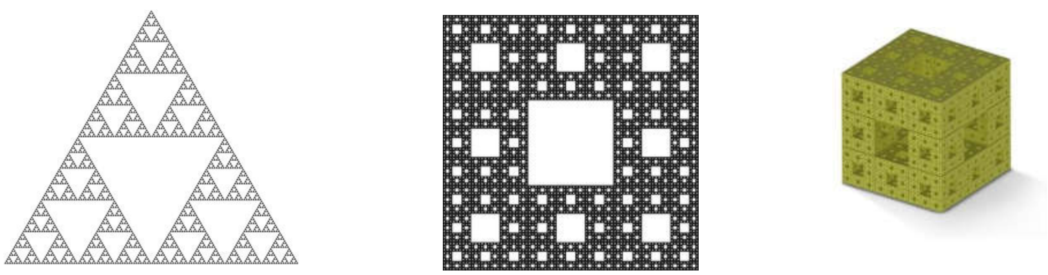

FIG. 3. Monopole, a carpet and a cube of Sierpinsky

All elements of the fractal antennas have a small size and a fairly wide band of frequencies. However, the most suitable for broadband signal emission are tree antennas (FIG. 4). The fractal is generated by sequentially dividing its tops in two branches at a given angle (up to 60 °). Three-dimensional trees are obtained by dividing the monopole into four branches in two orthogonal planes.

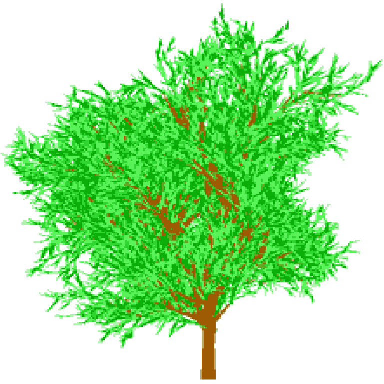

FIG. 4. Tree antennas

A comparative analysis of broadband antennas showed that the bandwidth of 3 dB for an ordinary dipole is 2.4% of the carrier frequency, and for the Koch fractal in the 5th iteration it is 3.1%. At the same time, the two-dimensional tree-like fractal has a wider band of 4.2% and a three-dimensional tree of 12.7%. from the carrier. Thus, the class of fractal antennas can significantly increase the bandwidth of radio systems for the implementation of wireless access to broadband networks.

References

1. Serkov A. Noise-like signals in wireless information transmission systems / A. Serkov, V. Breslavets, M. Tolkachov, G. Churyumov, Issam Saad // Advanced Information Systems. - 2017. - Vol. 1, No. - P. 33 - 39.

2. Serkov O.A. Evaluation of the efficiency of bipolar pulse signals application / O. A. Serkov, V. S. Breslavets, M. Yu. Tolkachov // Materials of XXX MNPK "Information and control systems on railway transport", No. 4 (26-27 October 2017), - Kh .: UkrDUZT - 2017 p.23-24.

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ДИНАМІКА ВЗАЄМОДІЇ СТРУМОПРИЙМАЧА, ОСНАЩЕНОГО СИСТЕМОЮ АВТОМАТИЧНОГО РЕГУЛЮВАННЯ НАТИСКАННЯ, З КОНТАКТНОЮ ПІДВІСКОЮ

На підставі розглянутих джерел [1 – 4] для проведення розрахунку взаємодії струмоприймача з контактною підвіскою була запропонована схема струмоприймача з використанням гумокордного елемента (ГКЕ) та системою автоматичного регулювання (САР), яку наведено на рис. 1.

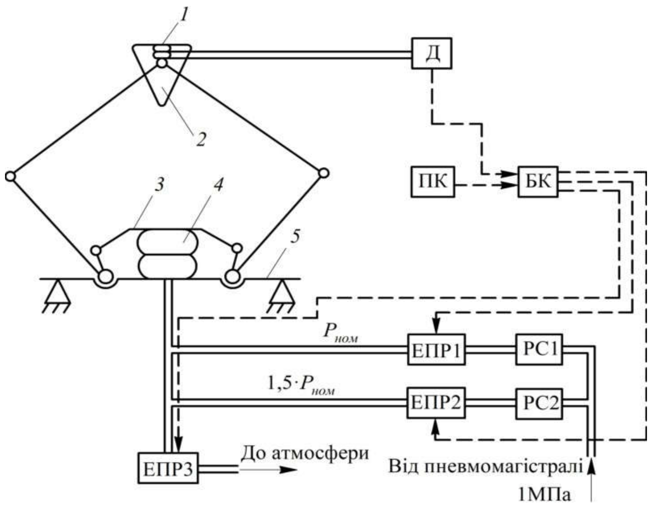

Рис. 1. Схема струмоприймача з пневматичним ГКЕ і САР натискання

Струмоприймач електрорухомого складу містить каретку *1*, виконану з використанням пружного пневматичного елемента, встановленого під полозом *2*, пневмопривод *3*, закріплений між рухомою основою ГКЕ *4* і опорою струмоприймача *5*. Порожнина ГКЕ з'єднана з джерелом стисненого повітря за допомогою двох магістралей, одна з яких подає до ГКЕ повітря, стиснене до робочого тиску 0,2 МПа, а інша – призначена для збільшення тиску в ГКЕ до 0,3 МПа. Обидві повітряні магістралі складаються з послідовно з'єднаних редуктора-стабілізатора (РС) і електропневматичного розподільника (ЕПР). Пружний