UDC 378.17:537.87

THE ANALYSIS OF ELECTROMAGNETIC ENVIRONMENT CREATED BY A LINEAR SERIES OF PERSONAL COMPUTERS IN CLASSROOM OF UNIVERSITY OF CLASSICAL TYPE

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Analysis of the electromagnetic environment created by a linear series of personal computers in the classroom of university of classical type. The zones of the most significant impact of EMR from computer-class equipment on students are identified.

Keywords. Personal computer; electromagnetic radiation; university

Introduction. The electromagnetic environment in computer classes of educational institutions is characterized by the presence of various sources of electromagnetic fields of different intensity and a fairly wide frequency range. the most dangerous local source of electromagnetic fields is the video terminal – VDT) - a computer complex: displays, system blocks, uninterruptible power supplies [1].

Method of research. The analysis of the electromagnetic environment generated in a training facility of the belarusian University of linear rows of computers, additionally the study of light levels and weather conditions in the area. The object of study is the process of forming the electric and magnetic field intensity created by a linear series of computers in the computer class of the University.

The purpose of the study was to perform an analysis of the electromagnetic environment created by a linear series of personal computers in a classical-type University classroom. To achieve this goal, the following tasks were solved: 1. To investigate the sanitary and hygienic parameters of the computer class of the University of the classical type; 2. To study the features of the distribution of the electromagnetic field created by computers in educational premises. 3. Develop recommendations for controlling the field strength in computer classes.

Research result. The study of weather conditions in the room was performed using the meteomer МЭС-200А. Results are presented in table 1.

It is determined that the parameters of microclimate after one hour after the start of class do not exceed the limits regulated by norms [2].

Table 1. – The parameters of the microclimate of a computer class

Parameter	Actual value	Optimal microclimate parameter for [2]
Air temperature, °C	20.3	19-21
Relative humidity, %	58	58 at a temperature of 20°C
Air speed, m/s	0.06	No more than 0.1

An equally important parameter that is normized in educational institutions is the illumination in classrooms. The room where students or employees use the video display terminal must have both natural and artificial lighting. Natural lighting should be provided through North -, North-East -, East -, West -, and North-West-oriented light openings, and the natural light coefficient shouldn't be lower than 1.5 %. The study was carried out under combined lighting (a combination of natural one-sided lateral with artificial General uniform), with the orientation of the light opening to the North-West. Figure 1 shows the change in the natural light coefficient (%) and the light index at a height equal to the table surface (E, in Lux) at distances from 1 to 6 meters from the light opening. At a distance of 6 m from the window, the indicators of the light environment increase, because artificial light begins to prevail.

Despite the fact that the value of the natural illumination coefficient corresponds to the standards in all points of the room (more than 1.5%), the illumination at the height of working surface is several times lower than the required 300-500 Lux [2], which significantly reduces the efficiency of visual work.

It is well known that the side and back walls of a computer monitor and other components are powerful source of electromagnetic radiation, with different frequency ranges of operation, for example: the frequency of 50 Hz is typical for a network monitor, a power supply transformer; 20-100 kHz of a static voltage Converter in a pulse power supply; 48-160 Hz of frame scan and synchronization units; 15-110 kHz-a line scan and synchronization unit; 50 Hz -1000 MHz of a system unit (processor); 20-100 kHz of uninterruptible power supplies, etc. [3]. According to [2], the following maximum permissible levels of electromagnetic fields from VDT are set, given in table 2.

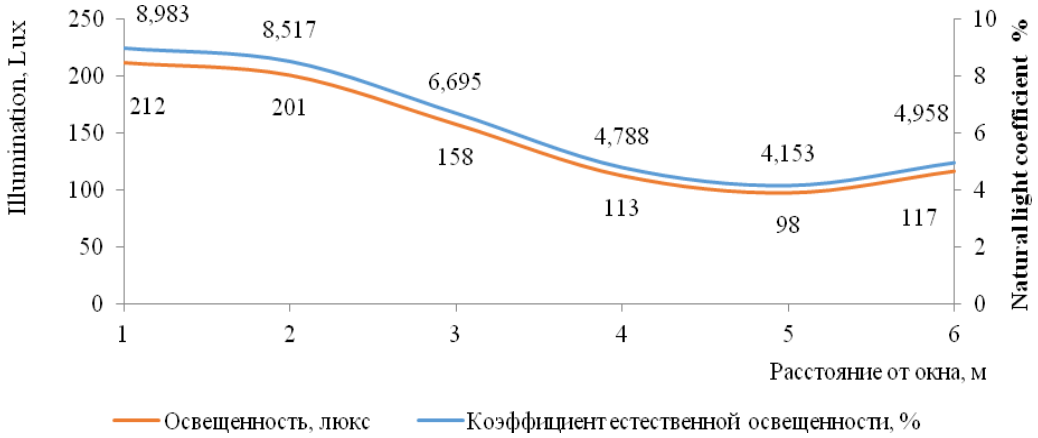

Figure 1. - Changing the conditions of the light environment depending on distance from the light opening

