LASCU MIHAELA RUXANDRA

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1. ***LASCU MIHAELA RUXANDRA**, "The Finite Element Method In Shielding Problems", International Review of Electrical Engineering (I.R.E.E.) Vol. 3, No. 1, January-February 2008, pp. 174-181, Print ISSN-1827-6660, CD-ROM ISSN-1827-6679.*

2. ***LASCU MIHAELA RUXANDRA**, Lascu Dan, "Finite Element Method Applied in Modeling Perturbations on Printed Circuit Boards", International Review of Electrical Engineering (I.R.E.E.), Vol. 3, No. 2, March-April 2008, pp. 273-280, Print ISSN-1827-6660, CD-ROM ISSN-1827-6679.*

3. ***LASCU MIHAELA RUXANDRA**, "Measurement Techniques for Determination of Shielding Effectiveness Characterizing Shielded Coaxial Cables", The 11th International Conference on Optimization of Electrical and Electronic Equipment - Optim, May 22-24, 2008, pp. 59-64, ISBN: 978-1-4244-1544-1.*

4. ***LASCU MIHAELA RUXANDRA**, Dan Lascu, "LabVIEW Event Detection using Pan–Tompkins Algorithm", Proceedings of the 7th WSEAS International Conference on Signal, Speech and Image Processing, Beijing, China, September 15-17, 2007, pp. 32-37, ISSN: 1790-5117, ISBN: 978-960-6766-07-7.*

5. ***LASCU MIHAELA RUXANDRA**, Lascu Dan, "A New Morphological Image Segmentation with Application in 3D Echographic images", WSEAS Transactions on Electronics, Issue 3, Volume 4, 2008, pp. 72-82, , ISSN 1109-9445.*

6. ***LASCU MIHAELA RUXANDRA**, Dan Lascu, "Electrocardiogram Compression and Optimal Filtering Algorithm", Proceedings of the 7th WSEAS International Conference on Signal, Speech and Image Processing, Beijing, China, September 15-17, 2007, pp. 26-31, ISSN: 1790-5117, ISBN: 978-960-6766-07-7.*

7. ***LASCU MIHAELA RUXANDRA**, "A new method for calculating the transfer functions in quasiresonant converters", Advances in Electrical and Computer Engineering (AECE), Vol. 13, Issue 3, 2013, doi:10.4316/aece, pp. 107-112, ISSN 1582-7445, e-ISSN 1844-7600.*

8. *Paulescu Marius, Dughir Ciprian, Tulcan-Paulescu Eugenia, **LASCU MIHAELA RUXANDRA**, Paul Gravila, Traian Jurca, "Solar radiation modeling and measurements in Timisoara, Romania: data and model quality", Environmental Engineering and Management Journal "Gheorghe Asachi" Technical University of Iasi, Vol. 9, No. 8, August 2010, pp. 1089-1095, Print ISSN: 1582-9596, Print ISSN: 1582-9596.*

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10. *Lascu Dan, Bauer Pavol, Băbăiţă Mircea, **LASCU MIHAELA RUXANDRA**, Popescu Viorel, Popovici Adrian, "Distance education in soft-switching inverters", Journal of Power Electronics, Vol. 10, Issue 6, South Korea, 2010, pp. 628-634, pISSN 1598-2092, eISSN 2093-4718.*

Praise Worthy Prize

International Review of Electrical Engineering (I.R.E.E.), Vol. 3, N. 1
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The Finite Element Method in Shielding Problems

M. Lascu

Abstract – *A very powerful tool for studying the magnetic field of shaped slotted screens has been developed. The proposed method is based on a circuital characterization of the structure, via the Finite Element Method (FEM), which is then combined with a modal expansion to compute the field inside and outside the envelope. Although I have centered my analysis in square slotted structures, the versatility of the Finite Element Method permits one to apply this method to any bidimensional envelope no matter how many slots or dielectric parts it contains. This paper is also a review describing the basics of the finite-element method and its applications to EMI/C problems. It demonstrates how this method can help in the analysis of shield degradation in the presence of external conductors and electromagnetic leakage through slot configurations in a shielded enclosure. The development is given for an EMI application related to shield degradation in the presence of external conductors. The magnetic field inside and outside the slotted screens has been studied using the Finite Element Method. As a practical application, the magnetically performance of a slotted cylindrical and rectangular screen has been studied. In general, it is shown that coupling to the interior of slotted screens is maximized at frequencies corresponding to resonance of the shorted screen, provided that the fields do not vanish near the aperture.*

Keywords: *Aperture, Finite Element Method, Grid, Mesh, Shield, Source*

I. Introduction

For obtaining a good ground net it is not necessary to dig at great distances inside the earth. For improving the ground net it is sufficient to obey some rules validated by experience.

