Electric Circuit E-learning System using LMS in Moodle

Gaku Komori  Non-member  (Tokyo University of Science, gaku.komori@gmail.com)
Shouta Takahashi  Non-member  (Tokyo University of Science, j8108064@gmail.com)
Naoyuki Aikawa  Member  (Tokyo University of Science, ain@te.noda.tus.ac.jp)
Yasuyuki Nishida  Senior Member  (Chiba Institute of Technology, nishida_yas@nifty.com)

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In electric and electronic engineering department, electric circuit theory is fundamental to learn electronic circuit and power electronics. Generally, the method of learning electric circuit theory is to study theory using textbook, lectures, exercises (solving electric circuit problems) and experiments. However, beginning students often find theoretical study and exercises difficult. Moreover, students cannot perform experiment by themselves, and there are limitations on the location and time that experiments can be conducted.

Recently, Computer Aided Instruction (CAI) and E-learning have alleviated these problems. CAI is a learning method involving simulation using a personal computer (PC). The simulation program with integrated circuit emphasis (SPICE) is atypical CAI program and is better suited to setting up complex circuits. However, SPICE is likely to be difficult for beginners. Specifically, understanding how to operate SPICE requires a great deal of time. Moreover, in order to make a simulation useful, simulation should realistically simulate the feel of using hardware.

Thus, in a previous paper, we proposed the Interactive Circuit And System Seminar (iCASS) which can be used over the Web system (http://www.sia.co.jp/icass). Moreover, iCASS allows students to learn by virtual simulation, provides motivation for learning through interactive animations and sounds, and offer the feel of using actual hardware. Although, iCASS is well suited to educational applications, the system does not provide exercises. As a result, iCASS cannot be used to teach theory, which requires students to solve numerous problems. When students solve problems, a lecturer must check the student’s answers, which becomes more difficult as the number of students increases. Although small-group instruction is one method of addressing this problem, the number of lecturers is limited. Namely, it is necessary to consider only the viewpoint of students, such as how to motivate their study and understanding of theory, but also the viewpoint of the lecturer, such as how to decrease teaching workload.

A system to teach electric circuit theory and workload of lecturers, referred to as the Online Assessment System with Integrated Study (OASIS), was recently proposed. OASIS can be used on the Web and can be used to generate electric circuit problems. In addition, OASIS can be used for to manage student progress. A system having the function of learning management is referred to as a Learning Management System (LMS). Moodle is typical examples. Such systems can manage learning results automatically and thereby reduce the lecturer’s workload.

The above-mentioned systems require knowledge of a programming language to generate problems. In other words, lecturers must generate the problems themselves using a programming language. However, not all lecturers are able to use programming languages. Thus, we herein consider a system whereby lecturers are able to generate problems using GUI tools that are similar to a circuit editor (e.g., SPICE). However, no e-learning system for generating electric circuit problems on the WEB using GUI tools has yet been proposed.

Thus, we propose Electric Circuit E-learning System using LMS in Moodle in this paper. The proposed system allows lecturer to make problems without any programming skill by using graphical tools and numerical value inputs as show Fig. 1. In addition, the proposed system has a function of learning management by Moodle. Thus, lecturer can use the function of Moodle in learning management as shown Figs. 2 and 3.

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Fig. 1. Proposed editor of electric circuit problem

Fig. 2. The screen of learning result in Moodle

Fig. 3. Calculation of an average, time, standard deviation, etc.
Statistical Outliers in Voxel SARs and their Effect of Whole-Body Average SARs in Pregnant Woman and Child for Far-Field Exposure

Ryota Asayama  Non-member  (Nagoya Institute of Technology, cja17505@stn.nitech.ac.jp)
Jianqing Wang  Non-member  (Nagoya Institute of Technology, ahirata@nitech.ac.jp)
Osamu Fujiwara  Senior Member  (Nagoya Institute of Technology, fujiwara@odin.nitech.ac.jp)
Tomoaki Nagaoka  Non-member  (National Institute of Information and Communications Technology, nagaoka@nict.go.jp)
Soichi Watanabe  Member  (National Institute of Information and Communications Technology, wata@nict.go.jp)

