Online ISSN : 2249-4596
Print ISSN : 0975-5861
DOI : 10.17406/GJRE

Global Journal

of Researches in Engineering: F

Electrical and Electronic Engineering

CPW Fed Rectangular

Neuro-Fuzzy Controlled Grid

Highlights

Planar CPW Antenna Loaded

Development of Low Frequency

Discovering Thoughts, Inventing Future

VOLUME 16 ISSUE 2 VERSION 1.0

Global Journal of Researches in Engineering: F
Electrical and Electronics Engineering

Global Journal of Researches in Engineering: F
Electrical and Electronics Engineering

Volume 16 Issue 2 (Ver. 1.0)

Open Association of Research Society

Incorporation No.: 0423089
License No.: 42125/022010/1186
Registration No.: 430374
Import-Export Code: 1109007027
Employer Identification Number (EIN):
USA Tax ID: 98-0673427

Global Journals Inc.

*(A Delaware USA Incorporation with "Good Standing"; **Reg. Number: 0423089**)*

Sponsors: Open Association of Research Society
Open Scientific Standards

Publisher's Headquarters office

Global Journals Headquarters
301st Edgewater Place Suite, 100 Edgewater Dr.-Pl,
Wakefield MASSACHUSETTS, Pin: 01880,
United States of America
USA Toll Free: +001-888-839-7392
USA Toll Free Fax: +001-888-839-7392

Offset Typesetting

Global Journals Incorporated
2nd, Lansdowne, Lansdowne Rd., Croydon-Surrey,
Pin: CR9 2ER, United Kingdom

Packaging & Continental Dispatching

Global Journals
E-3130 Sudama Nagar, Near Gopur Square,
Indore, M.P., Pin:452009, India

Find a correspondence nodal officer near you

To find nodal officer of your country, please email us at *local@globaljournals.org*

eContacts

Press Inquiries: *press@globaljournals.org*
Investor Inquiries: *investors@globaljournals.org*
Technical Support: *technology@globaljournals.org*
Media & Releases: *media@globaljournals.org*

Pricing (Including by Air Parcel Charges):

For Authors:
22 USD (B/W) & 50 USD (Color)
Yearly Subscription (Personal & Institutional):
200 USD (B/W) & 250 USD (Color)

Contents of the Issue

Global Journal of Researches in Engineering: F
Electrical and Electronics Engineering
Volume 16 Issue 2 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

CPW Fed Rectangular Microstrip Patch Antenna with Upper Pentagonal End Cut

By Paresh Jain & Prof. (Dr.) R.K Khola
Suresh Gyan Vihar University, India

Abstract- In this paper we have designed a CPW fed rectangular microstrip patch antenna at resonant frequency of 2.4 GHz. These types of microstrip antennas give high performance, robust in design and easy to fabricate. Patch elements are placed on FR-4 epoxy substrate of relative permittivity 4.4 kept at a substrate height of 1.6 mm. Simulation results are presented using HFSS version 13.0. The return loss obtained is–22*db*,and the impedance bandwidth achieved is 37%, VSWR is 1.15 and the gain is 2.55*db* at the centre frequency of 2.4 GHz.

Keywords: microstrip antenna, CPW fed,hfss 13.0, 2.4 GH_z and FR-4 epoxy.

GJRE-F Classification : FOR Code: 291701

CPWFERECTANGULARMICROSTRIPPATCHANTENNAWITHUPPERPENTAGONALENDCUT

Strictly as per the compliance and regulations of :

CPW Fed Rectangular Microstrip Patch Antenna with Upper Pentagonal End Cut

Paresh Jain [α] & Prof. (Dr.) R.K Khola [σ]

Abstract- In this paper we have designed a CPW fed rectangular microstrip patch antenna at resonant frequency of 2.4 GHz. These types of microstrip antennas give high performance, robust in design and easy to fabricate. Patch elements are placed on FR-4 epoxy substrate of relative permittivity 4.4 kept at a substrate height of 1.6 mm. Simulation results are presented using HFSS version 13.0. The return loss obtained is - 22.1dB and the impedance bandwidth achieved is 37%, VSWR is 1.15 and the gain is 2.55dB at the centre frequency of 2.4 GHz.

Keywords: microstrip antenna, CPW fed,hfss 13.0, 2.4 GH_Z and FR-4 epoxy.

I. Introduction

In the early 1970's the first practical microstrip antenna was fabricated by Howel & Munson and These above said antennas became popular during the 70's period as this antennas had the space borne applications. Antennas play a vital role in communication systems to transmit and receive signals. Microstrip antennas are versatile in geometrical dimensions and can be implemented easily. They are useful as they are of low profile, low power handling, low weight, simple and cheap [1]. Due to their attractive features like high rate of transfer of data and compact size have increased their demand and various applications immensely. The Microstrip antennas are of very high performance, robust in design and easy to fabricate [2].

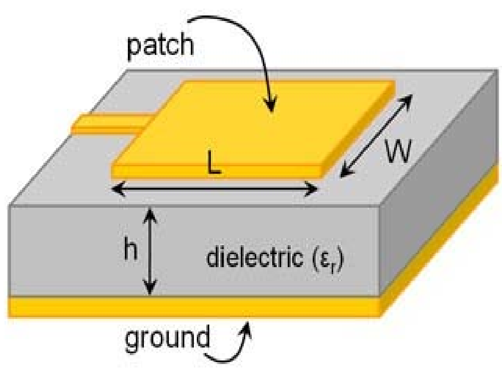


Figure 1 : Block of Schematic of Microstrip Antenna

Many problems such as the surface wave excitation and narrow bandwidth are overcome by various methods such as cutting slot, increasing thickness, etc. CPW is used in designing antenna which has low weight and low transmission losses and this method was introduced by C.P. Wen in 1969 [3]. CPW-Feed method is cheap and the line impedance and phase velocity are less dependent on substrate height then on slot width [4]. The design geometry and the results of the proposed antenna are presented in this paper.

II. Antenna Design

The design is based on transmission line model analysis and it has rectangular patch antenna with upper pentagonal end cut in a circular slot on the ground. The geometry of this antenna is shown in figure 2.In the designing of this antenna three basic parameters are required to be decided, such as thickness of substrate, relative permittivity and dielectric substrate. Thickness of substrate reduces the size of antenna and surface radiations and low dielectric constant is preferred because the antenna gives better efficiency, low losses and higher bandwidth, thus the patch elements are placed on FR-4 epoxy substrate of relative permittivity 4.4 kept at 1.6 mm. height. Feed line width is such that impedance is 50_ [5]. The antenna is designed with a centre frequency of 2.4GHz.The dimensions of the proposed antenna are shown in Table 1.

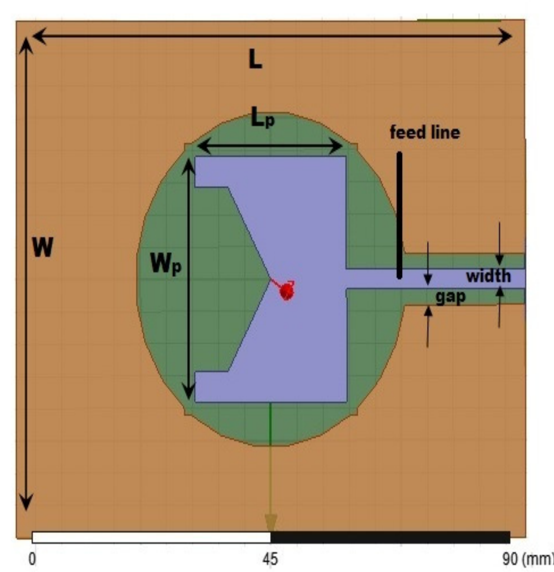


Figure 2 : Geometry of the proposed antenna

Author α: Ph.D. Scholar, ECE Department, Suresh Gyan Vihar University, Jaipur, India. e-mail: jp.jpri@gmail.com
Author σ: Professor (Dr.) ECE Department, Suresh Gyan Vihar University, Jaipur, India. e-mail: rkmkhola176@gmail.com

Table 1 : The dimensions of the proposed antenna.

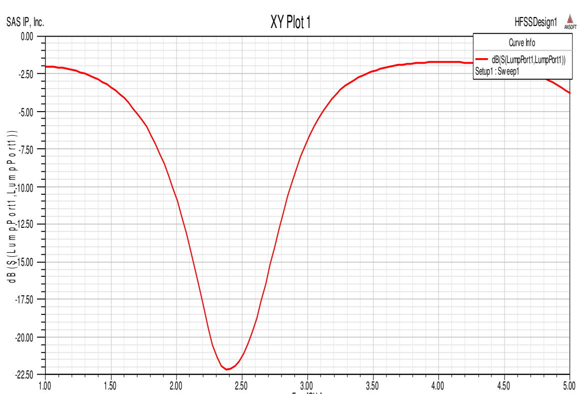
Parameter	Value
Length of patch (L_p)	29mm
Width of patch (W_p)	38mm
Length of substrate (L)	97.48mm
Width of substrate (W)	80mm
Length of feed line	34.24mm
Width of feed line	3.045mm
Height of substrate	1.6mm
Radius of circle	26mm

III. Results

Simulated results are obtained by using Ansoft HFSS 13.0 software. The results are presented and discussed in the following para.

a) Return Loss

The characteristics and measurement of the parameter return loss shows that how the antenna is effective in delivering the power from the source to the antenna. Return loss found is −22.1 *dB*__. The graph of return loss verses frequency is shown in figure 3.



X axis – Frequency in GHz.
Y axis - Return loss in dB.

Figure 3 : Return Loss

b) Bandwidth

Return loss graph can be used in calculating the bandwidth of the antenna. The proposed antenna gives the 10 __ impedance bandwidth of 37%. The antenna can operate in the frequency range from 1.97GHz to 2.87 GHz.

c) Radiation Pattern

The radiation pattern shows the direction in which the power is directed and is also shows the radiation distribution and the power distribution in the particular direction. The figure 4 shows the 3-D radiation pattern of the said antenna at centre frequency 2.4 GHz.

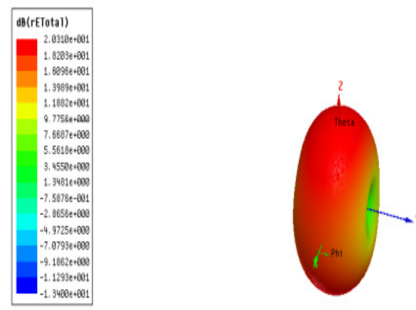
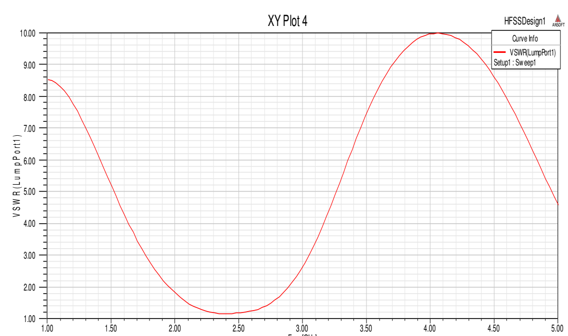


Figure 4 : Radiation Pattern.

d) VSWR

The voltage standing wave ratio is the ratio of the maximum and the minimum voltages at the feed line. The value of the VSWR which is determined for perfect matching of the antenna is such that it should be less than 2. The value should be 1:1 for maximum power transfer and for the antenna to perform efficiently. The plot of VSWR observed at the frequency 2.4 GHz. is 1.15 shown in figure 5.



X axis – Frequency in GHz.
Y axis - VSWR

Figure 5 : VSWR

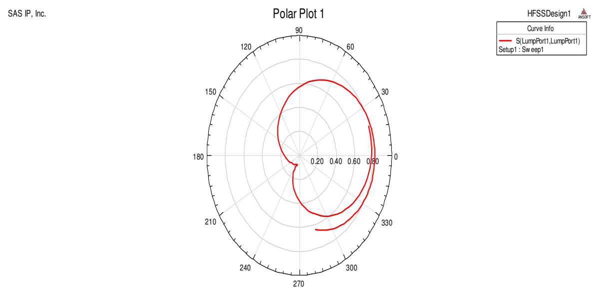


Figure 6 : Smith Chart

The smith chart in figure 6 shows VSWR of 1.15 at an angle of 109.23 and magnitude 0.0702 and impedance is 0.9466-0.1261i which indicates that the antenna is resistive in nature.

e) Gain

The parameter gain shows the amount of the power transmitted in the maximum radiation direction where the isotropic source is taken. The gain should not be less than 0 dB otherwise the antenna is not radiating. The gain of the proposed antenna measured to be 2.55 dB.and shown in figure 7.

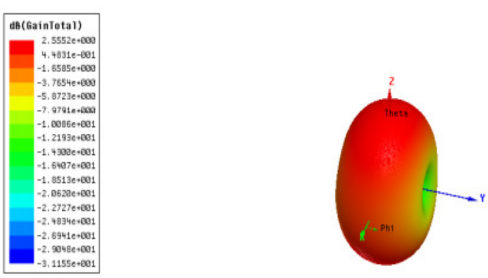


Figure 7 : Gain

IV. Conclusion

The proposed antenna is based on CPW-Fed technique and from the simulated result, gain is observed as 2.55__ and the return loss calculated is -22.1__, The VSWR value calculated is 1.17 and the impedance bandwidth calculated is 37% for the proposed antenna. Simulation and design of the microstrip patch antenna is done on a substrate of dielectric constant 4.4 and at a resonant frequency of 2.4GHz which ranges from 1.97GHz to 2.87GHz and successfully done using HFSS Software. Several other designs can be simulated using different parameters having better results and higher efficiency for applications in the field of wireless communication. Their main applications may be in extended UTMS, Wi-Fi, WiMax, etc.

