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Aspects of Engineering Education in Signal Technology Using Virtual Instrumentation

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Introduction

Education implies two fundamental aspects which must be allowed for defining and understunding hereof.

• Space or horizontally dimension (axis), where through we nominate the extension of education in all living and social-human life areas. This interpretative perspective lead to eliminate the detrimental mentality that the education involves only through scholastic institutions. The contemporary social evolutions relieved the existence of other numerous education extra- or non-scholastic sources, configurations beside of the formal education (of scholastic type) two other great educational areas – nonformal education and informal (which covers the wide areas of numerous spontaneous, unsystematic and transitory influences, which take place inside the space of social contacts of all types, in which the individual is implied at different moments of its extra-institutional being).

• Temporal or vertical-longitudinal dimension (axis). Its major aim is the extension of education during of entire individual life. The new acquisitions from the domain of ages and learning psychology demonstrated, undubiety, the persons' capability to learn and to be educated at any age, of course in ways and with intensities modelled by the psycho-social particularities at different ages.

The extensions brought by technological medium, insufficient explored and used, refer to:

- orientation unto student, by personalization of the forming path – the different composing of the educational objects depending on the requirements of each beneficiary – by forming individualization – the nonlinear information structuring, with the possibility to return at more difficult contents after the automatic identification of the blanks – autonomy by eluding of an imposed rhythm, spacial independence and asynchronous seminars

- distributed resources, by using/integration/accessing of the electronic libraries and of the multimedia materials

- the roles' fluidity, by the continuous balancing of the educated-educator role into the learning group („symmetric knowledge advancement"), by the continuous restructuration of the learning teams depending on the interests or based on the in task efficiency criteria.

As a result of joining of the diferent structures from education models it can be enumerated some factors which influent the choise of one structure.

• *The education object.* If we aim at the teaching staff retraining in the respect of the familiarizing with the education reform provisions, then the option should be for one independent, dual or unisection model.

• *The needs for education.* An open university is the best solution for great requirements.

• *Available resources* – human, physical and financial.

• *The autonomy and control degree* – depending on the orientation and on the supporting at the level of educational politics.

Generally, the educative institutions prefer to adopt a bimodal organization system, through specific projects which create a virtual institution inside of one traditional. The effects are evident after relatively short time – an university registering dozens of times as much then can hold in its course halls – but the long-term effects are those regarded, the institutions with tradition occuping a place in the tomorrow's educative framework, the virtual framework, towards a future of the *„without residence university, connected (first) with peoples and ideas"*.

Online learning features

- The education is oriented by a person, permitting for coursists to choose the content and some tools adequate for their different interests, needs and ability levels.

- The education is made in proper rhythm, the cousist having the possibility to accelerate or slow down.

- The geographical barriers are eliminated opening then wider education options.

- It happens a mutual information changing between coursist, as well as between tutor and each coursist in part; the interaction inside the area of the specific content is then ampler inside the traditional education.

- The coursist is guided to topics which give off pleasure, satisfaction, good spirits; the studies show that as

- The evaluation is objective and is made either by testing or by elaboration of papers/essaies or projects, participation at online forums.

• *If the coursist learn better by reading*, he look for a course with e-books, textbooks or other printed works.

• *If the coursist learn better by hearing*, he can look for a course with audio lections in the aim to be explained him the concepts.

• *If the coursist learn better by watching how are made the things*, he will look for a course with graphical demonstrations which illustrate the new concepts.

• *If the coursists learn better by executing*, he will look for a course with tasks to be performed, colloquies or examples of practical applications.

• *If the coursists learn better by speaking / communicating*, he will look for a course with e-mail, chat or thematic group discussions, in the aim to share his impression and for feed-back.

A comparative analisys can be followed through a simple instrument of grille type. It is given a brief from 0 to 4 for each item taken in calculation, where 0 means the absence of the feature, and 4 means that the indicator satisfies completely the expectations.

Table 1. eLearning solution

eLearning solution	**Click to learn**	**Macromedia**	**X solution**
scale	3	4	3
perception	4	4	4
symmetry	4	3	0
interactivity	4	4	2
teaching aids	4	2	3
control	4	3	2
integration	4	4	4
costs	3	3	3
time	4	3	4
flexibility	4	2	1
TOTAL brief	**38**	**32**	**26**

The sum on each column expresses, syntetically and approximately, the diferences between the analized solutions.