Keywords: far-field exposure, pregnant woman, 3-years child, voxel SAR, statistical outliers, whole-body average SARs

The WHO (World Health Organization) recommended the necessity of electromagnetic (EM) dosimetry evaluation for pregnant women with fetus and children as one of the most primary research subjects in 2006, which has promoted the studies on whole-body-average specific absorption rates (WBA-SARs) in various kinds of numerical pregnant woman and child models with respect to safety limits of WBA-SARs. For the present safety limits, however, they are being determined in view of the behavior destruction of health adult animals for radio-frequency EM exposure and EM absorption characteristics at resonant frequencies, which are not based on experiments for pregnant and young animals. In this paper, we calculated the voxel SARs and WBA-SARs in anatomical detailed models developed for a pregnant woman and a 3-years child at their resonant frequencies.

An anatomical human model is composed of very small cubic cells or tissue voxels. Denote by \( N \) the total voxel number. Then the SAR in the \( k \)-th voxel or voxel SAR \( \text{SAR}_k \) [W/kg] and the resultant WBA-SAR or \( \langle \text{SAR} \rangle \) are expressed as

\[
\text{SAR}_k = \frac{1}{\delta^3} \sum_{i=1}^{\delta^3} E_i \rho_i \gamma \text{SAR}_k = \frac{1}{\rho_k} \sum_{i=1}^{\delta} \sigma_i E_i^2
\]

\[
\langle \text{SAR} \rangle = \frac{1}{\rho_k^3} \sum_{i=1}^{\delta^3} \sigma_i \rho_i \gamma = \frac{1}{\rho_k^3} \sum_{i=1}^{\delta} \rho_i \rho_i \gamma = \frac{1}{\delta^3} \sum_{i=1}^{\delta^3} \rho_i \gamma \text{SAR}_k
\]

respectively, where \( \delta \) [m] is a length of voxel side, \( k \) is the voxel number in a human model, \( E_i \) [V/m] is internal electric field in the voxel, \( \sigma_i \) [S/m] and \( \rho_i \) [kg/m\(^3\)] are conductivity and density of the tissue voxel, respectively. The above equations shows that WBA-SAR is not always equal to the arithmetic average of voxel SAR, while we confirmed that the average voxel SARs approximately agree with the WBA-SARs.

Figure 1 shows the histogram and cumulative relative frequency of voxel SARs in pregnant woman with fetus and 3-years child models for vertically polarized wave exposure at their resonant frequencies. We found from the figure that the medians of voxel SARs in the pregnant woman and 3-years child models are 47% and 55% of their means, respectively, while their peak voxel SARs are 70 times larger than both of the means. This suggests a possibility that the FDTD calculated WBA-SARs could be overestimated due to the existence of statistical outliers. It was also found that although the total number ratio of voxel SARs for the outliers is 0.36% for the pregnant woman model and 0.34% for the 3-years child model, WBA-SARs except for these outliers are less than those in the pregnant woman and 3-years child models by 6.8% and 5.7%, respectively.

Fig. 1. Histograms and cumulative relative frequencies of voxel SARs in (a) pregnant woman, 3-years child and (b) fetus models for far-field exposure at resonant frequency

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Decolorization of Humate Solution by Ozone Bubbling and Ultraviolet Irradiation

Kotaro Rokkaku  Member  (Chiba Institute of Technology)
Fumiaki Fukawa  Member  (Chiba Institute of Technology)
Susumu Suzuki  Member  (Chiba Institute of Technology)
Haruo Itoh  Member  (Chiba Institute of Technology, haruo.itoh@it-chiba.ac.jp)

Keywords: persistent substance, humate solution, absorbance, total organic carbon concentration, ozone, ultraviolet

Previously, we presented the result of experiments on the decolorization of the humate solution (ammonium humate solution), one of the persistent substances utilizing the pulsed discharge in bubbles and water surface pulsed discharge. Ozone bubbling and ultraviolet irradiation are applied to the decolorization of water containing humic acid. Experiment is carried out to observe the variation of absorbance, carbon concentration and pH in humate solution, and observation is conducted by ozone bubbling and ultraviolet irradiation.