References Références Referencias

1. C. A. Balanis, Antenna Theory: Analysis & Design, John Willey & Sons, Inc., 1997.
2. A.B. Mutiara, R. Refianti, Rachmansyah, “Design of Microstrip Antenna for Wireless Communication at 2.4 GHz” Journal of Theoretical and Applied Information Technology, ISSN: 1992-8645, Volume-33 No 2, p.p. 184-192, November 2011.
3. John Wiley & Sons “Compact and Broadband Microstrip Antennas”. Kin-Lu Wong, Inc., 2002.
4. Raj Kumar, P. Malathi “On the Design of CPW- Fed Ultra Wideband Triangular Wheel Shape Fractal Antenna”, International journal of microwave and optical technology, Vol.5 NO.2, March 2010.
5. Indu Bala Pauria, Sachin Kumar, Sandhya Sharma, “Design and Simulation of EShaped Microstrip Patch Antenna for Wideband Application” International Journal of Soft Computer and Engineering, ISSN: 2231-2307, Volume-2, Issue-3,p.p. 275-280, July 2012.

This page is intentionally left blank

Global Journal of Researches in Engineering: F
Electrical and Electronics Engineering
Volume 16 Issue 2 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

Control Strategies of a Neuro-Fuzzy Controlled Grid Connected Hybrid PV/PEMFC/Battery

By T. Praveen Kumar, N. Subrahmanyam & M. Sydulu
National Institute of Technology, India

Abstract- This paper depicts power control strategies of a neuro-fuzzy controlled grid connected hybrid photovoltaic and proton exchange membrane fuel cell distributed generation system with battery as energy storage device. The essential source of energy for the hybrid distributed generation system is from photovoltaic cell and proton exchange membrane fuel cell and the battery acts as a complementary source of energy.The hybrid distributed generation system is connected to a grid through power electronic interfacing devices.A Matlab/Simulink model is developed for the grid connected hybrid distributed generation system, neuro-fuzzy controlled power electronic DC/DC and DC/AC converters to control the flow of power on both sides. Likewise we extended our work so as to distribute the power between power sources, the neuro-fuzzy power controller has been developed. Simulation results are presented to demonstrate the effectiveness and capability of proposed control strategy.

Keywords: shunt active power filters, total harmonic distortion, power conversion, power drives.

GJRE-F Classification : FOR Code: 080108

CONTROLSTRATEGIESOFANEURFUZZYCONTROLLEDGRIDCONNECTEDHYBRIDPVPEMFCBATTERY

Strictly as per the compliance and regulations of :

Control Strategies of a Neuro-Fuzzy Controlled Grid Connected Hybrid PV/PEMFC/Battery

T. Praveen Kumar [α], N. Subrahmanyam [σ] & M. Sydulu [ρ]

Abstract- This paper depicts power control strategies of a neuro-fuzzy controlled grid connected hybrid photovoltaic and proton exchange membrane fuel cell distributed generation system with battery as energy storage device. The essential source of energy for the hybrid distributed generation system is from photovoltaic cell and proton exchange membrane fuel cell and the battery acts as a complementary source of energy.The hybrid distributed generation system is connected to a grid through power electronic interfacing devices.A Matlab/Simulink model is developed for the grid connected hybrid distributed generation system, neuro-fuzzy controlled power electronic DC/DC and DC/AC converters to control the flow of power on both sides. Likewise we extended our work so as to distribute the power between power sources, the neuro-fuzzy power controller has been developed. Simulation results are presented to demonstrate the effectiveness and capability of proposed control strategy.

Keywords: shunt active power filters, total harmonic distortion, power conversion, power drives.

I. Introduction

The penetration level of green and renewable energy sources/distributed generation units are expected to grow in the near future as there is a probability of rundown conventional fuels for power generation. The distributed generation is classified as renewable and non-renewable. The distributed generation sources such as Fuel cells, Wind and Solar energy are increasing daily due to increase in demand for electrical power [1]. These energy sources are environmental friendly, reduces transmission and distribution losses, peak load shaving, can be used as backup sources and etc. Fuel cell is a promising device as it is efficient, modular and can be placed at any site for improving system efficiency [2] but it has slow start-up response. Solar energy is an important renewable energy source [3] but the intermittent nature of this technology is a major issue. The accessibility of energy is driven by climate and cell temperature however not on the loads of the systems. This innovation can be marked as irregular and typically PV array utilizes a Maximum Power Point Tracking (MPPT) (MPPT) strategy to consistently convey the most highest power to the load when there are variations in irradiation and temperature [4].Because of the intermittent nature of PV array it becomes an uncontrollable source In order to overcome the drawbacks with the slow start-up of fuel cells and intermittent nature of PV cell a nerofuzzy controlled grid associated hybrid photovoltaic as well as proton exchange membrane fuel cell (PEMFC) distributed generation system with battery as energy storage is suggested in this paper.

Author α: Research Scholar, Dept. of Electrical Engineering, National Institute of Technology, Warangal, Telangana, India.
Author σ ρ : Professor, Dept. of Electrical Engineering, National Institute of Technology, Warangal, Telangana, India.
e-mail: praveen3564@gmail.com

II. System Modeling

Fig. 1 shows the block diagram of the HRPS (Hybrid Renewable Power Sources) proposed in this paper that connected to main grid in Point Common Coupling (PCC). So by above discussions tww mathematical models recitation the dynamic behavior and each of these constituents are given below.

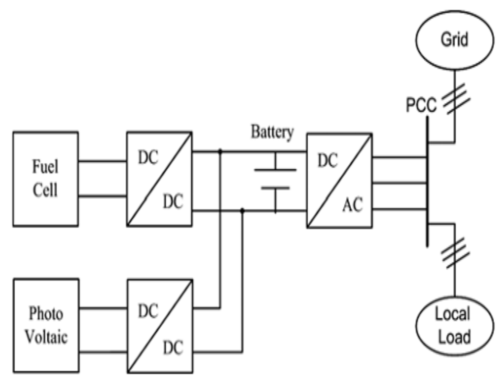


Fig-1 : Block Diagram of Grid connected Hybrid system

a) *Proton Exchange Membrane Fuel Cell Model*

A fuel cell functions like a battery by transforming the chemical energy into electrical energy, but it differs from a battery in that as long as the hydrogen and oxygen is supplied it will produce DC electricity continuously. Fuel cells play a vital role in distributed generation because of their advantages such as high efficiency, no contamination gasses and particular structure adaptability.

The Nernst's mathematical statement and Ohm's law oversee the normal voltage size of the fuel cell stack. The subsequent mathematical statement representations the voltage of the fuel cell stack:

$$V_{fc} = N_0(E_0 + \frac{RT}{2F}(\log\left(\frac{P_{H_2}P_{O_2}^{0.5}}{P_{H_2O}}\right)) - R_{int}\, I \qquad (1)$$

Where:
N_0 is the number of cells connected in series; R_{int} is the internal resistance of fuel cell stack [Ω]
E_0 is the voltage related with the reaction free energy;
R is the universal gas constant;
T is the temperature;
I is the current of the fuel cell stack;
F is the Faraday's constant.
$P_{H_2}, P_{H_2O}, P_{O_2}$ are dictated by the accompanying differential equations.

$$P_{H_2} = -\frac{1}{t_{H_2}}(P_{H_2} + \frac{1}{K_{H_2}}(q_{H_2}^{in} - 2K_r I_{fc}))$$

$$P_{H_2O} = -\frac{1}{t_{H_2O}}(P_{H_2O} + \frac{2}{K_{H_2O}}K_r I_{fc})) \quad (2)$$

$$P_{O_2} = -\frac{1}{t_{O_2}}(P_{O_2} + \frac{1}{K_{O_2}}(q_{O_2}^{in} - K_r I_{fc}))$$

Where, $q_{H_2}^{in}$ and $q_{O_2}^{in}$ are the molar flow of hydrogen and oxygen and where the Kr constant is well-defined by the relation between the rate of reactant hydrogen and the fuel cell current:

$$q_{H_2}^{r} = \frac{N_0 I}{2F} = 2K_r I \quad (3)$$

Besides, a straightforward model of reformer that creates hydrogen through methane has been deliberated and the model is second-order transfer function.So therefore itsmathematical form can be written as follows:

$$\frac{q_{H_2}}{q_{metanne}} = \frac{CV}{\tau_1\tau_2 S^2 + (\tau_1 + \tau_2)S + 1}$$

Where$q_{metanne}$ is methane flow rate [kmol/sec]; CV is conversion factor [kmol of hydrogen per kmol of methane];
$\tau_1, \tau_2$are reformer time constants [sec].

b) Photovoltaic Model (PV)

The equivalent circuit shown in Fig.2 is a one diode model of a solar cell which consists of a diode and a current source connected in parallel with a series resistance R_s. The current source foods the photocurrent I_{ph}, which is directly proportional to solar irradiance G. By referring manufacturer's data sheet, the two main parameters used to describe a PV cell are open circuit voltage and another is its short circuit current.

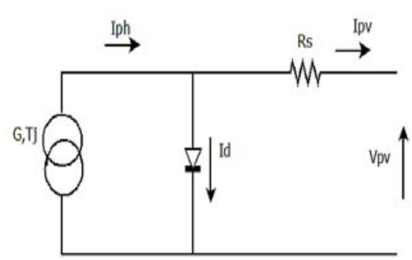


Fig.2 : Equivalent solar cell model with Rs

The mathematical model [3] of PV cell can be expressed as

$$I_{pv} = I_{ph} - I_0\left[\exp q\left(\frac{V_{pv} + I_{pv}.R_s}{AKT}\right) - 1\right] \quad (4)$$

Since Photocurrent $I_{ph}$is directly proportional to solar radiation G.

$$\mathrm{I}_{\mathrm{ph}}(G) = I_{sc}\frac{G}{G_{ref}} \quad (5)$$

The short-circuit current $I_{SC}$of solar cell depends linearly on cell temperature.

$$I_{sc}(T_j) = I_{sc}[1 + \Delta I_{sc}(T_j - T_{jref}]$$

$$I_{ph}(G, T_j) = I_{scs}\frac{\boldsymbol{G}}{\boldsymbol{G_{ref}}}[1 + \Delta I_{sc}(T_j - T_{jref}] \quad (6)$$

I_0also depends on solar irradiation as well as cell temperature and that can be mathematically expressed as follows

$$I_0(G, T_j) = \frac{I_{ph}(G, T_j)}{e\left(\frac{V_{oc}(T_j)}{V_t(T_j)}\right) - 1} \quad (7)$$

In the writing numerous MPPT strategies are accessible, for instance, incremental conductance (INC), consistent voltage (CV), and perturbation and observation (P&O). Therefore P&O strategy has been generally utilized in view of its basic input structure and less measured parameters. The panel voltage is purposely intentionally agitated (expanded or diminished) then the power is contrasted with the power got before to disturbance. In particular, if the power panel is increased because of the unsettling influence, the accompanying disturbance will be made in the same course and if the power diminishes, the new perturbation is made in the opposite direction.But the demerit with P & O is the outputpower is oscillating in nature. Because of this reason weuse the Fuzzy MPPT technique to deliver the maximumpower and to eliminate perturbations in the output power.

c) Fuzzy MPPT Control

The inputs to the fuzzy MPPT control can be measured or computed from the voltage and current of solar panel. Thecontrol rules are indicated in [4]with ΔPpv and ΔV pv asinputs andΔV pvref as the output. The membership functions of input and output Variables in which membership functions of input variables ΔPpv and ΔV pv are triangular and has seven fuzzy subsets. Seven fuzzy subsets are considered for membership functions of the output variableΔV pvref. These input and output variables are expressed in terms of linguistic variables (such as BN (big negative),MN (Medium negative), SN (small negative), Z (zero), SP(small positive), MP (medium positive), and BP (big positive).

Global Journal of Researches in Engineering (F) Volume XVI Issue II Version I Year 2016

d) *Battery Modelling*

The battery is a device which stores energy inelectro chemical form. Battery is used as energy storage device in wide range of applications like hybrid electric vehicles and hybrid power systems. In this paper, the battery energy storage is combined with hybrid PV/PEMFC distributed generation system. The battery model considered in this paper is shown in fig.3. The battery model used is based on voltage model proposed by Shepherd [4].

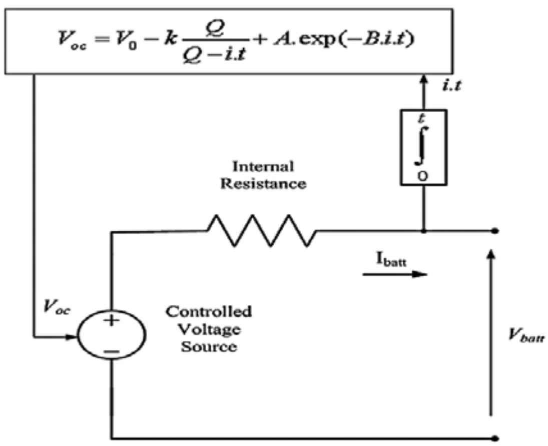


Fig. 3 : Battery Model

e) *DC/DC Boost Converter Model*

The role of boost DC/DC converters is to deliver power to the user in appropriate form at high efficiency. Generally the Power electronic converters are desirable in PV and fuel cell systems to transform DC voltage to the prerequisite values. Fig. 4 shows the DC/DC converter model.

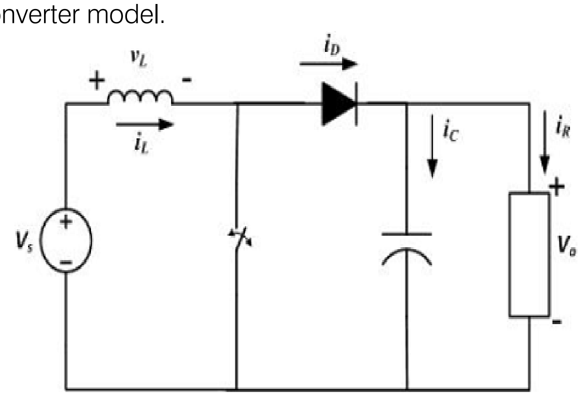


Fig. 4 : Boost DC/DC Converter Model.