In this paper are presented two possibilities of constructing ground nets; one using a vertical stick and the other a horizontal cable. The advantage of the stick is the reduced used surface. The advantage of the cable is his contribution to the equipotentiality of the zone.

The grounded conductors may be placed at a 20 cm distance one to the other, for not corrodating so fast. In case some round conductors are used, their surface has to be minimum 50 mm^2 for not corrodating so fast.

A grounded cable has to be placed at enough deepness for not to freeze. The deepness of the cable has to be minimum 1 m. The net of cables has to be covered with good earth and not with garbage of construction.

For the assurance of a great equipotential zone it is necessary to use a grounded net with meshes having the form of a grid.

In case the construction is placed on a reduced surface, for example 10 m^2 a simple cable is sufficient. In case there are taken into consideration some big construction, it is recommended to use a conductor grid with the dimension of the mesh 10×15 m. The distance between the grounding bars has to be maximum 20 m.

This recommendation has to be applied even for constructions created on great surfaces. A ground cable with a direct access, in protection to corrosion presents a double advantage because the ground cable is located all around and is bounded to the sticks all around.

In this paper I present the case when an external conductor is placed near of an aperture, aperture that is located on a shield, the quantity of energy is increasing very much, when a coupling is borne through the existence of this slot. The papers met in the literature [1]-[2] refer till now only to small geometries in comparison to the wavelength and to studies that specify the Finite Difference Method.

In this paragraph the problem will be solved using the Finite Element Method (*FEM*), the given solutions can be used for much larger geometries.

For designing shields, which works correctly in the presence of external conductors, it is important to understand the modality in which the conductors interact with the slots of the shield.

In the papers specified in the specialty [1]-[2] the performances of a shield are evaluated using the separation functions in four categories: shielding effectiveness, field attenuation $\overline{E}$, field attenuation $\overline{H}$ and the surface impedance. Every function is evaluated separately using quasistatic approximations. The implementation of more complex models is not a difficulty with the help of the Quickfield program. In practice most of the shields are not realized of one

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Finite Element Method Applied in Modelling Perturbations on Printed Circuit Boards

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Abstract – *This paper is concerned with predicting the electrical behaviour of metallization patterns printed onto dielectric substrates using the Finite Element Method (FEM). The method described was initially aimed at the modelling of Printed Circuit Boards (PCB) layouts, but is just as applicable to VLSI layouts. It involves the generation of an equivalent circuit to model the electrical properties of the layout. This can be obtained efficiently and provided directly to a circuit simulation program. Predictions can then be made of how the performance of a circuit implemented on a PCB is modified by its physical layout, or of the performance of printed components such as spiral inductors.*

Keywords: *Finite Element Method, Modelling, Printed Circuit Boards, Prediction, Simulation*

Nomenclature

B	Magnetic flux density
C	Capacitance
C_{ii}	Self capacitance between i^{th} conductor and ground
C_{ij}	Mutual capacitance between the ith and jth conductor
C_p	Line parasite capacitance
D	Electric flux density
E	Electric field
i	Current
L	Inductance
L_{ii}	Self inductance between i^{th} conductor and ground
L_{ij}	Mutual inductance between the ith and jth conductor
M	Mutual inductance coupling
u	Voltage
Z_G	Ground Impedance
ε	Permittivity
ε_o	Permittivity of free space
ε_r	Dielectric constant or relative permittivity
μ	Permeability
μ_o	Permeability of free space

I. Introduction

Miniaturization has been the one of the key driving forces behind the electronics industry for over thirty years now. Component technology has progressed from valves to transistors to integrated circuits to very large scale integrated circuits (VLSI), with features well under a micron in size.