Depending on the importance which the institute accord to certain items, we can pass to features analisys. If the flexibility of one system is of maximum importance, due to the continuous changing request from the forming market or due to the quick superannuation of the informations in the aimed field, then it can even renounce to the other itemss. Or it can made another grille, with maximum diferentiated briefs: for flexibility is given a mark between 0 and 20.

The building of one informational society (which will represent the passing to the *knowledge society*) can not be achieved without research and investments projects, either in the IT&C field or in the education field. The final desideratum being *the competence*, any technology, any approach will not eliminate or neglect the *relation professor - pupil/student*. All will be convenient and efficient instruments at hand either of the teacher or of the pupil/student. Sometimes, these instruments can be unique given the traditional instruments from education. Some representations can be reproduced or simulated only through the computer which offers methods and techniques concerning the *graphics, animation, sound*. For example, the three-dimensional representations or the evolution of some physical, chemical, biological etc. phenomena which develop dynamically, can not be represented or studied only using the computer. The *competence and experience on problem solving* can be obtained only having permanently in consideration the interdependence *physical reality-virtual reality* and if it made efforts for the *acquirement of new knowledge*, for the appropriate *knowledge* of all aspect concerning the physical model, respectively the virtual model, aspects determined by the particularities of the problems for solving from a certain field. For example, a computer scientist which elaborates programs for different problems solving, must have competence according to the below diagram.

Virtual instrument for comparing an analog signal before and after mathematical processing of it by means of derivation and integration operations

The presented application is implemented in LabVIEW and is dedicated to an earning program that presents the algorithm of differential and integral calculus implementation in the case of a sampled signal and how the numerical calculation applied to a sampled signal can influence the processing results.

The instrument's front panel is composed of two windows: inside the first window is implemented the generating of a signal and the mathematical processing of it with the aid of derivation and integration operations, and in the second window is shown the graphical representation of spectral analysis for the original signal and the mathematical processed one, as well the difference between the distortion factor for the original signal and the mathematical processed one.

The input signal can be composed by user in different shapes. It is obtained by adding three types of wave (Signal 1, Signal 2, Signal 3).

Each of the three signals can be adjusted and viewed on screen by pressing the appropriate button.