Table 2. – Maximum permissible levels of electromagnetic fields from VDT

Name of parameter	Permissible level
Electric field strength in the frequency range:	
5 Hz - 2 kHz	less than 25.0 V/m
2-400 kHz	less than 2.5 V/m
Magnetic flux density of the magnetic field in the frequency range:	
5 Hz - 2 kHz	less than 0.250 MTL
2-400 kHz	less than 025 nTl

Measurement of electric field intensity and magnetic flux density of the magnetic field was performed using a device «ВЕ-метр-АТ-002» in half an hour after powering the computer on a horizontal surface at distances of 10, 30, 50, 70 and 90 cm in front of LCD displays, their rear surfaces with left and right side surfaces, and at distance of 100 cm in the centre front between the side surfaces of adjacent displays.

Distribution dependences on the distance to the source of the highest values of electric field strengths and magnetic flux densities in the frequency range 2-400 kHz (Figure 3), created by a linear series of computers located along the walls of the University's classroom, are shown in figures 2 and 3, respectively.

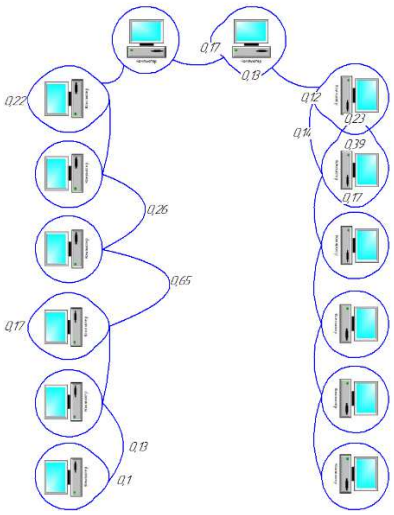

Figure 2. - The electric field Strength generated by a linear series of computers in the frequency range 2-400 kHz in V/m

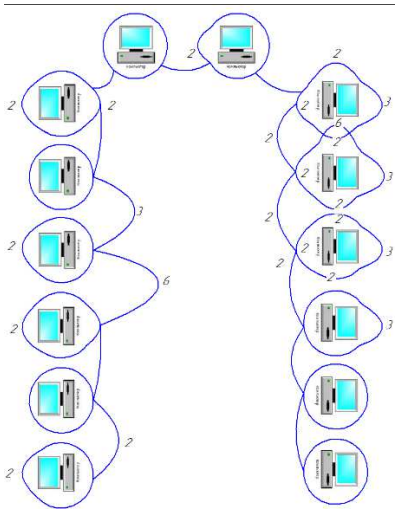

Figure 3. - The magnetic flux Density created by a linear series of computers in the frequency range 2-400 kHz in nTl

It should be noted that in the frequency range from 5 Hz to 2 kHz, the electric field strength values at all observation points do not exceed 0.01 V/m, which means that there is minimal or no EMI influence in the specified frequency range.

Analysis of the characteristics of the distribution of the intensities of electric fields in the frequency range of 2-400 kHz, is shown in figure 2 allowed us to establish that despite the absence of exceeding the RC (the value of 0.65 V/m 4 times below the permissible limits) the range of VDT manifests itself as antenna array, there is a growth with distance from sources, likely because of the imposition of AMY. A similar relationship is observed in the distribution of the magnetic flux density shown in figure 3. There is also no excess of norms for this indicator, the maximum value of 6 nTl is 4 times lower than the PDU. The maximum EMI falls in the middle of the linear row of computers, and closer to the edges of the row it falls off.

For one of the VDT, an in-depth analysis of the EMR propagation from the distance from the source in the horizontal plane (on the sides of the world) at a height of one meter from the floor was performed, the results of which are shown in figures 4-6.