Because the components have reduced sizes, the methods used to connect them together have changed, principally through the introduction and evolution of the design concerning the printed circuit board (PCB) [1].

The main design consideration concerning the PCBs was to produce the correct connectivity. From the circuit point of view the PCB tracks were assumed to provide lossless interconnections between components. Because circuit designs became more complex and constraints on space increased, problems began to be seen, particularly in high-frequency designs. The cause of these was that the PCB in fact behaves in a complex manner, with various electrical-loss and internal-coupling mechanisms. To improve the electromagnetic behaviour of the PCB tracks, spirals were designed on a typical PCB to behave like inductors.

The modelling approach was developed as a necessity to avoid redesigning several times before the circuit it supported would work to specification. PCBs have a planar structure and for most applications they are electrically small. The presence of large areas of metal nearby the PCB means that important coupling effects are confined to electrically short distances.

Simulation techniques are of great interest, because their results are used by the circuit designers. It is important to know the effect of the fields [1], [2], [3].

II. Electromagnetic Modelling

Electromagnetic modelling has a long history: some of the basic techniques were developed more than a century ago, by Maxwell and others. However, before the widespread use of computers, only a very limited range of problems could be tackled, such as isolated conducting objects of symmetrical shape.

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Measurement Techniques for Determination of Shielding Effectiveness Characterizing Shielded Coaxial Cables

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Abstract—**The measurement of shielding effectiveness of coaxial cables is often limited by the dynamic range of the measurement system. This paper presents a new test procedure for measuring the shielding effectiveness (SE) of shielded coaxial cables. The TEH modified measurement cell with an asymmetrically placed conductor and the proposed form of the cell establish in the zone, where the cable for testing is placed, a quasi-uniform field. Moreover, the method operates over a broad frequency range with high accuracy.**

I. INTRODUCTION

Shielding effectiveness (SE) is the ability of a material to reduce the transmission of propagating fields in order to electromagnetically isolate one region from another. Several measurements must be made to ensure SE test accuracy. Every test setup has a maximum measurement range, or dynamic range, that varies with frequency. The dynamic range must be greater than the effective shielding of the cable under test in order to ensure reasonable data. The dynamic range of a system is the difference between the baseline and leak tests. The baseline test measures the ratio between transmit and receive power using two antennas inside the reverberation chamber. For correct baseline measurements there must be no direct illumination between the transmit and receive antennas.

Measurement techniques [1], [2], like the *triaxial method* and *direct current injection (DCI)* characterize the shielding effectiveness through the coupling impedance. By the *DCI-method* the obtained electromagnetic field is not uniform. The proposed method using the *modified TEH cell* provides a quasi-uniform field. The method for the measurement of the shielding effectiveness of coaxial cables uses two propagation lines: a disturbing line and a cable under test. The shielding effectiveness is deduced from the voltages appearing at the end of the coaxial cable.

II. MEASUREMENT SET-UP. MODIFIED TEH MEASUREMENT CELL.

A modified TEH (Transmission-Line Holder) measurement cell (TEHMC) as in Fig.1. is a wide band linear transducer both in phase and in amplitude. It is used to convert radiofrequency signals into electroamgnetic fields. The measurement is made in two phases:

a) measurement of the voltage at the end of the coaxial cable without shield;

b) measurement of the voltage at the end of the coaxial cable with shield.

The TEHMC provides a direct result of shielding effectiveness. The technique calls for one set of measurements to be made with an unshielded cable of exactly the same construction as the shielded cable. The shielded cable then replaces the unshielded cable in exactly the same location. The measurements are then made with the shielded cable in place.

The shielding effectiveness of the shielded cable is represented by:

SE=voltage (dB) unshielded cable-
voltage (dB) shielded cable

Since this technique relies on an empirical solution and is only as good as the repeatability of the measurements, the following possible sources of error must be considered:

- Differences between the shielded cable core and the unshielded cable.
- Variances in the positioning of the two cable.

Variation in the output voltage level of the selective microvoltmeter.

The TEHMC with an asymmetrically placed conductor and the proposed form of the cell establish in the zone, where the cable for testing is placed a quasi-uniform field.

The Finite Element Method (FEM) analyzes the distribution of the fields numerically in the interior of the modified TEH cell.