As depicted above boost converter is defined by the following two nonlinear state space averaged equations [7]:

$$\frac{di_L}{dt} = -\frac{R_L}{L} - \left(\frac{1-d}{L}\right)V_0 + \frac{1}{L}V_s \qquad (8)$$

$$\frac{dV_c}{dt} = \left(\frac{1-d}{C}\right)i_L + \frac{i_R}{C}$$

where "d" is the duty cycle of the switching device, "U" is the input voltage, "i_L" is the inductor current, "V_c" is the output voltage and "i_0" is the output current.

f) *DC-AC Converter Model*

Converter (VSC) is shown in Fig. 5. To reduce harmonics, LCL filter is connected between the converter and also at the grid side [6]. So therefore the dynamic model of the three-phase VSC is represented in

$$\frac{di_{1k}}{dt} = -\frac{R_1}{L_1}i_{1k} + \frac{1}{L_1}(V_{1k} - V_{ck})$$

$$\frac{di_{2k}}{dt} = -\frac{R_2}{L_2}i_{2k} + \frac{1}{L_1}(V_{ck} - V_{sk}) \qquad (9)$$

$$C_f\frac{dV_{ck}}{dt} = i_{1k} - i_{2k}$$

Whre k={a, b, c}

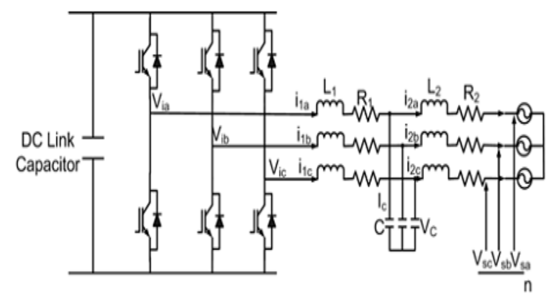


Fig.5 : DC/ AC Three Phase Inverter

III. Power Control Strategies of Hybrid System

By above discussions the Power flow control from hybrid power sources to local AC bus and to/from storage devices is required to keep up power balance at all times while fulfilling the the active and reactive power demanded by the load. Eq.(13) gives power balance expressions that should be satisfied together at the DC-link and at the P_{CC} all the time.

The rate and magnitude of fuel cell power P_{FC} and rate, sign and magnitude of battery power P_{Batt} depend on the magnitude and how fast the load changes.

$$P_{DG} = P_{PV} + P_{PC} + P_{Batt}$$

$$P_{Load} = P_{DG} + P_{Grid} \qquad (10)$$

$$Q_{Load} = Q_{DG} + Q_{Grid}$$

According to the control strategy proposed in this paper, P_{Load} and Q_{Load} are made equal to P_{ref} and Q_{ref} so that the hybrid power system output shadows the load demand only under normal loading conditions alsoP_{Grid} and Q_{Grid} are seems to be zero. Soif the local load demand surpasses the hybrid power system capacity, then remaining of the power is supplied from the grid side. Fig. 6 shows the overall structure of the control strategy.

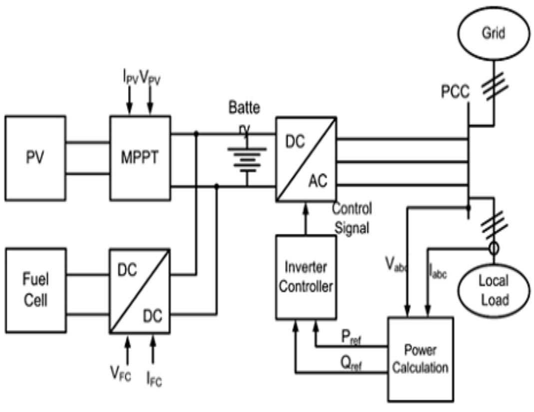


Fig. 6 : Overall system control structure.

Hence the control strategy also retains the DC-link/battery voltage within a band about the nominal DC-link voltage to have the inverter in synchronism with the grid. The following differential equation for DC link power balance is given:

$$C_{dc} v_{dc} \frac{dv_{dc}}{dt} = P_{FC} + P_{PV} + P_{Batt} - P_{Grid} \qquad (11)$$

Moreover, to meet the requirements of power balance in DC link it is significant to consider the dynamic limitations of fuel cell power. In this case, the fuel cell power could not change rapidly and the fuel cell controller with DCDC converter should regulate the operating point of fuel cell. But the amount of power that should be absorbed by battery energy storage in order to balance the power in DC link is significant and also it is greatly influenced by DC link energy, where its energy measurement is supported with the help of the following calculation:

$$E_{dc}(k) = (\tfrac{1}{2}) C_{dc} V_{dc}^2(k) \qquad (12)$$

In this paper, a power flow control structure has been established for hybrid power sources during voltage sag. It is based on Fuzzy Logic Control (FLC) strategy that determines the battery energy storage power according to the following inputs:

$$e(k) = E_{dc-ref}(k) - E_{dc}(k)$$
$$\Delta e(k) = e(k) - e(k-1) \qquad (13)$$

where E_{dc-ref} is the reference dc link energy which is calculated by reference dc link voltage.Subsequently, it is crucial to outline powerful and stable control technique to ensure the stability of the dc link of hybrid system.For this purpose, a fuzzy neuralcontrol startegy is devloped [8].

IV. Neuro-Fuzzy Control Startegy

In this paper a neuro-fuzzy control strategy, for each of the input, four fuzzy subsets have been employed. These are ZE (zero), L (low), M (medium) and H (high). So for all of these fuzzy sets, a gaussian membership function has been used. As each of the two inputs has four subsets, there are altogether 16 control rules in the neuro-fuzzy logic controller.

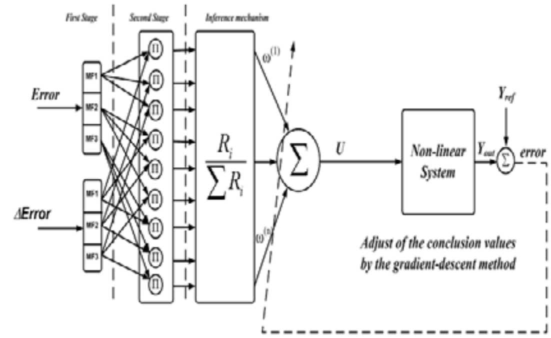


Fig.7 : The neuro-fuzzy scheme

The neuro-fuzzy calculation utilizes membership functions of gaussian kind. With Gaussian fuzzy sets, the algorithm is fit for using all data contained in the preparation set to calculate each rule conclusion, which is distinctive when utilizing triangular allotments. Fig.7 represents the neuro-fuzzy scheme for an illustration with two variables (x_1, x_2) and one output variable (y). In the principal phase of the neuro-fuzzy scheme, the two inputs are categorized into philological values by the set of Gaussian membership functions recognized to every variable. The second stage computes every tenet $R^{(l)}$ its separate enactment degree. Last, the derivation system weights every guideline conclusion $\omega^{(l)}$, instated by the group based algorithm, utilizing the enactment degree computed in the second stage. As mentioned the error signal among the model inferred value Yand the particular measured value (or teaching value) y', is employed by the gradient descent scheme to regulate each rule conclusion. Also he algorithm adjusts the values of $\omega^{(l)}$ to diminish an objective function E typically expressed by the mean quadratic error (12). In this equation, the value y'(k) is the preferred output value correlated with the condition vector x'(k) = (x_1', x_2',…xm'). The element Y(x'(k)) is the conditional response to the same condition vector x'(k) and calculated by Eq. (14).

$$E = \frac{1}{2}[Y(x(k) - y(k)]]^2$$

$$Y(x'(k)) = \frac{\sum_{l=1}^{c}\left(\prod_{j=1}^{m}\mu_{A_{j=1}^{(l)}}\left(x'_j(k)\right)\right)\omega^{(l)}(k)}{\sum_{l=1}^{c}\left(\prod_{j=1}^{m}\mu_{A_{j=1}^{(1)}}\left(x'_j(k)\right)\right)} \qquad (14)$$

Eq. (15) establishes adjustment for every conclusion $\omega^{(l)}$with the aid of gradient-descent method. Hare the symbol α is the learning rate parameter, and also t designates the number of learning iterations that are executed by the algorithm.

$$\omega^{(l)}(t+1) = \omega^{(l)}(t) - \propto \frac{\partial E}{\partial \omega^{(l)}} \qquad (15)$$

The inference function Eq. (14) depends on $\omega^{(l)}$ onlythrough its numerator. The expression composing the numerator is now represented by 'a' and is shown in Eq.(16).

$$a = \sum_{l=1}^{c}\left(\prod_{j=1}^{m}\mu_{A_{j=1}^{(l)}}\left(x'_j(k)\right)\right)\omega^{(l)}(k) \qquad (16)$$

The denominator of function Eq. (14) is dependent on a term $d^{(l)}$, defined in Eq. (17), and denoted by b in Eq. (18).

$$d^{(l)} = \prod_{j=1}^{m}\mu_{A_{j=1}^{(l)}}\left(x'_j(k)\right) \qquad (17)$$

$$b = \sum_{l=1}^{c}(d^{(l)}) \qquad (18)$$

In order to compute the adjustment of each conclusion value $\omega^{(l)}$, it is necessary to compute the variation of the objective function E, ∂E , in relative to the disparity that occurred in $\omega^{(l)}$ in the anterior instant, $\partial\,\omega^{(l)}$. So by, using the chain rule to calculate ∂E/ $\partial\omega^{(l)}$ results in Eq(19).

$$\frac{\partial \mathrm{E}}{\partial\omega^{(l)})} = \frac{\partial \mathrm{E}}{\partial \mathrm{Y}}\frac{\partial \mathrm{Y}}{\partial \mathrm{a}}\frac{\partial \mathrm{a}}{\partial\omega^{(l)})} \qquad (19)$$

The utilization of chain rule searches for the term contained in E that is straight forwardly reliant on the quality to be balanced, i.e., the conclusion value $\omega^{(l)}$. Therefore, we can verify by chain Eq. (19) that it starts with E dependent of Y value, and it basically depends on α term also finally, expression a is a function of $\omega^{(l)}$. Now after few moment, the alteration can be done for $\omega^{(l)}$ and also be interpreted that is propotional to the error that is between the neuro-fuzzy model response and the supervising value, but it can be weighted by the influence of rule (1), indicated by $d^{(l)}$, to the final neuro-fuzzy inference.

$$\omega^{l}(t+1) = \omega^{(l)}(t) - \alpha\frac{(Y(x'(k) - y'(k))d^{(l)}}{\sum_{l=1}^{c}(d^{(l)})} \qquad (20)$$

Next, a convergence theorem has been developed to assurance the stability of particular learning algorithm employed for the above-mentioned FNN [10]. A Lyapanov energy function is defined as follows:

$$V_k = J_k = \tfrac{1}{2}E_k^2 \qquad (21)$$

From Eq. (19), we can get

$$\Delta V = V_{k+1} - V_k = \tfrac{1}{2}(E_{k+1}^2 - E_k^2) \qquad (22)$$

The error difference, ΔE_k, can be defined as

$$\Delta E_k = E_{k+1} - E_k = \tfrac{\partial E_k}{\partial\omega}\Delta\omega \qquad (23)$$

$$\Delta\omega = \omega_{k+1} - \omega_k = -\alpha E_k\tfrac{\partial E_k}{\partial\omega} \qquad (24)$$

Using Eq. (22), we can get

$$\Delta V = \frac{1}{2}(E_{k+1} - E_k)(E_{k+1} + E_k)$$
$$= \tfrac{1}{2}(\Delta E_k)(2E_k + \Delta E_k) \qquad (25)$$

Substituting eq. (24) into eq. (23), we have:

$$\Delta V = \frac{1}{2}\frac{\partial E_k}{\partial\omega}\,\alpha E_k\frac{\partial E_k}{\partial\omega}(-2E_k + \frac{\partial E_k}{\partial\omega}\,\alpha E_k\frac{\partial E_k}{\partial\omega})$$
$$= \tfrac{1}{2}(E_k\tfrac{\partial E_k}{\partial\omega})^2\left[\left(\tfrac{\partial E_k}{\partial\omega}\right)^2\alpha^2 - 2\alpha\right] \qquad (26)$$

If $\Delta V < 0$, the convergence of the algorithm described in eq.(26) can be guaranteed. Therefore, we have:

$$(\tfrac{\partial E_k}{\partial\omega})^2\alpha^2 - 2\alpha < 0 \qquad (27)$$

From eq. ( ), we can obtain:

$$0 < \alpha < \frac{2}{(\frac{\partial E_k}{\partial\omega})^2} \qquad (28)$$

V. Simulation Results

To evaluate the viability of the proposed control strategy, the system is simulated in SIMULINK/ SIMPOWER for a period of 100sec of real and reactive load profiles.

Table. 1 : Hybrid distributed generation system parameters.

PEMFC Parameters	Values
Faraday's Constant	96487000 C/kmol
Hydrogen time constant(t_{H2})	26.1 sec
Hydrogen valve molar constant(K_{H2})	8.43×10^{-4}
Kr Constant=N0/4F	9.9497×10^{-7}
No load voltage (E_0)	0.6V
Number of cells (N_0)	384
Oxygen time constant (t_{O2})	2.91 sec
Battery Model parameters	**Values**
Maximum allowable terminal voltage	730 V
Minimum allowable terminal voltage	710 V
Operating Terminal Voltage	725 V

SOC,%	70
DC/AC Converter Parameters	
Nominal AC Voltage	400 V
Nominal Phase Current	125 A
Nominal DC Voltage	720 V
R_s	0.9 mΩ
Ls	0.01mH
Fs (Hz)	50 Hz
DC/DC Converter Parameters	
Rated Voltage (V)	200/650V
Resistance (R)	2.3Ω
Rated Power	50KW
Capacitance (C)	1.5 mf
Inductor (L)	415 μH

The decision of the DC- bus voltage depends on the output voltage of the inverter required which must provide the grid voltage. The association among the DC link voltage Vdc and the line-to-line RMS grid voltage $V_{LL,AC}$, where m_a is the modulation index in the linear region, is specified in Eq. (29) [9].

$$V_{dc} \geq \frac{1.633}{m_a} V_{LL,AC} + voltagedrops \qquad (29)$$

The proposed control strategies are realized using MATLAB/SIMULINK environment by means of the parameters given in Table. 1 [5].

