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INTERACTIVE VIRTUALIZATION IN THE JAVA SCRIPT SOFTWARE ENVIRONMENT OF ELECTROMAGNETISM ALGORITHMS FOR THE STUDY OF DYNAMIC AND STATIC PARAMETERS OF FERROMAGNETS IN ALTERNATING AND PERMANENT MAGNETIC FIELDS

The training program involves not only the study of theoretical material, but also the performance of laboratory work. They are necessary to develop the skills of measuring physical quantities, performing physical experiments, and the ability to draw correct conclusions from their observations. Modern computer technologies allow us to complement this traditional training scheme. Training programs that simulate physical processes and phenomena that are not always possible to show "live" in training conditions can provide students with significant assistance. The processes of the phenomenon of the physics section "Electromagnetism" are visualized and interactively virtualized using the Java Script computer software environment. Such forks on a computer are very effective for mastering a certain course of knowledge and develop independent research skills and awaken to a creative search for research methods. This virtual-interactive laboratory development has been introduced into the educational process of the Kazakh National Women's Pedagogical University and is successfully used in teaching, at the Department of Physics when performing laboratory work on electromagnetism.

Key words: *Algorithm, virtual interactivity, virtual interactive laboratory (VIL), webmeter, toroid, ammeter, voltmeter.*

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ӨЗГӨРМӨЛҮҮ ЖАНА ТУРУКТУУ МАГНИТТИК ТАЛААЛАРДАГЫ ФЕРРОМАГНЕТИКТЕРДИН ДИНАМИКАЛЫК ЖАНА СТАТИКАЛЫК ПАРАМЕТРЛЕРИН ИЗИЛДЕП-ҮЙРӨНҮҮ ҮЧҮН ЭЛЕКТРМАГНЕТИЗМ АЛГОРИТМДЕРИН JAVA SCRIPT ПРОГРАММАЛЫК ЧӨЙРӨСҮНДӨ ИНТЕРАКТИВДҮҮ ВИРТУАЛДАШТЫРУУ

Окуу программасы теориялык материалды үйрөнүүнү гана эмес, лабораториялык иштерди да аткарууну камтыйт. Алар физикалык чоңдуктарды өлчөө көндүмдөрүн иштеп чыгуу, физикалык тажрыйбаларды жүргүзүү, байкоолорунан туура жыйынтык чыгаруу үчүн зарыл. Заманбап компьютердик технологиялар бул салттуу окуу схемасын толуктоого мүмкүндүк берет. Окутуу шарттарында "тирүү" көрсөтүлө албаган физикалык процесстерди жана кубулуштарды моделдөөчү окуу программалары студенттерге олуттуу жардам көрсөтө алат. Физиканын "Электрмагнетизм" бөлүмүндөгү кубулуштун процесстери компьютердик программалык чөйрөнүн жардамы менен элестетилген жана интерактивдүү виртуалдаштырылган. Мындай ВИЛ компьютерде билимдин белгилүү бир курсун

өздөштүрүүдө, өз алдынча изилдөө көндүмдөрүн өнүктүрүүдө жана изилдөө ыкмаларын чыгармачыл издөөнү ойлонуула абдан натыйжалуу. Бул виртуалдык интерактивдүү лабораториялык иштеп чыгуу Казак улуттук аялдар педагогикалык университетинин окуу процессине киргизилген жана физика кафедрасында электрмагнетизм боюнча лабораториялык иштерди аткарууда ийгиликтүү колдонулуп жатат.

Өзөктүү сөздөр: алгоритм, виртуалдык интерактивдештирүү, виртуалдык-интерактивдүү лаборатория (ВИЛ), вебметр, тороид, амперметр, вольтметр.

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ИНТЕРАКТИВНАЯ ВИРТУАЛИЗАЦИЯ В ПРОГРАММНОЙ СФЕРЕ JAVA SCRIPT АЛГОРИТМОВ ЭЛЕКТРОМАГНЕТИЗМА ДЛЯ ИССЛЕДОВАНИЯ ДИНАМИЧЕСКИХ И СТАТИСТИЧЕСКИХ ПАРАМЕТРОВ ФЕРРОМАГНЕТИКОВ В ИЗМЕНЧИВЫХ И УСТОЙЧИВЫХ МАГНИТНЫХ ПОЛЯХ

