UDC 62-523.8

EMC METHOD FOR AUDIO BROADCAST IN LARGE ROOMS

V. Shvaichenko, Philosophy Doctor , Associated Professor
Kyiv National University of Technology and Design
V. Bakiko, D. Titkov, Othman Sharadjah, Philosophy Doctor
Igor Sikorsky Kyiv Polytechnic Institute

Keywords: audiosystems, cloud computing, electromagnetic compatibility, smart RFI-filter.

For sounding large rooms, for example, halls of cinemas or concert halls, sports palaces, distributed audio systems are used. The total power consumption can reach tens of hundreds of kilowatts. Therefore, there is a problem to ensure an increase in efficiency and reduce the mass and dimensions of the complex of such systems, taking into account the electromagnetic compatibility.

The most effective means of suppressing conductive interference in modern audio systems containing structural nodes operating in a switch mode are radiofrequency interference (RFI) filters [1, 2]. The nomenclature of such products is rather wide [3], however their effectiveness is limited, and the characteristic of introduced damping is quite variable depending on frequency. Switch mode power supplies and Class D power amplifiers of this systems are sources of unintentional radio interference. The presence of such distributed audiosystems characteristic of cinemas and concert complexes leads to a significant deterioration of the electromagnetic environment, and can even lead to failures of sensitive equipment, for example, microphone systems.

The ability to rebuild the parameters of RFI-filters with intelligent control [4], proposed in the development of IoT technology to RFI filters [5], improves the local electromagnetic environment. Therefore, it is urgent to evaluate the interaction of such interference suppressors in a complex of audiosystems and modify the algorithm for controlling the main / parasitic parameters of the filter elements. Adjustment of the maximum of the insertion loss is possible taking into account the features of the musical content, which reproduces the complex of distributed audiosystems. Integrated modern wireless communications with remote distributed cloud computing do not significantly increase the cost of such filters, but they create new possibilities for providing electromagnetic compatibility (EMC).

Diversity arrangement of active loudspeakers for great sound space can improve the perception of audiosystems to improve energy efficiency. But in this case increases the level of non-canonical harmonics generated in the mains, which is a influence to other equipment connected to the same mains. The noise level increases even more in the case of effective class D audio amplifiers. The same audio system configuration provides an opportunity to improve the known methods for interference suppression, which are based on the use of smart RFI-filters [5].

The conceptual model (CM) of the procedure for adaptive adjustment of filter parameters to ensure electromagnetic compatibility for large room scoring can be graphically represented as a functionally oriented graph. Each vertex corresponds to a certain basic concept - the concept corresponding to the class of objects, and to each arc - the sign of the relation, which in the general case is a functional dependence

$$f_{i,j} = (X_i\ X_j), \quad (1)$$

where X_i and X_j are parameters characterizing the states of the i-th and j-th nodes at the instant , or some relationship between these concepts.

The relationship between concepts can assume a semantic value of ± 1, an algebraic value $\pm W_{ij}$.

The peculiarity of the approach is not only in the allocation of several groups of concepts in the CM, but also in the allocation of the corresponding modes of the electromagnetic compatibility process.

1) Normal operation. The scoring is provided without degrading the quality, the concept state variables are in the interval

$$[(X^{El,U,G})_0,\ (X^{El,U,G})_{Lim}\,)], \quad (2)$$

where $(X^{El,U,G})_0$ are the initial values of the variables, $(X^{El,U,G})_{Lim}$ are the critical values of the variables.

2) Potentially hazardous mode. The levels of interference during the scoring can exceed the permissible ones, they are caused by the sounding process itself, due to harmonics of the audio content falling within the protected range, which requires taking immediate measures to change the filtering parameters in the process of ensuring electromagnetic compatibility. The concept state variables are in the interval

$$[(X^{El,U,G})_0,\ (X^{El,U,G})_{RFI}\ ], \quad (3)$$

where $(X^{El,U,G})_{RFI}$ are the values of the variables at which there may be an excess of the interference of the rated values at specific frequencies (RFI interference at the critical frequencies).