In Fig.1. is represented in cross section the flux density *B* using the QUICKFIELD program, a FEM program.

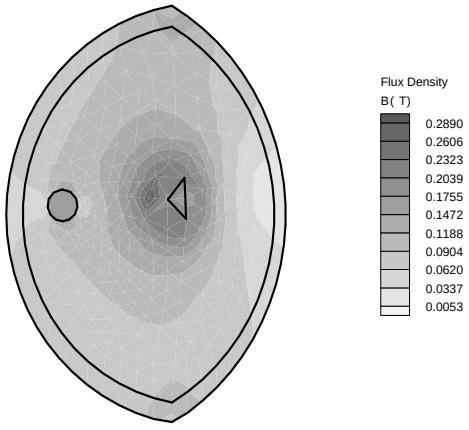

Figure 1. Flux density in the cross section of the modified TEH cell

LabVIEW Event Detection using Pan –Tompkins Algorithm

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Abstract: - QRS and ventricular beat detection is a basic procedure for electrocardiogram (ECG) processing and analysis. Large variety of methods have been proposed and used, featuring high percentages of correct detection. Nevertheless, the problem remains open especially with respect to higher detection accuracy in noisy ECGs. LabVIEW (Laboratory Virtual Instrument Engineering Workbench) is a graphical programming language that uses icons instead of lines of text to create programs. We developed in LabVIEW the filtering for removal of artifacts in biomedical signals and the Pan-Tompkins algorithm. We have investigated problems posed by artifact, noise and interference of various forms in the acquisition and analysis of several biomedical signals. We have also established links between the characteristics of certain epochs in a number of biomedical signals and the corresponding physiological or pathological events in the biomedical systems of concern. Event detection is an important step that is required before we may attempt to analyze the corresponding waves in more detail.

Key-Words: - biomedical signal, database, electrocardiogram ECG, artifact, noise, graphical programming language LabVIEW, filtering, notch filter, event detection, Pan-Tompkins algorithm.

1. Introduction

Biomedical signals are fundamental observations for analyzing the body function and for diagnosing a wide spectrum of diseases.

The problems caused by artifacts in biomedical signals are vast in scope and variety; their potential for degrading the performance of the most sophisticated signal processing algorithms is high.

An ECG signal [1] can be disturbed by a high-frequency noise. The noise could be due to the instrumentation amplifiers, the recording system, pickup of ambient electromagnetic signals by the cables. The signal illustrated has also been corrupted by power-line interference at 60Hz and its harmonics, which may also be considered as a part of high-frequency noise relative to the low-frequency nature of the ECG signal.

Low-frequency artifacts and base-line drift may be caused in chest-lead ECG signals by coughing or breathing with large movement of the chest. Poor contact and polarization of the electrodes may also cause low-frequency artifacts. Base line drift may sometimes be caused by variations in temperature and bias in the instrumentation and amplifiers as well.

The most commonly encountered periodic artifact in biomedical signals is the power-line interference at 50Hz or 60Hz. If the power-line waveform is not a pure sinusoid due to distortions or clipping, harmonics of the fundamental frequency could also appear. Harmonics will also appear if the interference is a periodic waveform that is not a sinusoid. Power-line interference may be difficult to detect visually in signals being non-specific waveforms; however, the interference is easily visible if present on well-defined signal waveforms such as the ECG or carotid pulse signals. In either case, the power spectrum of the signal should provide a clear indication of the presence of power-line interference as an impulse or spike at 50Hz or 60 Hz; harmonics will appear as additional spikes at integral multiples of the fundamental frequency.

If we have an ECG signal recorded from the abdomen of a pregnant woman and simultaneously a recorded ECG from the woman's chest; and we compare these, we see that the abdominal ECG demonstrates multiple peaks corresponding to the maternal ECG as well as several others at weaker levels and higher repetition rate [1].

The non-maternal QRS complexes represent the ECG of the fetus. Observe that the QRS complex shapes of the maternal ECG from the chest and abdominal leads have different shapes due to the projection of the cardiac electrical vector onto different axes.