Обучающая программа предполагает не только изучение теоретического материала, но и выполнение лабораторных работ. Они необходимы для выработки навыков измерения физических величин, выполнения физических опытов, умения делать правильные выводы из своих наблюдений. Современные компьютерные технологии позволяют дополнить эту традиционную схему обучения. Обучающие программы, моделирующие физические процессы и явления, которые не всегда удается показать "в живую" в обучающих условиях, могут оказать учащимся существенную помощь. Процессы явлений раздела физики «Электромагнетизм» визуализированы и интерактивно виртуализированы с помощью компьютерной программной среды Java Script. Такие ВИЛ на компьютере очень эффективны для освоения определенного курса знаний и развивают самостоятельные исследовательские навыки и пробуждают к творческому поиску методов исследования. Данная виртуально-интерактивная лабораторная разработка внедрена в учебный процесс Казахского национального женского педагогического университета и успешно применяется в обучении на кафедре физики при выполнении лабораторных работ по электромагнетизму.

Ключевые слова: алгоритм, виртуальная интерактивизация, виртуально-интерактивная лаборатория (ВИЛ), веберметр, тороид, амперметр, вольтметр.

Introduction. Physics is an experimental science. Therefore, the training program involves not only the study of theoretical material, but also the performance of laboratory work. They are necessary to develop the skills of measuring physical quantities, performing physical experiments, and the ability to draw correct conclusions from their observations.

Modern computer technologies allow us to complement this traditional training scheme. Training programs that simulate physical processes and phenomena that are not always possible to show "live" in classroom conditions can provide students with significant assistance. The importance of such programs, however, should not be exaggerated. It must be

remembered - nothing can replace a real physical experiment in which a part of a natural phenomenon is talking to the researcher, and not a copy of "virtual reality" modeled by a person!

The program "Virtual interactive laboratory for the study of the processes of dynamic and static parameters of ferromagnets in alternating and permanent magnetic fields, the phenomenon of the physics section "Electromagnetism" is very effective in mastering this course and can be used in the learning process in different ways.

Firstly, it can be used to show demonstrations during the explanation of new material. Such demonstrations are very visual, improve perception and arouse interest in the subject. The advantage of such demonstrations, in comparison with conventional videos, is also that the teacher can quickly, by changing the parameters in the program, answer students' questions: "What happens if...?" The answer is simple - let's do it and see!

Secondly, the program can be used as a "laboratory" workshop. These classes are best conducted in a computer classroom. In this case, each student will be able to do their laboratory work independently. For such a lesson, preliminary preparation is usually necessary - when the theory of the phenomenon is already known, then meaningful work with experimental installations can benefit in a deeper understanding of the subject. The set of laboratory works and demonstrations offered by us does not exhaust all the possibilities of the program, and the teacher can always supplement this list with his own developments.

Thirdly, research and projects can be carried out on the basis of the program. Within its capabilities, the program allows you to conduct research on fairly complex magnetic processes and phenomena, the theory of which goes beyond the scope of the training program. Below are examples of laboratory work and demonstrations that can be used in the program. It should be borne in mind that the calculations performed by our program for the model of real electrical circuits are of a qualitative nature.

Materials and methods. The present requirement of time, visualization and interactivity, including animated images in the movements of physical phenomena and working with them requires a convenient software tool for implementation. The modern visual programming system Java Script provides a convenient tool for creating a simulation environment for any physical task.

To simulate the virtual interactive laboratory work-No. 1-The study of the dynamic hysteresis of ferromagnets, first all the necessary devices were modeled ammeter, voltmeter, oscilloscope, webermeter, rheostat, capacitor, resistor, toroidal coil and power supply-alternator as in Figure-1.

Figure 1 - Necessary devices and parts modeled for laboratory work

Next comes the installation of the electrical circuit with connecting wires, as in Figure

2.