3) Threatening regime by the criterion of electromagnetic compatibility. In the process of scoring, the spectrum of interference acquires certain artifacts-harmonics, in which not only the norms for interference propagating into the power supply network of sound engineering systems, but also the normal functioning of the units of the scoring system can be exceeded. These additional artifacts manifest themselves in the form of distortions, which cannot be eliminated. The values of the variables go beyond the limit values

$$(X_i^{El,U,G}) \geq (X_i^{El,U,G})_{RFI}\ ]. \quad (4)$$

The concept is suggested of smart RFI filter with remote data procession as an information system element. It stands to reason to supplement the known structure with the wireless module (transmitter) for remote operation control of RFI filter. The structure of such smart filter is presented in Fig. 1, where 1 – mains, 2 – passive part of smart RFI-filter, 3 – Wi-Fi module of client, 4 – audio system, 5 - Wi-Fi module of server, 6 – router, 7 – server.

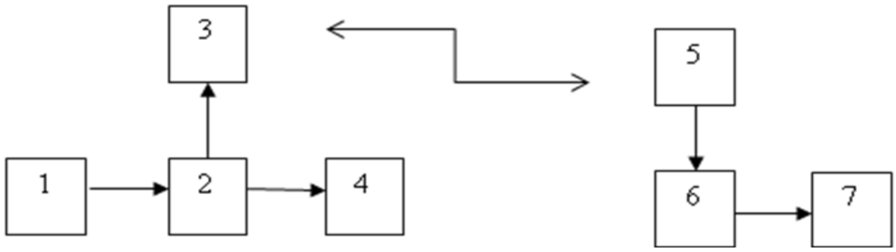

Figure 1 –Block diagram of a smart RFI filter.

Smart RFI filters are used to connect to the server at times of interferences, send it a unique identifier and the current state of the signal, the server analyzes the accumulated data from the filter, calculates the correction coefficients, and returns the filter. The filter corrects the signal, digests it again and the process repeats cyclically.

For practical reason here shows the pert of simple program for reading the ADC shows and transfer values to the server.

The coordination of the procedure for setting the filter parameters of a complex of distributed audio systems in large rooms in the event of degradation of the electromagnetic environment will allow real-time improvement of electromagnetic compatibility.

The proposed concept of a network of smart RFI- filters of audio systems with a wireless channel and remote distributed processing minimizes the cost and response time for exceeding the normalized values at critical frequencies at the top of the audio range.

Software and hardware allow relatively easy expansion of the functionality of such smart RFI- filters by generating in antiphase the impulse interferences generated by the elements of the audio systems.

References

1. Векслер Г.С. Подавление помех в цепях электропитания / Г.С. Векслер, В.С. Недочетов, В.В. Пилинский и др. – К.: Техніка, 1990. – 167 с.

2. Кечиев Л.Н. ЭМС и информационная безопасность в системах телекоммуникаций / Л.Н. Кечиев, П.В. Степанов. – М.: Озон.ру, 2005. – 320 с.

3. Смирнов И.Г. Телекоммуникационные системы: электромагнитные помехи и электромагнитная совместимость / И.Г. Смиронов // Компьютерные сети: сети и системы связи, 1997, №4. – С.23-27.

4. V. Pilinsky, V. Shvaichenko, A. Dovzhenko, E. Shvaichenko, “Intelligent Mains Radiofrequency Interference Filters”. Proc. of EMC EUROPE 2010 Wroclaw, - P. 810-813.

5. Особливості мікропроцесорного керування параметрами дроселя протизавадового фільтра для керування характеристиками загасання в смузі частот 3…5 декад / В.В. Пілінський, С. М. Веретюк, А.О. Довженко, В. Б. Швайченко // Электроника и связь. 2011, № 4. - С. 182-187.