A silent discharge type ozone generator and low pressure mercury lamps are provided in this study. Ozone is produced by dielectric barrier discharge type ozonizer which is equipped with a coaxial electrode and is bubbled in the humate solution from the injection needle. Two kinds of low pressure mercury lamps of which the shortest wave length of light emission is limited at 180 (UV180) and 200 nm (UV200), are prepared as UV source. The sample used in the reactor is ammonium humate solution. The concentration of the humate solution is 50 mg/l. A sample of 8 ml is used in the experiment. The absorbance, pH and carbon concentration in the humate solution are measured by a photo absorption spectrometer in the range from 280 nm to 600 nm, a total organic carbon analyzer and a pH meter, respectively.

Figure 1 shows the temporal variation of absorbance during ozone bubbling of 15 g/m³ for 5 - 35 min. The absorbance decreases with an increase in time.

Figure 2 shows the temporal variation of absorbance in ultraviolet irradiation time (UV180). The ultraviolet irradiation time using the mercury vapor lamps was 30 - 150 min. The absorbance in the case of using UV180 decreases with an increase in time. However, it hardly varies after 90 min. On the other hand, the absorbance for UV200 hardly varies throughout the experiment.

Figure 3 shows the variations of the total organic carbon concentration (TOC) and the inorganic carbon concentration (IC) with ultraviolet irradiation time. The initial concentration of organic carbon in the humate solution is 23 mg/l. TOC decreased to 0.9 mg/l when ultraviolet irradiation was conducted for 120 min using UV180, although it hardly varied after 90 min. UV200 had no significant effect on the TOC. The effect of ultraviolet irradiation was thus clearly confirmed. IC was hardly detected in each time at ozone bubbling and ultraviolet irradiation. The luminescence intensity of ultraviolet irradiation is important for the decomposition of humate. It is clarified that the variation of absorbance in humate solution by ozone bubbling is effective, and UV in shorter than 200 nm wavelength is remarkable important to decolorize the humate solution.
Two-dimensional Magnetostriction of Electrical Steel Sheet under High Magnetic Flux Condition

Daisuke Wakabayashi  Student Member  (Oita University, v10f1006@oita-u.ac.jp)
Takashi Todaka  Member  (Oita University, todaka@cc.oita-u.ac.jp)
Masato Enokizono  Member  (Oita University, enoki@cc.oita-u.ac.jp)

Keywords : two-dimensional magnetostriction, vector magnetic properties, electrical steel sheet, high magnetic flux density

Noise reduction of electrical machines is a very important subject to be solved in a point of view of environmental improvement. It is well known that the major cause of noise is magnetostriction of electrical steel sheet. We suggested new evaluation method for magnetostriction to make clear the relationship between the magnetic property and the magnetostriction. The strain tensor can be calculated from the magnetostriction in three directions. We can obtain the magnetostriction in arbitrary direction. We call this the two-dimensional magnetostriction. This paper presents measured two-dimensional magnetostriction of electrical steel sheets under high magnetic flux conditions.

Figure 1 shows the measurement system for magnetostriction. The excitation frequency is 50 Hz. The specimen’s are non-oriented and grain-oriented electrical steel sheets.

Figure 2 shows the two-dimensional magnetostriction. The principal strain of expansion occurs near the magnetic flux density vector on a non-oriented electrical steel sheet. The principal strain of contraction occurs the rolling direction under low magnetic flux density on a grain-oriented electrical steel sheet. However, the principal strain of contraction occurs near the magnetic flux density vector under high magnetic flux density. Figure 3(a) shows the direction of principal strain of expansion on a non-oriented electrical steel sheet. The direction of principal strain of expansion was maximum at $\theta_B = 90$ deg. Figure 3(b) shows the direction of principal strain of contraction on a grain-oriented electrical steel sheet. The direction of principal strain of contraction did not maximum at $\theta_B = 90$ deg.