Figure 2 - Wiring diagram mounted with connecting wires

Based on the mounted electrical circuit, measurements are carried out to obtain a picture of the magnetic hysteresis family as a dependence of magnetic induction-B, on the magnetic field strength-H, as in Figures 3 and 4
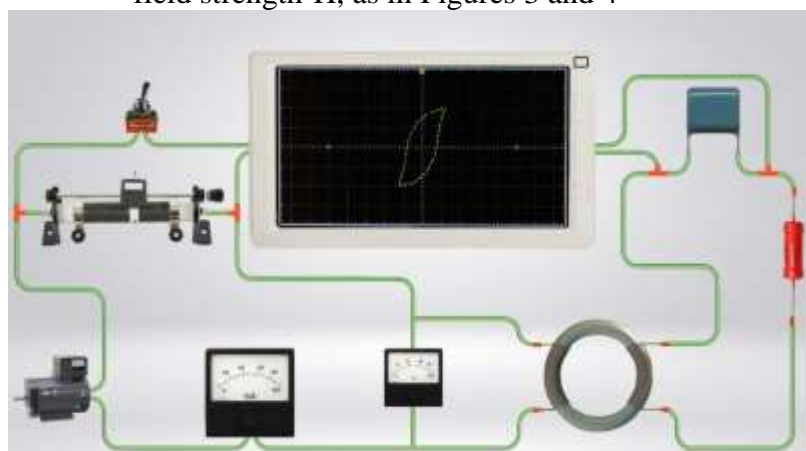

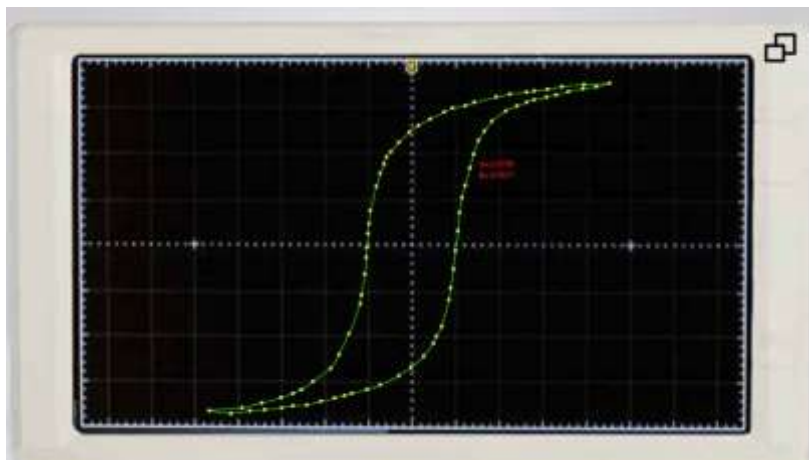*Figure 3 - A picture of small magnetic hysteresis as one of the family of hysteresis curves on the oscilloscope screen*

Figure 4 - A picture of the magnetic hysteresis loop on the oscilloscope screen, each point corresponds to the value of V, N

Results and discussion. Theoretical aspects for the implementation of the work. Measurement of the magnetization curve and hysteresis loop in a constant magnetic field. To measure the magnetization curve, it is necessary to demagnetize the sample, and then, gradually increasing the magnetic field, bring the ferromagnet into a saturation state, while measuring the magnitude of the magnetic field and induction at each point. [10,11,12,13,14,15]

To create an external magnetic field on a sample made in the form of a toroid (Fig. 1), a winding of n1 turns is wound, which is called the primary winding. when a current is passed through this winding, a magnetic field is created in it, directed tangentially to the circumference of the toroid. This field magnetizes the sample. the field value is calculated by the formula (1).

To measure the induction, a measuring winding with the number of turns n_2, which is also called a secondary winding, is wound onto the sample.

If a direct current i is passed through the primary winding, then the sample $\vec{H}$ is magnetized under the influence of an external field and induction is created in it $\vec{B}$. To measure induction, a microwebermeter F5050 is used, to the input of which a signal is supplied directly from the secondary winding of the sample.

Let 's write down Faraday 's law in the form

$$\int_{0\Phi}^{t} \varepsilon_{ind} dt = -n_2 \int_{1}^{\Phi_2} d\Phi = \Delta\Phi n_2, \tag{1}$$