In order to show the response of the power control strategy during the unbalanced voltage condition, another simulation results have been extracted. In this case, The proposed control strategy has been inspected in case of unbalanced voltage conditions. An unbalanced voltage, resulting from unbalanced load, is applied at the grid side. The unbalanced voltage starts at 1.2 sec for duration of 2 sec. The grid voltage during unbalanced voltage has been shown in Fig.8.

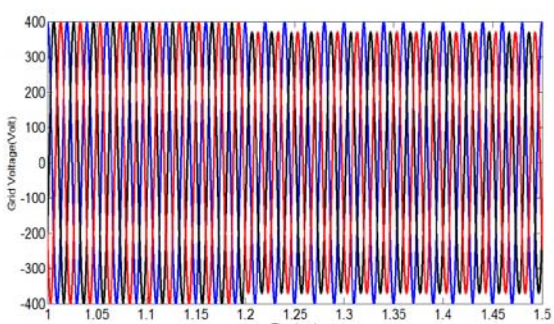


Fig.8 : The unbalanced grid voltages

Fig. 9 shows the 3-phase voltages; which are well regulated underthe unbalanced disturbance.

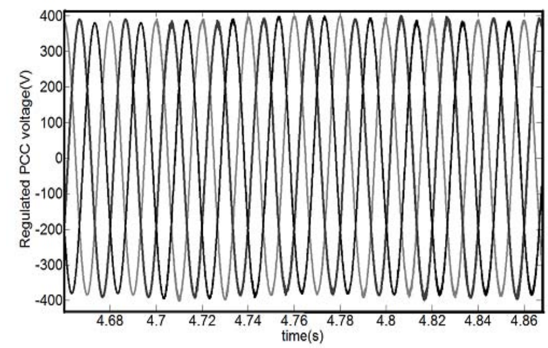


Fig.9 : Regulated grid voltage

From Fig.10 and Fig.11 the gid voltage and cuurents under the neuro-fuzzy controller have great improvement in case of Total harmonic distortion THD that was depicted in Fig.12.

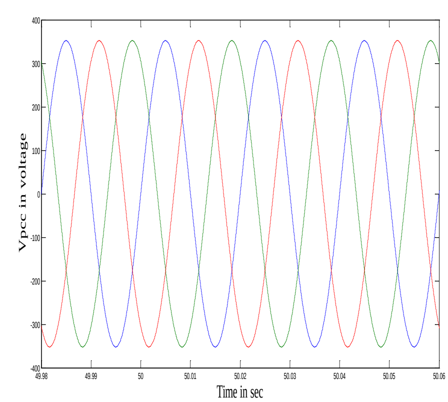


Fig. 10

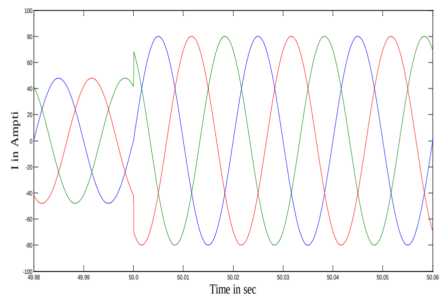


Fig. 11

From Fig.12 THD is only 3% in case of neuro-fuzzy controller and 15.27% in case of without neuro-fuzzy controller.

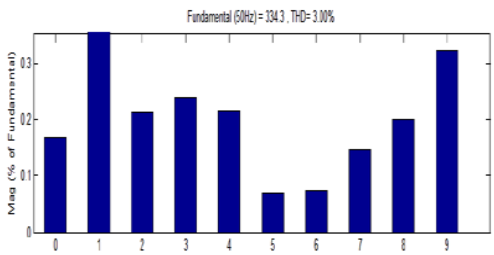


Fig. 12

The DC link voltage is shown in Figs.13. During the unbalanced voltage, there is an increase on DC linkvoltage but it is not much more than 10% of nominal value. In these conditions, to stabilize the dc-linkpower, the neuro-fuzzy controller manages the power flow between power sources.

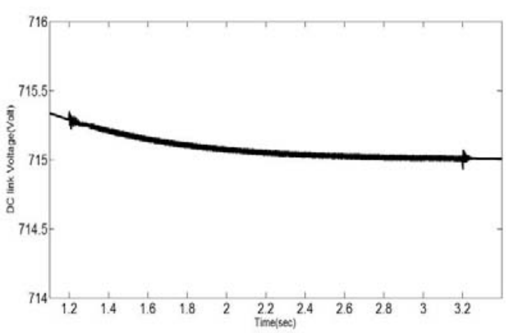


Fig.13 : DC-link voltage

VI. Conclusion

This paper presents modeling, control and power control in in a grid connected PV/Fuel Cell/Battery hybrid power generation system in a microgrid. Here SIMULINK/SIMPOWER was utilized to to model the system and simulate a power flow control strategy. PV, fuel cell and and battery subsystems with power electronic converters are modeled. In addition, to disseminate the power between power sources, the neuro-fuzzy power controller has been produced to settle the DC- link power. Our simulation results are shown to exhibit the viability and ability of proposed control strategy amid various operating conditions in utility grid.

References Références Referencias

1. Edward J. Coster, Johanna M. A. Myrzik, Bas Kruimer, Wil L.Kling, " Integration issues of distributed generation in distribution grids" proceedinds of IEEE, January 2011.
2. Djamila Rekioua and Ernest Matagne, “Optimization of Photovoltaic Power Systems”, Springers, 2012
3. M. Hashem Nehrir and C. Wang, “Modelling and Control of Fuel Cells”, Wiley, 2009.
4. C. M. Shepherd, "Design of primary and secondary cells II. Anequation describing battery discharge", J. Electrochem. Soc. 112,657 (1965).
5. Amin Hajizadeh, Samson G. Tesfahunegn, and Tore M. Undeland, "Intelligent control of hybrid photo voltaic/fuel cell/energy storage power generation system" J. Renewable Sustainable Energy 3,043112 (2011); doi: 10.1063/1.3618743.
6. Hussein K., Muta I., Hoshino T. and Osakada M., “Maximum photovoltaic power tracking: an algorithm for rapidly changing atmospheric conditions”, IEE Journal of Generation, Transmission and Distribution, Vol. 142, pp. 59,1995.
7. Yuri B., Shtessel Y. B., Zinober A. and Shkolnikov A., “Sliding mode control of boostand buck-boost power converters using method ofstable system centre”, Automatica, Vol. 39, pp.1061-1067, 2005.
8. Hajizadeh A. and Golkar M. A., “Intelligent Robust Control of Hybrid Distributed Generation System under Voltage Sag”, Journal of Expert Systems with Applications, Vol. 37, pp. 7627-7638, 2010.
9. Mohan N., Undeland T.M. and Robbins W.P., Power Electronics Converters, Applications and Design, Wiley, 2003.
10. Noroozian R., Abedi M., Gharehpetian G. B. and Hosseini S. H., “Operation of Stand Alone PV Generating System for Supplying Unbalanced AC Loads”, *Iranian Journal of Electrical & Electronic Engineering* (*IJEEE*), Vol. 3, pp. 98-115, 2007.

This page is intentionally left blank

Global Journal of Researches in Engineering: F
Electrical and Electronics Engineering
Volume 16 Issue 2 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

Development of Low Frequency Pulsed NQR/NMR Spectrometer

By Preeti Hemnani, A. K.Rajarajan, Gopal Joshi & S. V. G Ravindranath
S. I. E. S Graduate School of Technology, India

Abstract- An FPGA based NQR spectrometer has been designed for detection of ^{14}N nuclei. The digital circuits required for NQR spectrometer i.e Pulse Programmer, DDS, digital receiver have been built inside FPGA. Combining FPGA chip with analog components, NQR spectrometer has been developed. ^{14}N from $NaNO_2$ is observed using same spectrometer. By adding a permanent magnet of uniform field NMR signal of proton as well as deuterium was also observed.

Keywords: *FPGA, NQR, NMR.*

GJRE-F Classification : *FOR Code: 290903p*

DVELOPMENTOFLOWFRQUENCYPULSEDNQRNMRSPECTROMETER

Development of Low Frequency Pulsed NQR/NMR Spectrometer

Preeti Hemnani [α], A. K.Rajarajan [σ], Gopal Joshi, [ρ] & S. V. G Ravindranath [ω]

Abstract- An FPGA based NQR spectrometer has been designed for detection of ^{14}N nuclei. The digital circuits required for NQR spectrometer i.e Pulse Programmer, DDS, digital receiver have been built inside FPGA. Combining FPGA chip with analog components, NQR spectrometer has been developed. ^{14}N from $NaNO_2$ is observed using same spectrometer. By adding a permanent magnet of uniform field NMR signal of proton as well as deuterium was also observed.

Keywords: FPGA, NQR, NMR.

I. Introduction

The nuclear magnetic resonance (NMR)[1] since its invention in the year 1946, has developed into a very useful and popular tool for material characterization and medical applications like magnetic resonance imaging(MRI). While the development of NMR as a technique itself is significant, the role of advancement in digital electronics in the instrumentation and techniques of NMR cannot be overstated. Since the invention of the original continuous wave NMR, digital signal processing (DSP) and advanced Fourier transform techniques have become integral part of modern day pulsed NMR techniqe The specificity of NMR to the nucleus has made it more useful for purposes that are less popular than routine characterization of biological molecules or MRI, where NMR of proton is mainly used. Nuclear Quadrupole Resonance (NQR) shares the same electronics and detection technique except for the presence of magnet. Observable in the non-cubic crystalline samples, NQR is not only nucleus specific but becomes compound specific making it a tool for detection, quantification and characterization of various chemicals for various purposes like remote detection of drugs, explosives or quantifying the chemicals in already packed medicines[1][2].

An NQR spectrometer for detection of nuclei ^{14}N (frequency range up to 6 MHZ) has been designed, con structed in Electronics Division, BARC is shown in Figure 1. The stable nitrogen ^{14}N has natural abundance of 93.6% and nuclear spin I = 1 with its associated nuclear electrical quadruple moment. The ^{14}N NQR transitions in various solids fall in the frequency range 0 to 6 MHz [3], hence the choice of the frequency band of our spectrometer. ^{14}N NQR signal from sample of 20g of $NaNO_2$ was observed at 4.64MHz. Also by adding permanent magnet ^1H and ^2H NMR signal from H_2O and D_2O was observed.

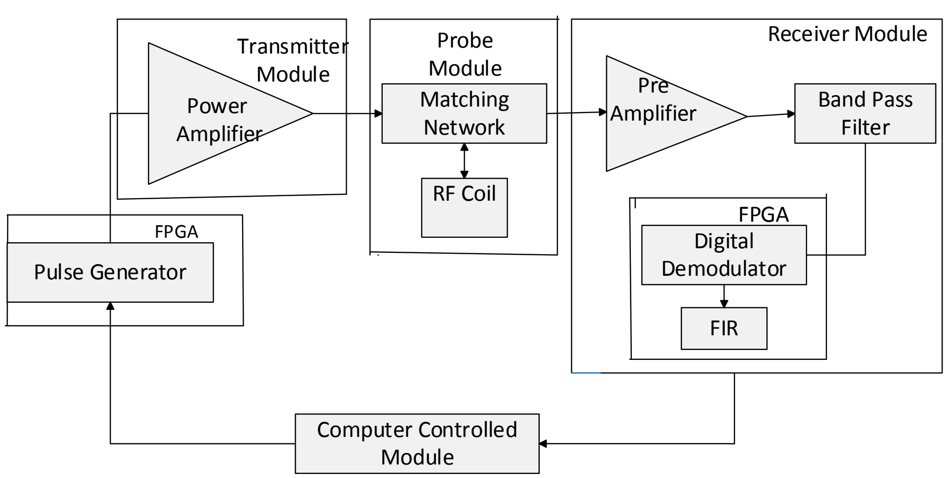


Figure 1 : Schematic diagram of FPGA based NQR spectrometer

Author α: Homi bhabha national institute, India.
e-mail: preetiahemnani@gmail.com
Author σ: Solid state Physics Division,BARC
Author ρ: Electronics Division,BARC, India.
Author ω: Atomic and molecular physics division, India.

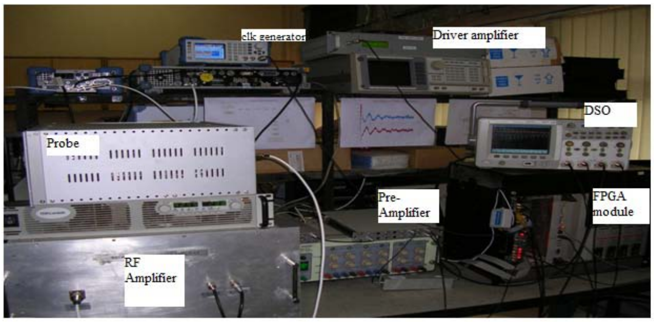


Figure 2 : NQR spectrometer developed in Electronics Division, BARC

II. Instrument Description

NQR instrument is designed and constructed using a digital technique which includes FPGA chip, ADCs and DACs. With the field programmability the digital part of NQR instrument could be constructed with FPGA resulting in compact and programmable NQR instrument with high sensitivity and suitable for applications such as detection of drugs, mines and plastic explosive in packages.