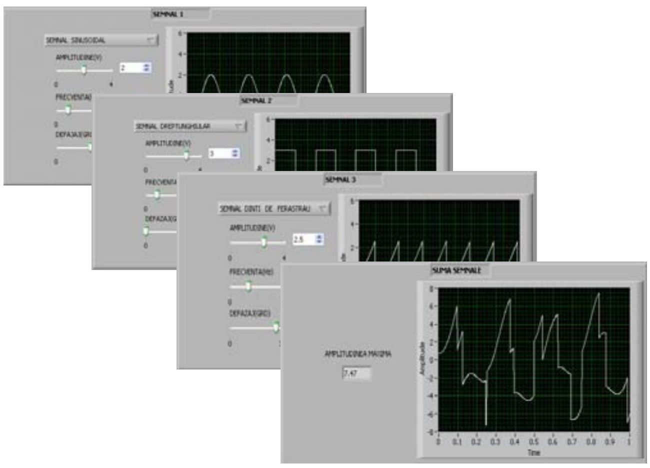

Fig. 1. The composing of the input signal

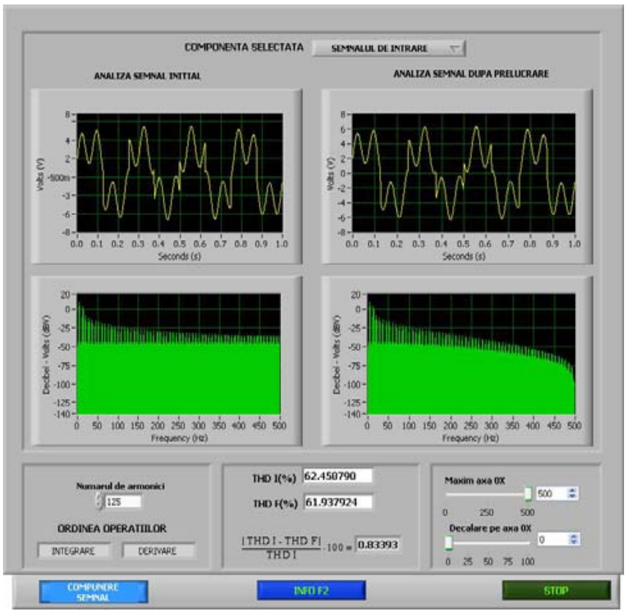

Fig. 2. Spectral analysis of the original signal and of the mathematical processe

The instrument allows, for each considered signal, to be possible to choose the signal type (sinusoidal, rectangular, saw tooth or a white noise) as well the amplitude, frequency and phase shift so that to obtain wave forms of more complex and more similar to the real analogue signals. The final signal is viewed by pressing the „SUMA SEMNALE” button (signal adding). By adding of that 3 types of wave, the amplitude of the resulted signal can exceed this input field, studying so the behaviour of the converter in this case and how this is reflected in the signal reconstituted from the sampling and coding processes.

The initial signal is generated by composition of three adjustable signals. Each of these signals can be of several types (sinusoidal, rectangular, triangular, saw tooth or white noise) depending on the position of control with winding which define its. For each we can choose amplitude, frequency and phase. The three signals can be displayed and adjusted by pressing the appropriate buttons.

At the bottom of the screen are represented by two graphs the results of mathematical processing of the initial signal. Through a button placed above these graphics the user can change the order of performing operations: derivation-integration or integration-derivation.

At the bottom-left of the instrument is the „ANALIZA SPECTRALĂ” button (spectral analysis).

On pressing it will display a new window (Figure 2).

This is divided, in the top part, in two columns. In the first of these is represented the spectral analysis of the initial signal, and in the second is represented the spectral analysis of the processed signal. Through the „COMPONENTA SELECTATĂ” button (the selected component) the user can view the components of the two signals and their spectral analysis.

We can select the following components:

- input signal
- fundamental signal
- residual signal – composed of noise and harmonics
- harmonic
- noise

At the bottom of the instrument, on the left part, are indicated the number of harmonics taken into account and the order of performing operations.

In the second column are indicated the total distortion factors for the original signal and for that processed, as well the error calculated by formula:

$$e = \frac{|\text{THD I} - \text{THD F}|}{\text{THD I}} \cdot 100 \cdot \qquad (1)$$

Through controls placed on the right side of the instrument we can scale the graph of the spectral analysis in the aim to identify more precisely the harmonic signals.

The entire program is included in a *While* repetitive structure that interrupts the running by pressing the „STOP” button. Inside of it we find three sub-programs for signals generating. Those results are added and represented on a graph [1, 2].

The obtained wave form is decomposed in components:

- the amplitudes vector
- the distance between two consecutive points on the axis of time *dt*

The amplitudes vector is sent to a *Case* decisional structure with two frames. Depending on the logical value of the control for selecting the order of operations we will choose the first frame of the *Case* structure in which is made the derivation and then the integration, or the second frame in which is made the integration and then the derivation. At the exit of the *Case* structure is made the composing of the wave forms after that two operations and its displaying on two graphics.

Over the initial and final signal is applied the Harmonic distort Analyzer function which perform the spectral analysis, the calculation of the THD factor as well the signal decomposition.

The graphics scaling is made by properties nodes which define the graphics scale.

From the spectral analysis of signals can be observed:

- the harmonics of the processed signal have a decreasing rate confronted by those of the initial signal, for high frequency some missing.
- irrespective of the type of initial signal the distortion factor for the initial signal is always greater than that of the processed signal.
- the *e* error is the great so as the signals are more irregular (Figure 3).
- along with the changing of the operations order change also the value of the *THD F* distortion factor of the final signal.

After the given observations it can be concluded that the mathematical operations act on the signal as a low-pass-filter eliminating a part of signal harmonics, this fact being due to the implemented computing algorithm.

The correct recomposing of the signal subjected to processing depends on the amplitude of the last point from the series that describes the initial signal. This value will influence decisive the shape of the final zone of the derived or integrated signal.