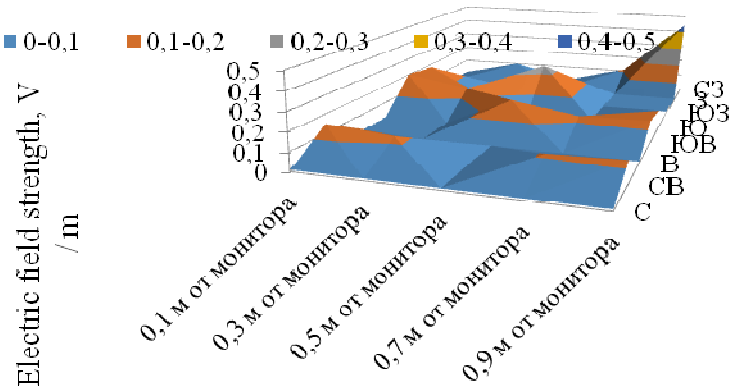

Figure 4. - Value of the intensity of the alternating electric field VDT in the frequency range 2..400 kHz in V/m

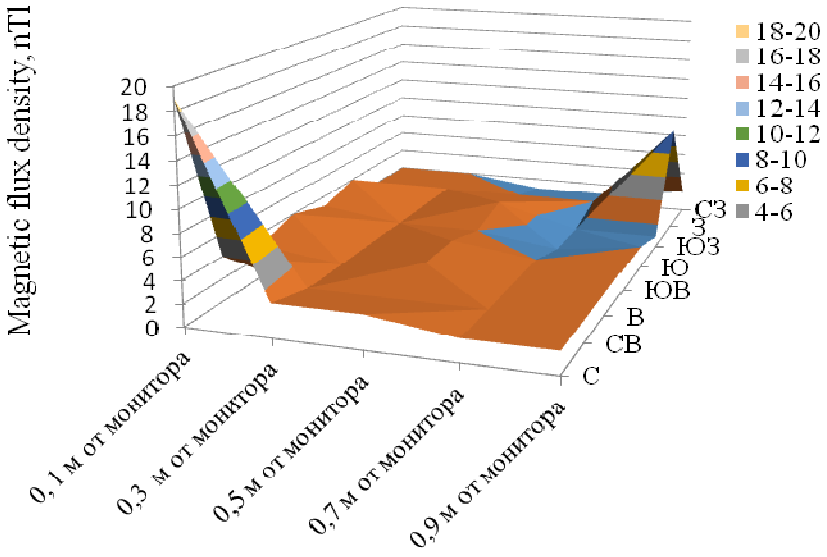

Figure 5. - Value of the magnetic flux density, VDT in the frequency range 2..400 kHz in nTl

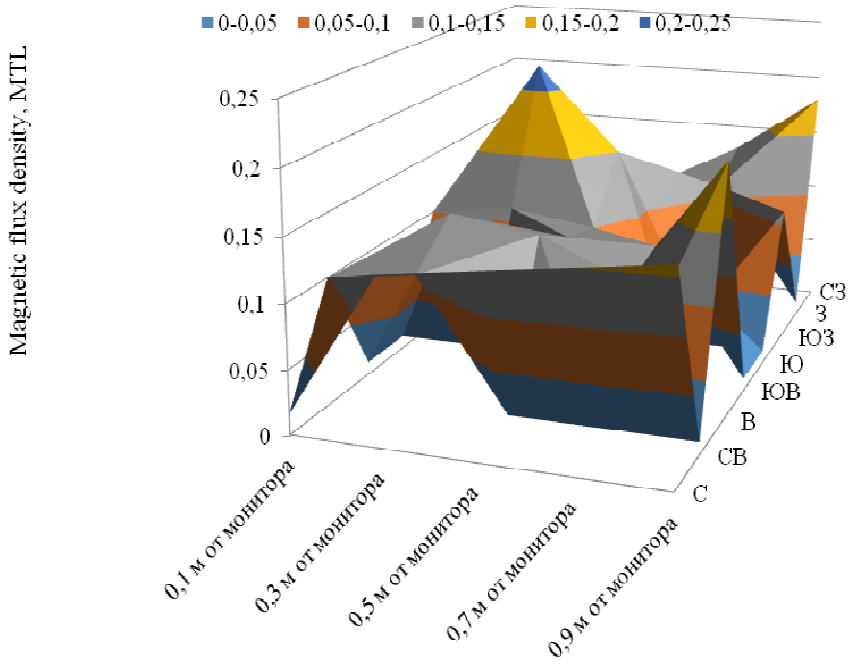

Figure 6. - Value of the magnetic flux density, VDT in the frequency range of 5 Hz-2 kHz in MTL

Analysis of the EMI prevalence from the distance from the source in the horizontal plane showed that with increasing distance from one VDT, which is part of a linear series of computers, both the field strength and the magnetic flux density increases and exceeds the field strength and magnetic flux density created by one individual computer.

Conclusion. The analysis of the electromagnetic environment created by a linear series of personal computers in a classical-type University classroom allowed us to come to the conclusion that it is necessary to measure the electric field strength and magnetic flux density in the range 2..400 kHz at a distance of 0.5 meters from the monitor, as prescribed by the rules, and 1 meter, where it is possible to exceed the remote control for EMI, due to the fact that the linear range of VDT can manifest itself as an antenna array.

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