Specifications of the NQR instrument are 0-6MHz, pulse lengths 1-500 μsec and radio frequency pulse power up to 200 watts, acquisition time 50 msec. The spectrometer consists of

i) Transmitter which consists of RF power amplifier.
ii) Probe which consists of coil which consists of RF tuning and matching circuit.
iii) Receiver which consists of preamplifier, Band pass filter, ADC.
iv) FPGA module which consists of pulse programmer, DDS, gate, quadrature demodulator, FIR low pass filter.
v) Computer controlled module which interface for command/data transfer.

Block diagram of experimental setup is shown in Figure 1 and photograph is shown in Figure 2. In this experiment, a set of RF pulses is applied to pick up coil and the resulting magnetic moment is picked up by same coil. The radio frequency is generated by a direct digital synthesizer (DDS), and switched on and off by an RF switch controlled by pulse generator. These pulses are then amplified by a RF amplifier before going to the probe circuit. The probe circuit consists of pick up coil and pair of adjustable capacitors. The probe circuit is configured in such a way that with appropriate adjustment of capacitors, the impedance of circuit is 50.

By matching the impedance of the probe circuit to characteristic impedance of the coaxial cables carrying the signal and other components in the circuit (amplifiers etc), all of the power generated by the power amplifier is transferred to the probe circuit, and the signal generated by the probe circuit is efficiently transferred to the detection circuitry.

The precessing magnetic moment induced by applied pulses generated a voltage across the pickup coil, which is amplified by the low noise amplifier before being mixed with signal from DDS. This mixed down signal which is at frequency equal to difference between DDS frequency and frequency of the precessing spins is filtered.

a) Transmitter-RF Amplifier

A 500 W, 27 MHz Class AB RF power amplifier has been used for this NQR spectrometer. This has two stages and is housed in two different instrumentation bins. The total gain of the RF amplifier is 54 dB. Continuous or pulsed RF sinusoidal input to amplifier comes from FPGA (DDS and Pulse Programmer). In first stage 4 W RF power is generated and using 4:1 splitter 4 W RF power is split to get four 1W drive signals to four power stages. N channel enhancement type MOSFET has been used in power stages .Four 150 W power stages have been combined to get 500 W RF power is using 4:1 power combiner. The output power is available through a directional coupler on the front panel. The forward and reflected powers from the directional coupler are also routed to the front panel.

b) Probe

Probe circuit is a single coil pulsed resonance sample circuit which allows optimization in the transmitting and receiving end. In the transmitting mode the circuit is matched to transmitter output impedance 50 ohm and in receiving mode it is matched to optimum input impedance of pre-amplifier.

The probe circuit used here is parallel tuned LC circuit impedance matched to 50 ohms with a series capacitor (figure 3). The sample coil (L_{coil}) is made out of 17 AGW copper wire and has 32 turns of 20 mm diameter. The inductance of the coil is 6 μH. The capacitors C_T and C_M are high voltage (5 kV) variable (5 pf – 125 pf) vacuum capacitors. In order to reduce the noise the probe circuit is shielded inside an aluminum box and is well grounded. The coils are made mechanically stable by potting them in resin based adhesive (Araldite ®).

The capacitors are varied in order to tune the circuit to the resonance frequency and match the circuit to 50 ohms for maximum power transfer from the transmitter. The approximate values of C_T and C_M can be calculated by following Equations [4].

$$\omega^2 L C_T = 1 \quad (1)$$

$$\frac{Q\,\omega L\, C_M^2}{C_T+C_M} = 50 \quad (2)$$

$$C_T = \frac{1-\sqrt{(R/50}}{\omega^2 L} \quad (3)$$

$$C_M = \frac{\sqrt{(R/50}}{\omega^2 L} \quad (4)$$

The tuning and matching are achieved by maximizing the forward power and minimizing the reflected power. The forward and reflected power is monitored using the directional coupler built in the transmitter.

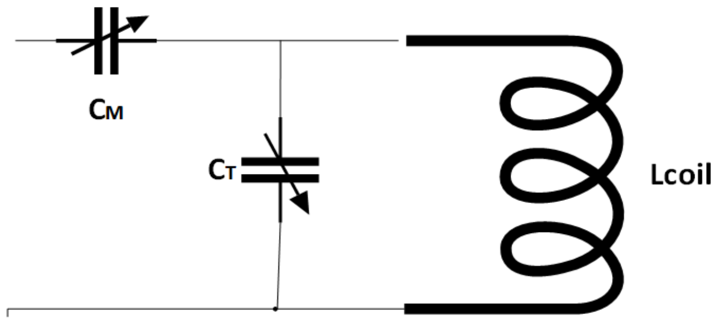


Figure 3 : Probe

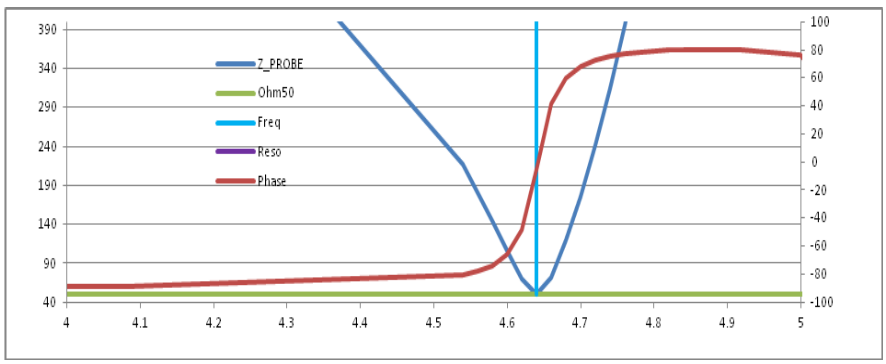


Figure 4 : Impedance of Probe vs Frequency. Horizontal axis is Frequency in MHz, Vertical axis in left is Z_Probe in Ohms, Vertical axis in right is phase in degrees

Powder sample ($NaNO_2$) is packed in test tube of 18 mm diameter and 46 mm length. The size of the coil and the test tubes are chosen in order to maximize the filling factor.

c) Direct Digital Synthesis

Direct Digital Synthesis (DDS)[5] is a method of producing an analog waveform by generating the sinusoidal signal in digital form and then performing a digital to analog conversion. The operations within a DDS device are primarily digital therefore, it offers fast switching between output frequencies, fine frequency resolution, and operation over a broad spectrum of frequencies.

The digital part of the phase tunable and frequency fixed DDS, denoted here as DDS, is built inside FPGA as a core module, while the non-digital parts, i.e., digital to analog converter (DAC) and filter, are outside the FPGA as shown in Figure 5. The output level of a DAC is updated in synchronous with a master clock. As a consequence of discrete change in the output voltage at clock rising edges, the output of a DDS circuitry contains signal components with the image frequencies in addition to the fundamental one. The output signal is passed through a filter to select fundamental frequency.

The main components of a DDS circuitry are a p hase accumulator, phase to amplitude converter (sine lookup table), and a DAC. It has ability to produce two independent outputs 90° out of phase, which are mandatory for quadrature detection. Output frequency of DDS is given by equation no. 5.

$$F_{out} = \frac{M \; X \; F_c}{2^n} \quad (5)$$

where $\boldsymbol{M}$ is Phase tuning word (PTW)
$\boldsymbol{F_{out}}$ is Output frequency of DDS
$\boldsymbol{F_c}$ is Internal reference clock frequency(CLK)
$\boldsymbol{n}$ is Length of phase accumulator

The resolution of DDS in spectrometer designed is $Fc/2^{22}$=10.96 Hz.

Changes in the value of M results in immediate and continuous phase changes in output frequency. As the output frequency is increased the number of samples per cycle decreases, since sampling theory states that at least two samples per cycle are required to construct the output, the maximum fundamental output frequency of DDS is $F_c/2$. However for practical applications the output frequency is limited to somewhat less than that the maximum, improving the quality of reconstructed waveform and permitting the filtering of output.

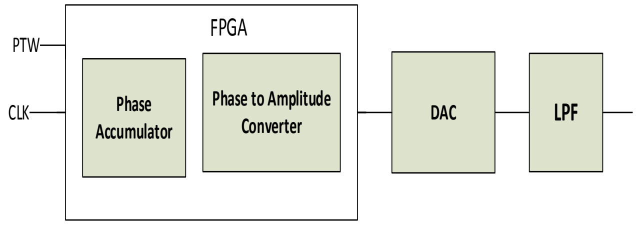


Figure 5 : Direct Digital Synthesizer

d) Programmable Pulse Generator

Finite state machine (FSM) was written for programmable pulse generator using state diagram editor of active HDL software. FSM was then converted to VHDL code reproduces the pulse programmer inside the FPGA. The function of pulse programmer is to generate timing sequences for enabling transmitter, receiver, acquisition, RF modulating pulse. In addition pulse programmer also controls the phase of RF pulses as per the requirement for the observation of free induction decay (FID) and spin echo by triggering the DDS at appropriate phase points.

Following are pulses that are generated by pulse generator. They control various parts of the spectrometer.

1. Transmitter Enable.(1-200 μsec)
2. Receiver enable.(1 – 11 sec)
3. RF modulating Pulse.(1-100 μsec)
4. Acquisition Trigger (1 -10 sec)
5. RF Phase Control (0°, 90°, 180°, 270°)

Transmitter enable pulse is to enable the RF power amplifier in between which RF pulses are send to the probe. RF modulating pulse at resonance frequency is send to the probe for the exciting nuclei sitting in a probe. After the RF pulses the pulse programmer disables the transmitter and enables the receiver by receiver enable pulse. Now the receiver is ready to receive the signal and send to digital quadrature detector. The pulses are shown in Figure 6.

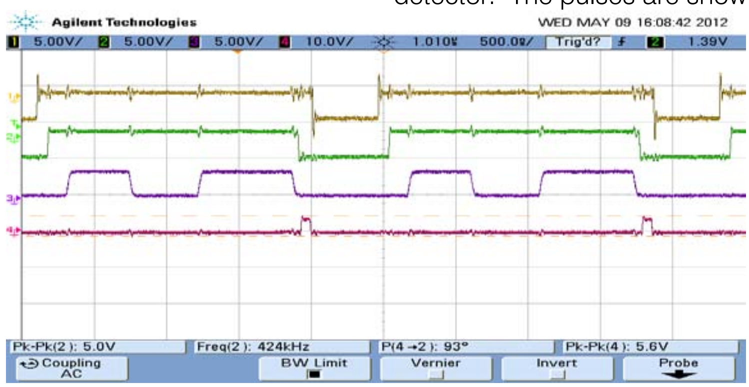


Figure 6 : Start,TxEn,RF_pulse,RxEn

The DDS is programmed to generate an RF frequency (reference frequency). This signal is routed through the phase shifter which is controlled by the pulse programmer. The phase shift is to provide pulses along the different axes in the vector model. By convention,

phase shift of 0° is an x-phase pulse,
phase shift of 90° is an y-phase pulse
phase shift of 180° is an -x-phase pulse
phase shift of 270° is an -y-phase pulse

e) RF Modulating pulse

RF modulating pulse can be one pulse sequence for observation of FID or a two pulse sequence for observation of spin Echo.

VHDL code has been written for the pulses to be 90° at x and 180° at y. The two pulse sequence is shown in Figure 7.

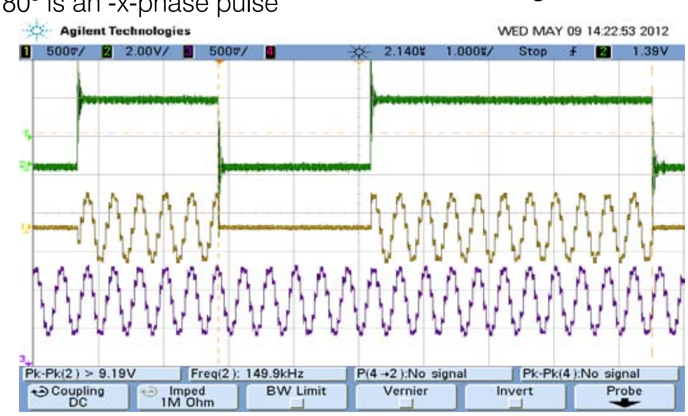


Figure 7 : Two Pulse (90°at x and 180° at y) on Scope

f) Crossed Diodes and Quarter Wave Impedance Transformer

The high power output of transmitter to the probe needs to be isolated from the sensitive receiver amplifier. This is achieved using crossed diodes and quarter wave lines [6]. Between the RF power amplifier and the probe there is a pair of cross diodes which show a high series impedance when the transmitter is off and a low impedance during the pulses. Thus between the pulses, the power amplifier and its associated noise is isolated from the probe circuit. The signal from the probe circuit passes through a quarter wave line to reach another pair of cross diodes which are shunted to ground at the input of pre-amplifier. The diode shorts the preamp end of the cable when transmitter is on, thus protecting the sensitive pre-amplifier from high RF power out from the power amplifier. Between pulses, the voltage across the diodes is too small to turn them on, and they act like an open circuit, letting the NQR signal pass to the preamplifier.

Though at high frequencies a suitable length of a co-axial cable like RG-58 itself can serve the purpose of a quarter wave line, at the frequencies of our interest (viz. < 6 MHz), co-axial cables are inconvenient because of the long lengths. So we have used 50 Ohm compatible quarter wave π -sections following the method given by Fukushima et al [7].

A quarter wave transmission line acts a transformer which transforms it output impedance according to the equation.

$$Z_{output} = \frac{Z_0^2}{z_{input}} \quad (6)$$

where $Z_0 = 50$ is the characteristic impedance of the transmission line. Thus, during the pulses, when the shunt diodes are acting as short, the input impedance of the transmission line is infinite acting as if the receiving circuit were completely disconnected from the probe.

The equivalent of (λ/4) cable for operating frequency as 4.64 MHz for $NaNO_2$ is a π network shown in figure 8 a.