The application allows the graphical observation of some conclusions drawn from the numerical analysis theory namely that the derivation operation tends to increase the errors occurred in the numerical interpolation of the graphics and the integration to reduce these errors.

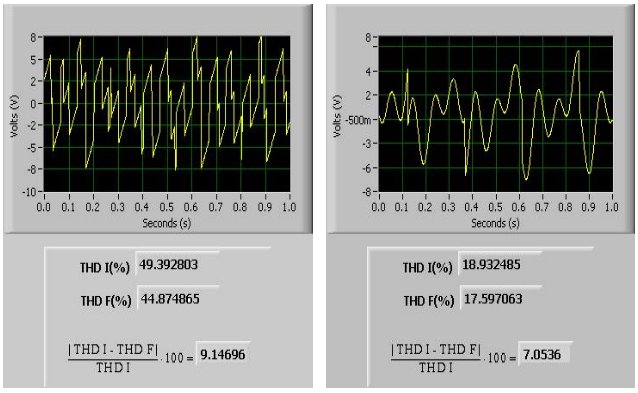

Fig. 3. Spectral analysis of the original signal and of the mathematical processe

Starting from this application can be achieved a virtual instrument which allows highlighting the role of sampling windows (Hanning, Hamming, etc..) into the spectral analysis of processed digital signal as well the digital filters.

Conclusions

Applying the digital technologies the entire learning concept is changed, the online education giving a series of advantages:

- reduces considerably the training and learning costs
- saves the costs of teacher and student travelling
- economize significant the travel time
- saves many costs concerning the opportunities
- integrates many media used for teaching and learning allowing a productive communication.

The students and the educators can evaluate the proper work or can be evaluated by others:

- the content evaluation and form evaluation for electronic presentations
- the using of spelling and grammar utilitarian from a text processor or other programs in the aim to edit and revise the created texts
- the applying of the ethic and legal principles concerning the plagiary and the copyright
- the understanding and respecting of the „ethics" in the using of the electronic mail, of the newsgroups and of the other services and functions from Internet
- the using of the electronic mail and of the online discussion groups (listservs, newsgroups) in the aim to communicate with the professors and with other students concerning the proper performances, the accomplished tasks and for information
- reflections concerning the using of the electronic resources and of the digital tools for information processing in the developed process.

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The paper aims to present virtual instruments used in learning and understanding the numerical computing algorithms used in signal processing. The software applications were designed to answer at certain standards of engineering education that can be applied at distance. The proposed virtual instrument allows generating composed signals, derivation and integration, and study how the techniques of numerical derivation and integration leads to a loss of information by comparing the results obtained in the signal spectral analysis. Ill. 3, bibl. 6 (in English; abstracts in English, Russian and Lithuanian).

М. Р. Милици, И. Мигай, Л. Д. Милици. Исследование виртуальных инструментов для обучения и познания технологии сигналов // Электроника и электротехника. – Каунас: Технология, 2009. – № 6(94). – С. 113–116.

Предложены модели обработки сигналов с помощью виртуальных инструментов. Программное устройство было создано с учетом дистанционного обучения при освоении инженерных наук. Созданные виртуальные устройства позволяют генерировать, рассчитать и интегрировать электронные сигналы. Экспериментально и теоретически оценены потери информации. Ил. 3, библ. 6 (на английском языке; рефераты на английском, русском и литовском яз.).

M. R. Milici, I. Mihai, L. D. Milici. Signalų technologijos mokymo aspektai taikant virtualias priemones // Elektronika ir elektrotechnika. – Kaunas: Technologija, 2009. – Nr. 6(94). – P. 113–116.

Pateikti signalų apdorojimo moduliui skirti virtualūs instrumentai. Programinė įranga buvo sukurta įvertinant ir nuotolinio mokymosi galimybę studijuojant inžinerinius mokslus. Pateikti virtualūs įrankiai leidžia generuoti, apskaičiuoti ir integruoti signalus. Taip pat suteikiama galimybė stebėti minėtus procesus bei įvertinti prarandamą informaciją. Il. 3, bibl. 6 (anglų kalba; santraukos anglų, rusų ir lietuvių k.).

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