Electrocardiogram Compression and Optimal Filtering Algorithm

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Abstract: - In this paper novel compression techniques are developed for portable heart-monitoring equipment that could also form the basis for more intelligent diagnostic systems thanks to the way the compression algorithms depend on signal classification. There are two main categories of compression which are employed for electrocardiogram signals: lossless and lossy. Design of an optimal Wiener filter is implemented to remove noise from a signal, considering that the signal is statistically stationary and the noise is a stationary random process that is statistically independent of the signal. Two programs for compression and Wiener optimal filtering are realised in MATLAB.

Key-Words: - Electrocardiogram, Compression, Filtering, Matlab, Noise, Diagnostic.

1 Introduction

The electrocardiogram (ECG) is one of the most important and widely used quantitative diagnostic tools in medicine. It is extremely useful for the diagnosis and management of heart abnormalities such as heart attacks and offers helpful clues to the presence of generalized disorders that affect the rest of the body, such as electrolyte disturbances and drug intoxication. ECGs can show long-term effects: previous cardiac events such as heart attacks that can result in permanent modification to the morphology of the ECG. Commercial ambulatory recorders typically have sample rates up to 360 samples per second with a resolution of 10 or 12 bit giving a bit rate of around 4000bit/s. A typical commercial sample rate of 256 samples per second with 10bit resolution on two channels over seven days implies a memory requirement of close to 400MB of data [3].

On top of the storage issue, there is increasing interest in remote monitoring, using real-time or off-line transmission of complete records. As a result, compression is a key concern for makers of ECG equipment.

There are two main categories of compression which are employed for ECG signals: lossless and lossy. Lossless compression refers to any scheme whereby the signal reconstructed after compression is identical in every respect to the original signal. By contrast, lossy schemes allow differences between the original and the reconstructed signal.

The ECG is a real-world signal and is generally acquired from a relatively noisy electrical environment. Any lossless compression scheme has to reconstruct this random signal perfectly. This severely limits the effective compression ratio of lossless schemes when applied to ECG data. Lossless compression schemes may offer compression ratios of two or less. However, if restrictions on perfect reconstruction of the noise are relaxed, there is considerable scope for enhancing performance by utilising knowledge concerning the morphology of the ECG and its cyclo-stationary characteristics.

Having established that lossy compression schemes offer the greatest scope for achieving useful compression ratios, two further categories may be identified within that class: direct and indirect transformation processes. Direct compression schemes are generally less computationally intensive and operate on the time-domain ECG signal, using relatively simple approaches such as piece-wise linear approximation. The highest compression ratio with the best reconstruction quality can only be achieved using indirect compression methods, also called transform methods.

The recognising beats techniques generally exploit the cyclo-stationary nature of the ECG record. The nature of the beats within the ECG must be understood. More specifically deviations from the typical beat must be explicitly or implicitly recognised in order to represent them efficiently. A

A New Morphological Image Segmentation with Application in 3D Echographic Images

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Abstract: This paper reviews ultrasound segmentation methods, in a broad sense, focusing on techniques developed for medical ultrasound images. Segmenting abnormal from normal myocardium using high-frequency intracardiac echocardiography (ICE) the 3D real-time images present new challenges for image processing in LabVIEW. Gray-level intensity and texture features of ICE images of myocardium with the same structural/perfusion properties differ. There are significant limitation conflicts with the existing segmentation techniques. The novelty of this paper consists of a new seeded region growing method to overcome the limitations of the existing segmentation techniques. The segmentation techniques are implemented using graphical programming LabVIEW and Vision. We use three criteria for region growing control: First, each voxel is merged into the globally closest region in the multifeature space. Second structural similarity is introduced to overcome the problem that myocardial tissue, despite having the same property, may be segmented into several different regions using existing segmentation methods. Third equal opportunity competence criterion is employed making results independent of processing order. This novel watershed segmentation method is applied to *in vivo* intracardiac ultrasound images using pathology as the reference method for the ground truth. The corresponding results demonstrate that this method is reliable and effective.

Key-Words: - ultrasound, echocardiography, graphical programming, watershed transform, watershed segmentation, image processing, LabVIEW, Vision.

1 Introduction

Three-dimensional echocardiography is a relatively new imaging modality and image analysis is not yet well developed. Early work used either freehand ultrasound with 2-D image acquisition synchronized with recording the location of the slice with a position sensor, rotational 3-D probes, which acquired a sparse set of 2-D image sequences, or real-time 3-D echocardiography based on the Volumetrics system [1], [2], [3].