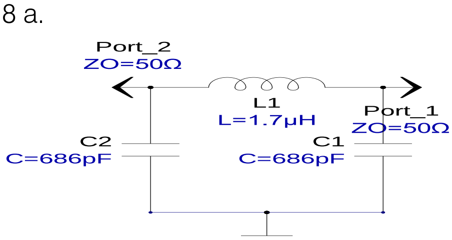


Figure 8 a) : Equivalent of (λ/4) cable

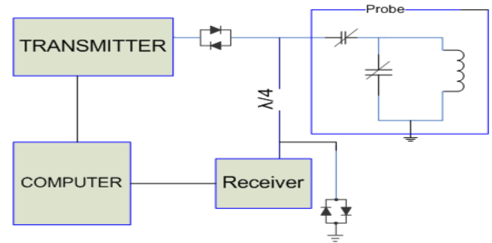


Figure 8b) : Block Diagram of Spectrometer showing cross diodes

g) Pre-Amplifier

NQR signal is expected to be of order of -100 dBm [8] so it needs to be amplified considerably before it can be observed on an oscilloscope. Three stages, each of which contains two amplifiers (BMC 1124, broadband RF amplifier, gain 14 dB) are connected in series as preamplifier with a gain of 84 dB and noise figure of 6.74 dB to achieve necessary level of amplification of NQR signal. Low pass filters (5 MHz) are connected after every stage to reduce Noise.

At the end of preamplifier band pass filter of bandwidth 500 KHz center frequency 4.64 MHz is cascaded to further reduce noise thus improving the signal to noise ratio.

h) Digital Quadrature Detection

The NMR receiver design is extremely important since it directly determines the final spectrum quality. The NMR signal is first amplified to a level of perhaps several hundreds of millivolts. The signal is then passed to ADC. The ADC converts the signal from voltage to data points. This signal is then demodulated in FPGA using mixer with I and Q components of reference signal which comes as DDS output.

Principle

DQD technique[9],[10] works on lock in amplifi cation technique where signal is multiplied to I and Q components of reference signal (figure 9). If signal is S(n) then

$$S_I(n) = S(n) * Cos(\omega_o n)$$

$$S_Q(n) = S(n) * Sin(\omega_o n)$$

If $S(n) = Sin(\omega n)$

Then

$$S_I(n) = Sin(\omega - \omega_o)n + Sin(\omega + \omega_o)n$$

$$S_Q(n) = Cos(\omega - \omega_o)n - Cos(\omega + \omega_o)n$$

The lower frequency component is the desired signal. In the demodulation process the signal oscillating at frequency $(\omega - \omega_o)$ is of interest and component at $(\omega + \omega_o)$ are dropped off with lowpass FIR filter.

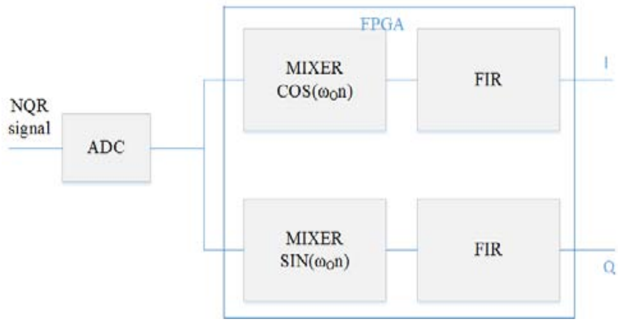


Figure 9 : Digital Quadrature Detection

i) FIR filter

Inside the FPGA, each of the demodulated I and Q components of the signal is made to pass through a finite impulse response FIR low pass filter, generated using fdatool of MATLAB. The FIR filter used is 31-stage, Hamming-window filter with a cut-off frequency of 30 kHz and sampling frequency 2.875 MHz.

The FIR digital filters with various cutoff frequencies can be incorporated, out of which users can select the appropriate one according to the sampling interval, or spectral width, of an individual NMR experiment.

j) Signal accumulator

The signal intensity of ^{14}N NQR seldom exceeds the thermal noise signal therefore it can be detected with high degree of reliability after multiple acquisitions. A memory module for storing the NQR signal is also prepared inside the FPGA using dual port RAM module. In the current NQR spectrometer, up to 16384 data points can be stored for each of the in-phase and quadrature signals . The stored data can be transferred to PC every scan or can be averaged n times ($n \leq 4096$) before data transfer.

III. Experimental Results

a) NQR/NMR signal Detection

Two popular methods of observing NQR/NMR signals are: i) observe FID using a single pulse excitation. ii) Observe spin echo using a double pulse sequence. The choice of the sequence depends mainly on the relaxation time (T_2^*) of the sample. For a long relaxation time of milliseconds as in the case for ^{14}N signal from $NaNO_2$, a single pulse sequence is appropriate and for a short relaxation time as in the case of ^{1}H and ^{2}H double pulse sequence is used to observe a spin echo.

The main challenge for NQR techniques is the extremely poor signal to noise ratio (SNR). To improve SNR, many repetitions of the experiment are necessary. The most commonly method is to use repeated single RF pulse and acquire NQR signal after each pulse. The rate at which RF pulse has to be repeated depends on physical parameters of nuclear relaxation which are spin –spin relaxation and spin lattice relaxation. Spin lattice relaxation time is denoted by T_1 determines the time necessary to regain its original thermal equilibrium state and gives bound to how quickly a pulse sequence can be repeated. The spin-spin relaxation time denoted by T_2 indicates decoherence and thus determines the RF pulse length. In practice we can apply a pulse sequence of length T_2 and repeat the pulse sequence every T_1. For most of explosives the relaxation times are very long which lead to long detection times [11].

The NQR Spectrometer (Fig 1) designed has been used to observe an NQR signal from Sodium Nitrite sample.

Fig 10 shows the ^{14}N NQR signal in 20g of Sodium Nitrite. The observation frequency is 4.642 MHz where as the signal is off resonant by about 2500 Hz resulting in oscillatory FID. RF excitation pulse length of 20 μsec and power of 120 W was used for excitation. The entire cycle is repeated after every 0.5 s (large compared to the spin lattice relaxation time of 0.7 ms). The signal strength is at the expected level of 6 μvolts. The NQR signal shown in Figure 10 is averaged for 1024 times.

The NQR spectrometer was modified to NMR spectrometer by placing the coil in a permanent magnet. Here sample in a coil is placed between poles of a horse shoe magnet of magnetic field 1.35 K Gauss and spin echo experiment was carried out. A small quantity of ferric nitrate is added in order to reduce the T_1 of pure water and the proton signal from water is observed.

Fig 11 shows the spin echo (^{1}H from H_2O:FeNO3). The observation frequency is 5.765 MHz We used t1 = 5 μsec, t2 = 10 μsec, τ = 200 μsec, RF excitation power was about 70 W. The entire cycle was repeated after every 0.5s. The signal strength without averaging is 50 μvolts. The signal shown in figure 11 was averaged for 256 times.

Also Deuterium NMR was observed using a magnet of magnetic field of 3.85 K Gauss. The deuterium signal is shown in Figure.12. The observation frequency is 3.855 MHz. t1 = 5 μsec, t2 = 10 μsec, τ = 2.5 msec. The signal strength without averaging is 8 μ volts.

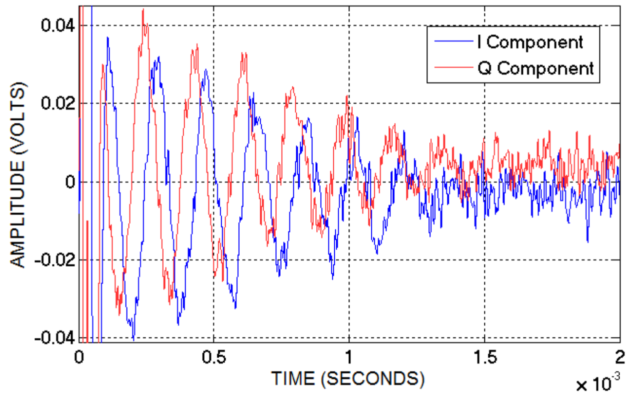


Fig. 10 : ^{14}N NQR signal from $NaNO_2$

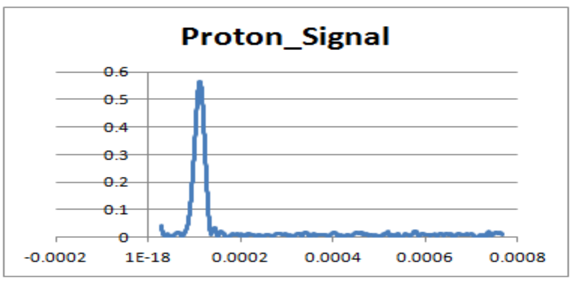


Fig. 11 : ^{1}H NMR signal from H_2O .The horizontal axis is time in seconds and vertical axis shows signal strength in volts

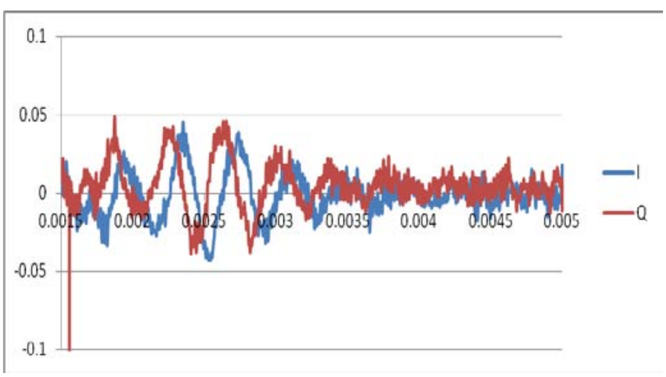


Fig. 12 : ^{2}H NMR signal from D_2O. The horizontal axis is time in seconds and vertical axis shows signal strength in volts

IV. Conclusion

This spectrometer can further be developed into a miniature spectrometer by combination of RF amplier, reciever module and FPGA module on one board and thus enhances opportunities for novel and exciting NQR/NMR experiments like explosive detection, mine detection etc.

V. Acknowledgment

It is pleasure to thank Sujo C.I, Paresh.D.Motiwa la and ED workshop for their help and support in development of spectrometer.

References Références Referencias

1. Fukushima, Roeder, "Experimental Pulse NMR", Nuts and Bolts approach.
2. Hideo Itozaki and Go ota, "NQR for Explosive Detection." International journal of Smart sensing and intelligent systems.Vol 3 sept 2008.
3. Janez seliger,Veselko zagar, "New methods for detection of ^{14}N NQR frequencies", Applied magnetic resonance(2012).
4. Yi Ji Jiang "A Simple Method for Measuring the *Q* Value of an NMR Sample Coil" Journal of Magnetic Resonance **142,** 386–388 (2000).
5. Eva Murphy, Colm Slattery, "All about Direct digital synthesis", Analog Dialogue 38-08, August (2004)
6. I.J.LOWE C.E Tarr, Journal of Physics E1 320(1968).
7. Eiichi, Fukushima, Stephen B, W. Roeder, "Experimental Pulse NMR".
8. Abragam, "Nuclear Magnetism", Oxford Publication.
9. Jordan Kirsh and Robert Newman, "Digital quadrature detection in nuclear magnetic resonance spectroscopy", *Analytical Center, East China Normal University, Shanghai 200062, People's Republic of China.*
10. Li Gengyinga and Xie Haibin, "Digital quadrature detection in nuclear magnetic resonance spectroscopy",*Analytical Center, East China Normal University, Shanghai 200062, People's Republic of China.*
11. A.N .Garroway ,M.L Buess,J.B . Miller ,B.H Suits , A.D Hibbs, A.G Barall,R. Mathews and I.J Burnett, Remote Sensing by Nuclear Quadrupole Resonance, IEEE trans. Geosience and Remote sensing . Vol 39 no .6pp june 2001.

This page is intentionally left blank

Global Journal of Researches in Engineering: F
Electrical and Electronics Engineering
Volume 16 Issue 2 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

A Planar CPW Antenna Loaded with Rectangular Slot for Triple Bands Operation

By Pooja G. Phad & Veeresh G. Kasabegoudar
MBES College of Engineering, Ambajogai, India

Abstract- In this paper a planar CPW antenna loaded with rectangular slot is presented. The proposed antenna offers three frequency bands and hence suitable for triple bands wireless applications. The proposed geometry has hexagonal shaped radiator loaded with a rectangular slot to excite three resonant frequencies in the UWB frequency range. The three resonances of triple bands obtained are at 5.9GHz, 9.9GHz, and 14.4GHz. The antenna was designed and developed on easily available low cost FR-4 glass epoxy substrate. The proposed antenna's prototype was developed for its validation and found reasonable agreement between the simulated and measured results.

Keywords: *CPW fed antenna, planar antenna, triple bands antenna.*

GJRE-F Classification : *FOR Code: 291701*

APLANARCPWANTENNALOADEDWITHRECTANGULARSLOTFORTRIPLEBANDSOPERATION

Strictly as per the compliance and regulations of :

A Planar CPW Antenna Loaded with Rectangular Slot for Triple Bands Operation

Pooja G. Phad [α] & Veeresh G. Kasabegoudar [σ]

Abstract- In this paper a planar CPW antenna loaded with rectangular slot is presented. The proposed antenna offers three frequency bands and hence suitable for triple bands wireless applications. The proposed geometry has hexagonal shaped radiator loaded with a rectangular slot to excite three resonant frequencies in the UWB frequency range. The three resonances of triple bands obtained are at 5.9GHz, 9.9GHz, and 14.4GHz. The antenna was designed and developed on easily available low cost FR-4 glass epoxy substrate. The proposed antenna's prototype was developed for its validation and found reasonable agreement between the simulated and measured results.

Keywords: CPW fed antenna, planar antenna, triple bands antenna.