While the sample is in a constant field, the voltage at the ends of the secondary winding is zero. if the magnetic field and the associated magnetic flux in the sample are abruptly changed from Φ_1 to Φ_2, then an ЭДС of induction occurs in the secondary winding, depending on time, as shown in Fig.5. The pulse area, according to (121), is equal to the change in the flow of $\Delta\Phi$. it is measured by the microwebmeter Φ5050. thus, it is not the flux itself that is measured, but the change in the magnetic flux $\Delta\Phi = \Phi_1 - \Phi_2$. To determine the magnitude of the flow, either the initial or the final value must be known. for example, if $\Phi_1 = 0$, then $\Phi_2 = -\Delta\Phi$. if you cause a flow change from $-\Phi$ to $+\Phi$, then the flow change is $\Delta\Phi = -2\Phi$.
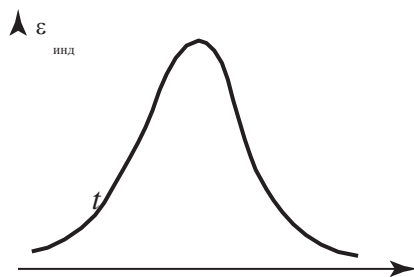
Figure 5 - ЭДС pulse supplied to the input of the microwebermeter

Neglecting the inhomogeneity of the magnetization of the sample, we can assume that $\Phi = BS$, where S is the cross—sectional area of the sample. Figure 6 shows the electrical diagram of the installation for measuring the magnetization curve and the hysteresis loop in a constant magnetic field. It is necessary to add the work of the webmeter and its software implementation
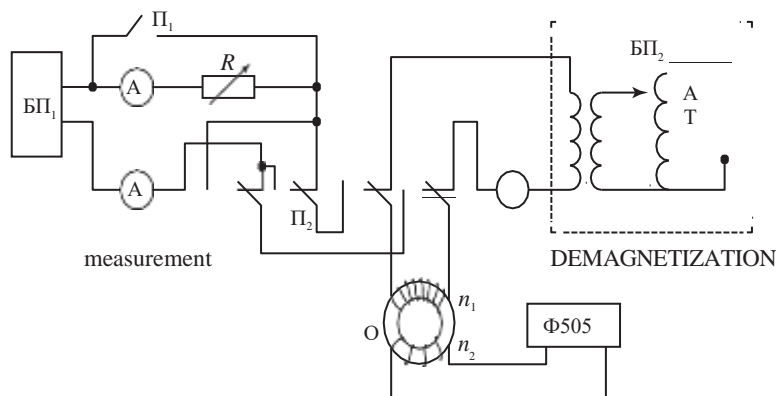

Figure 6 - Electrical diagram of the installation: БП₁ power supply with output voltage regulator; O — test sample (give sample data); R — resistance store; A₁, A₂, A₃ — ammeters; П₁, П₂, П₃— switches; Ф 5050 — microwebermeter; БП₂ — power supply for demagnetization of the sample alternating magnetic field

Measurement of the hysteresis loop. Bring the sample into a state of magnetic saturation. In this case, the toggle switch Π_1 must be closed and the resistance store R is set to 0. In this case, the sample is in the 0 state (Fig. 7).
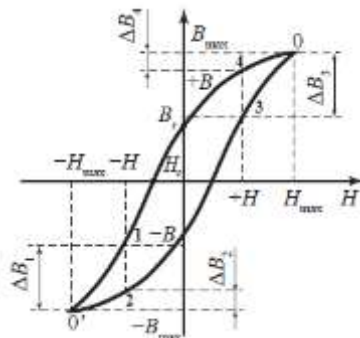

Figure 7 - Measurement of the hysteresis loop

Measure 20-28 points on the hysteresis loop, making 5-7 measurement cycles, respectively. It should be borne in mind that the measurement of the hysteresis loop is carried out in order to determine the coercive force, therefore, the reduction of the current (field) must be brought to values less than the coercive force. It is quite easy to determine this from the readings of a microwebermeter, since in the region of the coercive force at switches 1-0' and 3-0, $\Delta\Phi$ should be approximately $\frac{1}{2}\Phi_{\max}$, and this number is known from measurements of the magnetization curve.

Conclusion. A new branch is developing as part of information technology – virtual interactivity and visualization of hard-to-understand topics of physics, chemistry, biology and other subjects [2,3,7,8,9]. And the creation of virtual interactive laboratories with controlled measuring instruments on these subjects is very rare. Therefore, the technology given in this paper for creating a virtual interactive laboratory (ВИЛ) in the physics section "Electricity" will be very relevant to the creators of similar ВИЛ – at a higher level in other subjects of knowledge. Such ВИЛ on a computer are very effective for mastering a certain course of knowledge and develop independent research skills and awaken to a creative search for research methods. This fork in the physics-Electricity section, due to the visual and interactive intervention in the process of changing the conditions of the experiment, is very useful for the rapid development of the topic of physics by students and the development of research skills.

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