However, a second generation of real-time 3-D echocardiography systems has recently been produced by Philips Medical Systems. This data is of higher quality than the rotational 3-D probe and Volumetrics systems [4]. One, therefore, has to take particular care in interpreting the results from early 3-D work as being representative of what it is possible to achieve today.

Ultrasound (US) image segmentation is strongly influenced by the quality of data. There are characteristic artefacts which make the segmentation task complicated, such as attenuation, speckle, shadows, and signal dropout; due to the orientation dependence of acquisition that can result in missing boundaries. Further complications arise as the contrast between areas of interest is often low. The scientific novelty of this paper consists of a new seeded region growing method to overcome the limitations of the existing segmentation techniques.

However, there have been recent advances in transducer design, spatial/temporal resolution, digital systems, portability, etc., that mean that the quality of information from an ultrasound device has significantly improved. This has led to increased use of ultrasound in not only its traditional area of application, diagnosis and CAD, but also emerging areas such as image-guided interventions and therapy. Thus, there is currently a re-emergence of interest in understanding how to do one of the oldest image processing tasks, image segmentation, applied to ultrasound data. As this paper attempts to demonstrate, while in other areas of medical imaging, notably X-ray computed tomography (CT) and magnetic resonance imaging (MRI), application

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SOLAR RADIATION MODELING AND MEASUREMENTS IN TIMISOARA, ROMANIA: DATA AND MODEL QUALITY

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Abstract

This paper introduces the first station in Romania (Eastern Europe) outfitted for systematic monitoring of solar irradiance on tilted surfaces. The resulted database is in many aspects unique for Romania, allowing for the first time to derive specific parameters like diffuse fraction or sunshine number. Also for the first time, the data collected on tilted surfaces can be used to test models reported in literature and to recommend the most fitting for the region, as is detailed in the paper.

Key words: solar energy estimation, solar irradiance monitoring, tilted surfaces

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1. Introduction

The risk of climatic changes induced by CO_2 emissions into the atmosphere (IPCC, 2007) has put urgency on renewable energy resources. Even if some primary resources can be used right away in thermal or mechanical systems, the main interest is for conversion into electricity, since electricity is the most flexible, all-purpose form of energy (Ciubota-Roşie et al., 2008; Gavrilescu, 2008; Lakó et al., 2008). Annual growth rates reported by the photovoltaic industry (EPIA, 2009) indicate a boom in solar applications. Following the general trend, Romania also experiences an increase of solar energy applications. One of the most exciting terrestrial photovoltaic applications is the integration of solar modules into the roofs and facades of buildings, providing useful distributed power generation. Large scale solar architecture requires knowledge of collectable solar energy amount on surfaces with arbitrarily orientation in various places of the world.

Generally, solar radiation is a significant meteorological variable in a wide range of applications, from crop modeling to photovoltaic power plants (Vişa et al., 2009). Accurate solar radiation measurements involve local or global networks. Most countries worldwide, including Romania, set up a national network contributing to World Radiation Data Center (WRDC, 2010) located at the Main Geophysical Observatory, St. Petersburg, Russia. However, compared to the needs, there is a low density of stations equipped for monitoring solar radiation. The use of the numerical models turns out to be the smart substitute to overcome the scarcity of recorded data (Badescu, 1999; Paulescu and Schlett, 2004; Paulescu et al., 2010; Tulcan-Paulescu and Paulescu, 2008). Additionally, even fewer stations worldwide are equipped for systematic measurements of solar components on inclined surfaces with arbitrarily azimuthally orientation. So far, in Romania, there are only sporadic, short-time series of data recordings on tilted surfaces, in most cases employing non-certified instruments and without public access to the data.