I. Introduction

The Federal Communication Commission (FCC) allocated the frequency band spectrum from 3.1 to 10.6 GHz for monetary communication applications in year 2002 [1]. This resulted in the development of several antennas which operate in the ultra wideband (UWB) range. It is also expected that in this range frequency satisfactory radiation properties are required. An UWB antenna which satisfies the more requirements like a small size, consistent group delay, omnidirectional radiation patterns, and gain beyond whole band [2, 3]. There are several works reported in literature on these kinds of antennas [3-15]. By adding half wavelength V-shaped slot on radiating patch, UWB antenna achieves sharp band notched characteristics [3]. A lower pass band, 2.4 GHz Bluetooth band (2.4 – 2.484 GHz), can be realized by adding a pair of U-shaped parasitic strips bilaterally beside the feed line which covers whole UWB band [4].

In [7], by inserting an U shaped slot on radiating patch which produces band notch characteristics. The main goal in UWB antenna design is achieving the wide impedance bandwidth with high radiation efficiency. Section 2 describes the basic geometry and its operation. Geometry oprtimization procedure is covered in Section 3. Experimental validation of the proposed antenna is presented in Section 4. Finally, Section 5 concludes the work carried out and guidelines the future scope.

II. Antenna Geometry

Figure 1 shows basic geometry of the proposed antenna. The proposed antenna is having a low profile geometry with overall dimensions of 24 x 25mm x 1.6mm (*LxWxh*). The substrate used for design and fabrication is FR4 glass epoxy substrate with relative permittivity of 4.4, thickness of 1.6mm, and loss tangent equal to 0.02. The geometry is basically a CPW fed monopole antenna. An elliptical slot is etched in the ground with major axis radius of 11.55 mm and minor axis radius of 10 mm. Hexagonal stub is attached to the signal conductor of the CPW line to ensure the impedance matching. Also, a rectangular slot is made on the hexagonal stub to excite multiple bands and to enhance their bandwidths. The other dimensions are mentioned in Table 1 based on the optimization procedure discussed in Section 3.

Table 1 : Dimensions of the optimized geometry

Parameter	L_1	W_1	L_2	L_3	L_s	Ws	W_2	W_3	g_1	g_2	a	b	c
Values (mm)	24	25	2.59	3.6	7.2	7.1	5.29	2.2	0.1	1	10	11.55	5.66

III. Geometry Optimization and Discussions

This section covers the geometry optimization by varying some parameters of the antenna geometry. The parameters utilized for optimization are gap g_1, width of signal conductor (W_3) of CPW feed, length of rectangular slot (L_s), and the width of rectangular slot (W_s). High frequency structure simulator (HFSS-v.13) [16] was used to carry out the parametric optimization.

Author α σ: P. G. Dept., MBES College of Engineering, Ambajogai, India. e-mails: pooja_it_me@yahoo.com, veereshgk2002@rediffmail.com

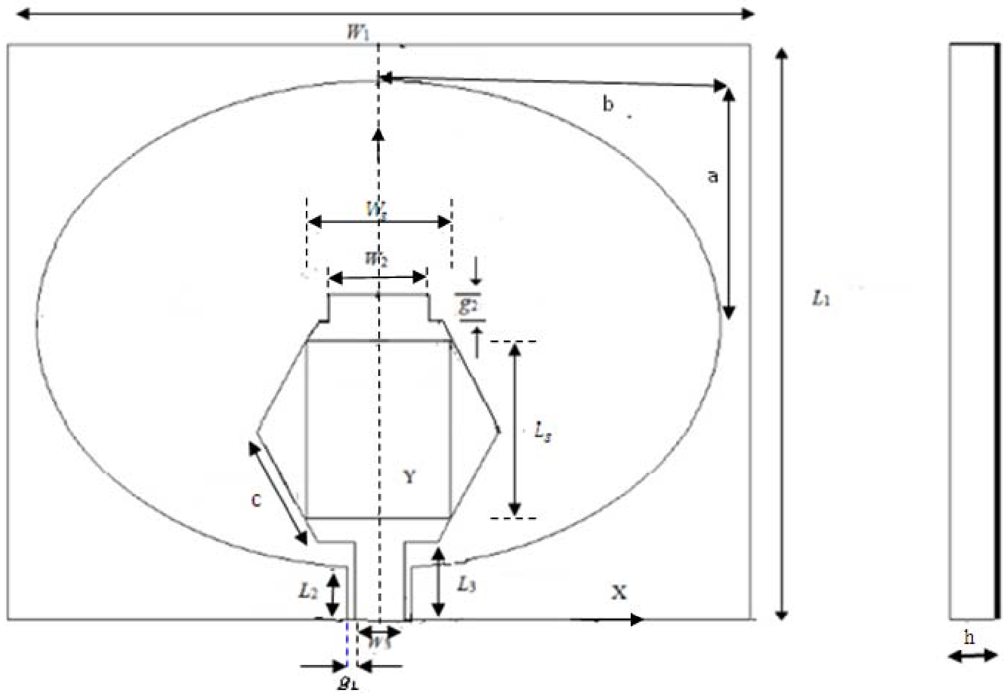


Figure 1 : Basic geometry of the proposed antenna (left: top view; right: cross sectional view).

a) Variation of Gap (g_1)

The gap between signal conductor and ground (g_1) was varied from 0.1 to 0.2 in steps of 0.05 mm by keeping all other parameters constant. Effect of g_1 on S_{11} characteristics is presented in Figure 2. From Figure 2 it may be noted that impeadance matching may be fine tuned with this parameter. From this study the gap value of $g_1 =$ 0.1mm was noted as an optimum.

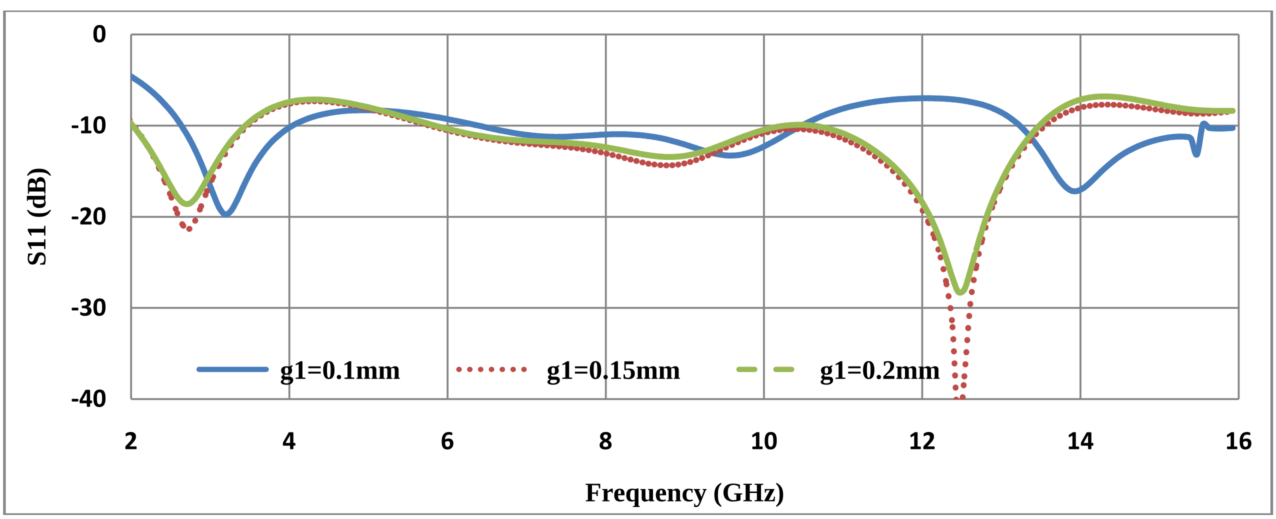


Figure 2 : The effect of the length g_1 on reflection coefficient characteristics.

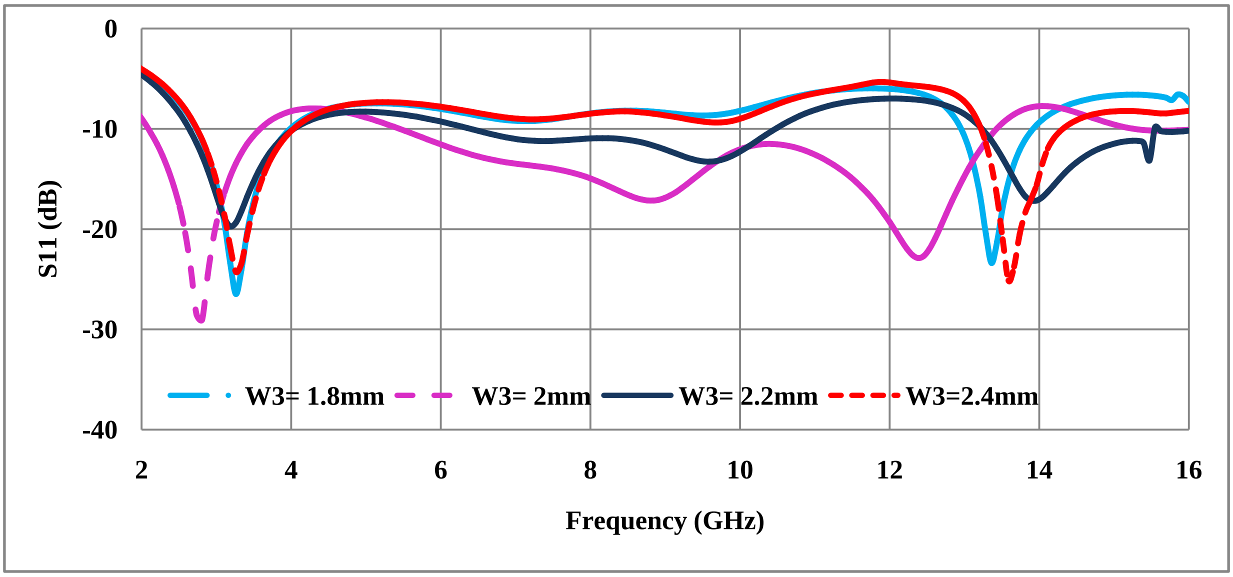


Figure 3 : The effect of the signal conductor width W_3 on reflection coefficient characteristics.

b) Effect of Length of Rectangular Slot (L_s)

In anoter effort, rectangular slot length (L_s) was varied from 5.7 mm to 7.2 mm in steps of 0.5mm with all other parameters kept constant. Effect of variation of rectangular slot's length on reflection coefficient characteristics are presented in Figure 4. In this observation, a slot value of L_s = 7.2 mm offered the optimum impedance bandwidth. It may be noted that slot length beyond 7.2mm cuts the edges of the hexagonal signal conductor stub.

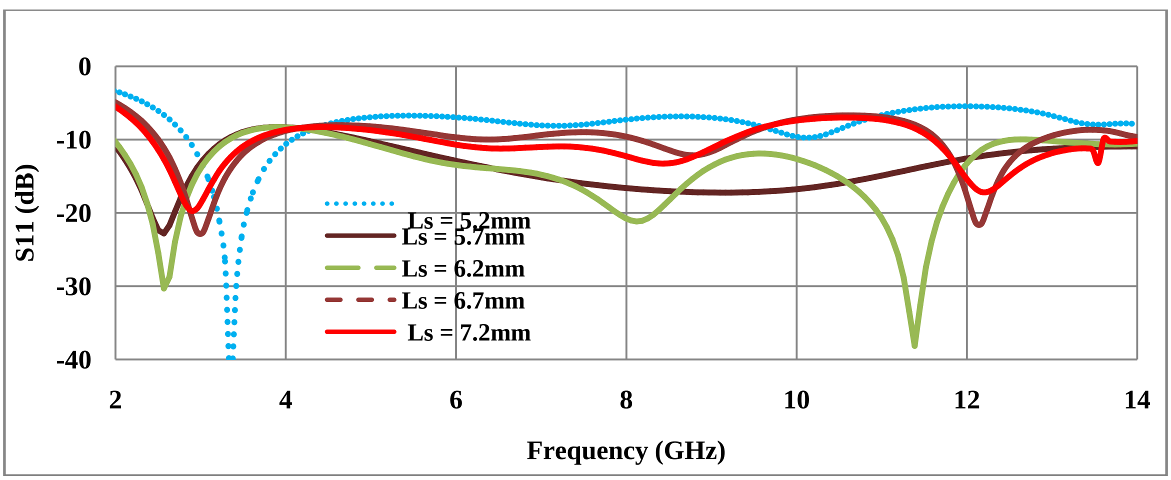


Figure 4 : The effect of the length of rectangular slot L_s on reflection coefficient characteristics.

c) Effect of Width of Rectangular Slot (W_s)

Finally, the width of rectangular slot was varied from 5.1 mm to 7.1 mm in steps of 0.5 mm by keeping all other parameters constant. The effect of variation of W_s on the antenna's input characteristics are presented in Figure 5. These characteristics indicate that a rectangular slot width of W_s = 7.1 mm offers the optimum performance.

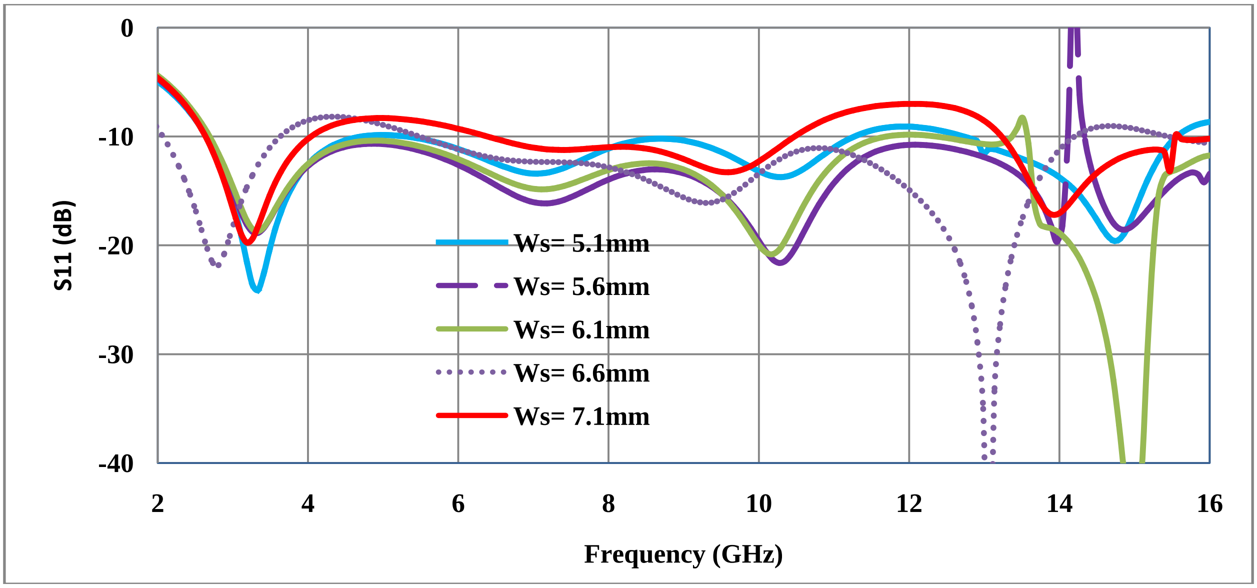


Figure 5 : The effect of the Width of rectangular slot W_S on reflection coefficient characteristics.