This paper reports results after one year of successful operation of the first Romanian station

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A New Method for Calculating the Transfer Functions in Quasiresonant Converters

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***Abstract*—A matrix method for deriving the audiosusceptibility and the control to output transfer functions in quasiresonant converters (QRCs) is presented. The method is based on the state-space description of the parent converter and it has the advantage of generality in the sense it can be applied to any topology. Moreover, it can be easily absorbed in MATLAB under Symbolic Toolbox, substantially reducing the calculation effort and time. Using this method the control to output transfer function of the QRC Cuk converter is calculated for the first time. The method is verified compared to other tools and perfect agreement is observed for second order classical converters.**

***Index Terms*—canonical models, Pulse-width modulated (PWM) converters, quasiresonant converters, small-signal, state-space averaging.**

I. INTRODUCTION

Switching DC-DC converters have penetrated in almost all areas of power electronics. Because in the great majority of the applications these converters have to operate as switching regulators, converter modeling has become a very important aspect when designing the control loop. The main difficulty in modeling these topologies comes from their nonlinear time-varying nature. There have been developed two main approaches in converter modeling: circuit oriented techniques and analytical tools. Circuit models [1] have the advantage of revealing the physical insight into converter operation in a straight and often intuitive manner. Among analytical tools, the state-space averaging [2] is by far the most popular, providing a systematic and general technique, as it can be applied to all PWM topologies under the linear ripple assumption. It allows both DC and AC analysis still keeping its generality. Moreover, it was used to develop the so called canonical circuit model, which proposes a single equivalent circuit in order to represent the dynamics for a large class of converters [3].

Many quasiresonant converter topologies have been introduced [4-12] along with a large variety of control methods [13-14]. Although the QRCs are still nonlinear time varying systems, their operation is quite different compared to their PWM counterparts.

Different solutions for modeling these quasiresonant structures have been proposed [15-18], but the analyses have been carried out using circuit-oriented techniques [19-23]. In fact, circuit averaging was applied both for steady-state and small-signal AC analysis viewing the quasiresonat switch as a two-port circuit. Finally, a three-terminal small-signal circuit model that allows to predict the AC behavior was developed.

Even it seems to be quite natural to apply the same approaches to the QRCs as to the PWM converters, the main handicap when applying the state-space averaging is the fact that linear ripple assumption is not valid for the resonant elements. However, it is clear that the PWM and QRC families have common roots and it is expected that state space averaging to be ultimately successfully applied to both classes. In addition, QRCs are difficult to handle, especially higher order converters such as Cuk, Zeta or Sepic.

In [24] it is shown that the analysis of PWM and QRC converters can be unified as long as averaging is performed over an interval T that is short with respect to the natural time constants of the converter, a condition referred to as the linear ripple assumption. The main difference is that the duty cycle d in the PWM converters is replaced by the switch conversion ratio μ in the QRCs. All these assume continuous conduction mode (CCM) operation of the parent PWM converter.

An important remark is that in any DC-DC converter there can always be identified two *smooth* variables, namely a voltage and a current, denoted by v_T and i_T, that are related to the PWM switch as presented in Fig. 1. It can be seen that this figure is closely related to the three terminal cell introduced by Vorperian in [23].

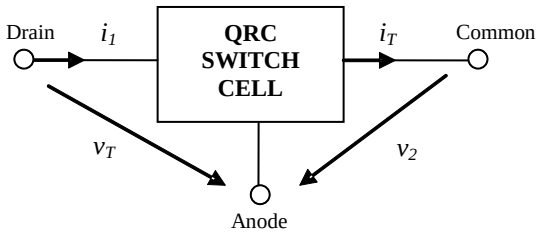

Figure 1. PWM switch terminal variables

The switch cell conversion ratio is defined as:

$$\mu = \frac{v_2}{v_T} \tag{1}$$

All the variables are considered to be averaged, but for the sake of simplicity the averaging symbol will be omitted. Because in an averaged model the steady state variables become constant, capitals will denote the steady-state values, except for switch conversion ratio μ and the switching frequency f_s, for which the symbols μ_0 and f_{s0} will be used, respectively. Hatted variables will denote the small signal perturbations.

The paper is organized as follows: a linearized state-space model is developed in section II, first the scalar transfer functions and then the matrix transfer functions are derived in section III, verification of the proposed model is performed in section IV, while section V is devoted to the conclusions.

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E-LEARNING PRACTICAL TEACHING OF UNCONTROLLED RECTIFIERS

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Keywords

Education tool, teaching, virtual instrument, software for measurements, measurement.

Abstract

The paper describes blended learning approach to teaching uncontrolled rectifiers. It is based on “Learning by Doing” paradigm supported by several learning tools: electronic course materials, interactive simulation, laboratory plants and real experiments accessed by Web Publishing Tools under LabVIEW. Studying and experimenting access is opened for 24 hours a day, 7 days a week under the Moodle booking system.

Introduction

Efficient learning in engineering assumes a mixture between theory and practical work. The drawback of a pure theoretical approach in a curriculum is that less attention is paid to the phenomena looming around laboratory experiments and real components. The results of this, corroborated with the rapid development of computer simulations, were that hands-on laboratory experience was vanishing and that computer simulations gained more and more attention. However, it is of crucial importance for the student to gain practical experience. Physical experiments help the students in practical testing and allow them to see the influence of second and higher order effects or parasitics that are often difficult to simulate as in reality. Hence it is of great importance to give the student a real world experience.

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Distance Education in Soft-Switching Inverters

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Abstract

The paper describes aspects regarding an E-learning approach of resonant ac inverters. The learning process is based on "Learning by Doing" paradigm supported by several learning tools: electronic course materials, interactive simulation, laboratory plants and real experiments accessed by Web Publishing Tools under LabVIEW. Built on LabVIEW and accompanied by a robust, flexible and versatile hardware, the experiment allows a comprehensive study by remote controlling and performing real measurements on the inverters. The study is offered in a gradual manner, according to the Leonardo da Vinci project EDIPE (E-learning Distance Interactive Practical Education) philosophy: theoretical aspects followed by simulations, while in the end the real experiments are investigated. Studying and experimenting access is opened for 24 hours a day, 7 days a week under the Moodle booking system.

Key Words: Engineering education, Remote controlled experiments, Internet-based distance measurement, Courseware, Resonant inverters.

I. INTRODUCTION

The rapid changes in society and technology have also generated a demand for more flexible engineers having more qualifications than just a high level of technical or scientific specialization. Distance learning has been promoted across the entire education sector due to the increasing number of people that educate themselves as part of their professional development. The drawback of a pure theoretical approach in a curriculum is that less attention is paid to the phenomena looming around laboratory experiments and real components. The results of this, corroborated with the rapid development of computer simulations, were that hands-on laboratory experience was vanishing and that computer simulations gained more and more attention. However, it is of crucial importance for the student to gain practical experience. Physical experiments help the students in practical testing and allow them to see the influence of second and higher order effects or parasitics that are often difficult to simulate as in reality. Hence it is of great importance to make the student familiar with the real world experience. Although classical hands-on laboratories are very useful, they may have limitations regarding space, time and staff costs. These problems can be significantly alleviated by using remote experiments and remote laboratories, when the students operate with real systems, although they are not present in the laboratory. For engineering related distance education the use of a web-based delivery mechanism is the only realistic method for providing hands-on experience, allowing remotely located students to complete laboratory assignments unconstrained by time or geographical considerations. They can change parameters, perform experiments, observe results in graphical or numerical form and download them [1], [2]. Modern education shifts emphasis from *teaching* to *learning*, assuming that knowledge is not transferred, but the learner himself constructs knowledge on the basis of prior knowledge and additionally acquired information. While in the teaching-oriented approach the student is rather passive, in the vision of learning-oriented the student plays an active role, constructing knowledge on the basis of prior knowledge and additionally acquired information, with teaching as a facilitating precondition. This approach is referred to as constructivism and neo-constructivism [3], [4]. In this spirit, in order for the "Learning by doing" or "Learning by experimenting" approaches to be successful, clear learning objectives have to be formulated. The course module "Resonant AC Circuits" presented in the paper is integrated in the Leonardo da Vinci EDIPE program framework. It is dedicated to bachelor students, particularly to the students in Politehnica Univesity Timişoara enrolled in Telecommunications Systems and Technologies studies but also to anyone interested in understanding resonant inverters operation.

II. LEONARDO DA VINCI PROJECT AND ITS PHILOSOPHY

The Leonardo da Vinci project EDIPE was approved to create a full set of distance experiments called PEMCWebLab in an integrated learning platform, providing the user with a practical experience in Power Electronics and Electrical Drives

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