IV. Experimental Validation of the Geometry and Discussions

The prototype of antenna geometry shown in Figure 1 was fabricated and tested experimentally for its validation. The dimensions used for prototype development are as listed in Table 1. Substrte used for development is an FR4 glass epoxy material whose height is 1.6mm and having a relative permitivity of 4.4 with dielectric loss tangent of 0.02. The photograph of the fabricated design is as shown in Figure 6. Antenna's reflection coefficient parameters were measured using Agilent's network analyzer. Measured characteristics are compared with simulated values and presented in Figure 7. Although, a mismatch was observed due to fabrication inaccuracies, tri band operation was observed. Three resonances are obtained at 5.9GHz, 9.9GHz, and at 14.4GHz.

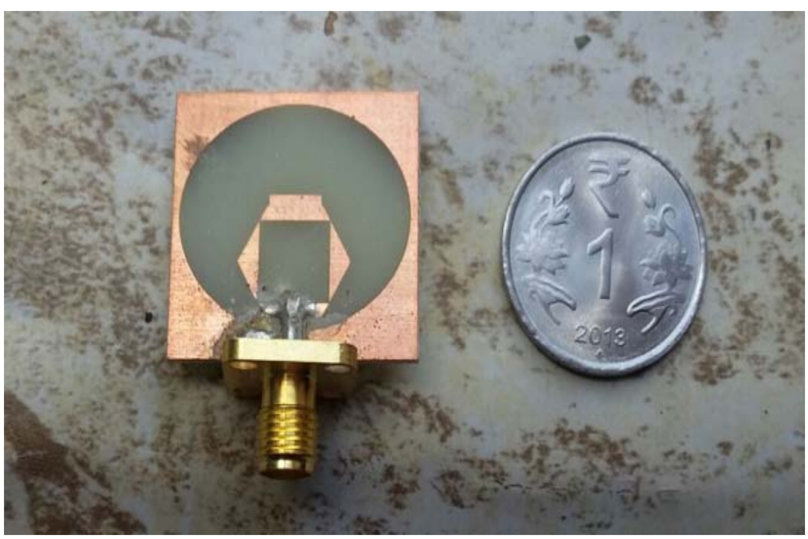


Figure 6 : Photograph of the fabricated prototype.

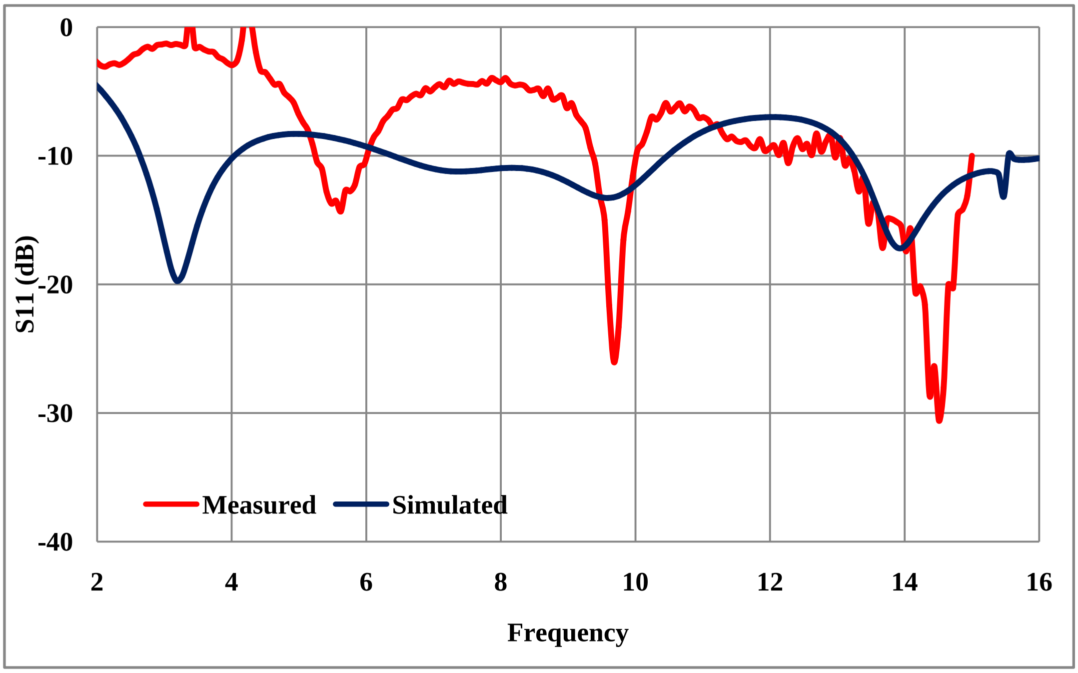
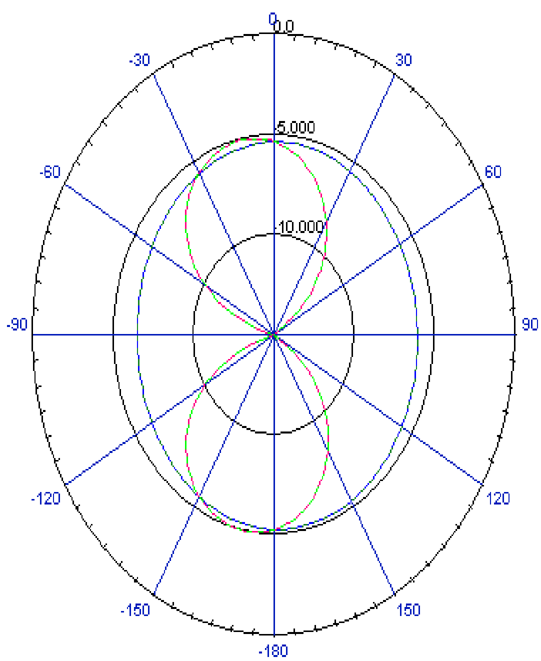
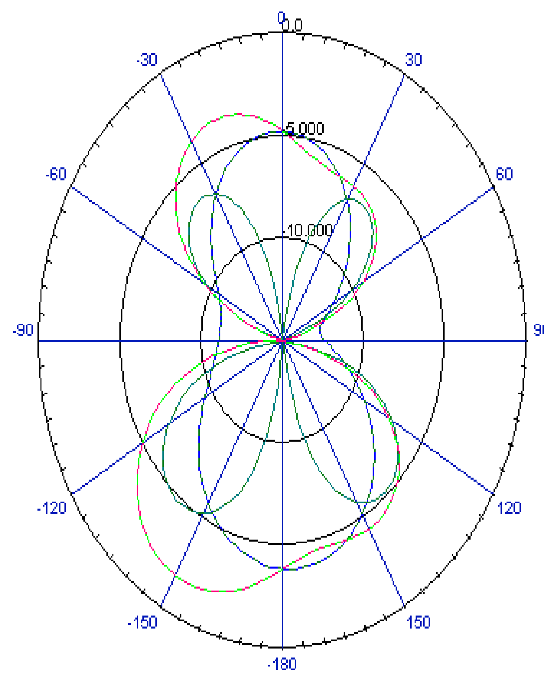


Figure 7 : Comparison of measured and simulated reflection coefficients.

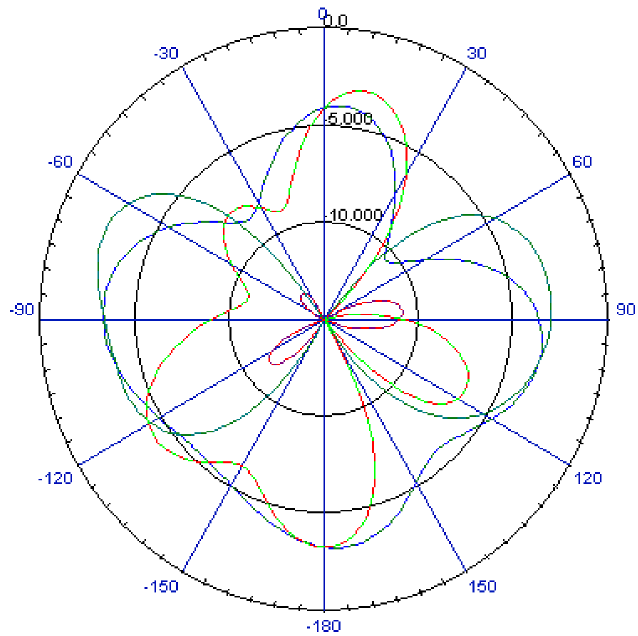
Radiation patterns are plotted at three different frequencies are depicted (Figure 8) to demonstrate the proper working of antenna.



(a) *f*=3.189GHz



(b) *f*= 9.66GHz



(c) *f*=13.96 GHz

Figure 8 : Radiation patterns at three resonances of the antenna.

V. Conclusions

A planar patch antenna fed with CPW feed has been presented for tribands operation. Proposed antenna is basically a monopole antenna. A rectangular slot was loaded to excite three resonance bands. Slot and hexagonal dimensions are tuned for impedance matching of antenna. Three resonances obtained are at 5.9GHz, 9.9GHz, and at 14.4GHz. Stable radiation patterns have been obtained across the bands of operation. The proposed antenna is suitable for tri-bands applications. The future work includes the bandwidth optimization of the three frequency bands.

References Références Referencias

1. Federal Communications Commission (FCC), Revision of Part 15 of the Commission's Rules Regarding Ultra-Wideband Transmission Systems First Rep. and Order, ET Docket 98-153, FCC 02-48, and Adopted: Feb. 2002; Released, Apr. 2002.
2. C.A. Balanis, *Antenna Theory and Analysis*, 2nd Edn., Wiley & Sons, New York, 1997.
3. T. G. Ma and S. K. Jeng, "A printed dipole antenna with tapered slot feed for ultrawide- band applications," *IEEE Trans. Antennas Propag.,* vol. 53, pp. 3833-3836, Nov. 2005.
4. Q. X. Chu and T. G. Huang, "Compact UWB antenna with sharp band-notched characteristics for lower WLAN band," *Electron. Lett.*, vol. 47, pp. 838-839, Jul. 2011.
5. M. M. S. Taheri, H. R. Hassani, and S. M. A. Nezhad," UWB printed slot antenna with bluetooth and dual notch bands," *IEEE Antennas Wireless Propag. Lett.*, vol. 10, pp. 255-258, 2011.
6. C.-C. Lin, P. Jin, and R. W. Ziolkowski, "Single, dual and tri-band-notched ultrawideband (UWB) antennas using capacitively loaded loop (CLL) resonators," *IEEE Trans. Antennas Propag.*, vol. 60, pp. 102-109, Jan. 2012.
7. S. K. Mishra, R. K. Gupta, A. Vaidya, and J. Mukherjee, "A compact dual-band fork-shaped monopole antenna for Bluetooth and UWB applications," *IEEE Antennas Wireless Propag. Lett.*, vol. 10, pp. 627-630, 2011.
8. W. S. Lee, D. Z. Kim, K. Z. Kim, and J. W. Yu, "Wideband planar monopole antennas with dual band-notched characteristics," *IEEE Trans. MTT*, vol. 54, pp. 2800-2806, Jun. 2006.
9. J. J. Liu, S. S. Zhong, and K. P. Esselle, "A printed elliptical monopole antenna with modified feeding structure for bandwidth enhancement," *IEEE Trans. Antennas Propag.,* vol. 59, pp. 667- 670, Feb. 2011.
10. Y. Luo, L. Xu, Z. Xin, and S. He, "A compact CPW fed UWB antenna with GSM, GPS, bluetooth and dual notch bands applications," *Progress in Electromagnetics Research C*, vol. 35, pp. 205-219, 2013.
11. R. Chair, A.A. Kishk, and K. F. Lee, "Ultra-wideband coplanar waveguide fed rectangular slot antenna," *IEEE Antennas and Wireless Propagation Letters*, vol. 3, pp. 227-229, 2004.
12. A. Sompan, S. Sewattanapon, C. Mahatthanajatuphat, and P. Akkaraekthalin, "An

elliptical dipole antenna with rectangular slot reflector for wideband applications," IEEE *ECTI*, pp. 200-203, 2011.
13. S. Sadek and Z. Katbay, "Ultra wideband bow tie antenna," *IEEE Trans. Antennas Propag.*, pp. 262-263, 2009.
14. R. K. Yadav, J. Kishor and R. L. Yadava, "Design of hexagonal patch antenna for mobile wireless system," *IEEE IJSTM*, vol. 2, issue 4, December 2011.
15. X. L. Liang, T. A. Denidni, L-N Zhang, R-H Jin, J-P Geng, and Q. Yu , " Printed binomial curved slot antennas for wideband applications," *IEEE Trans. Microwave Theory and Techniques,* vol. 59, no. 4, pp. 1058-1065, 2011.
16. HFSS 10.0 user's manual, Ansoft Corporation, Pittsburgh.

This page is intentionally left blank

Global Journal of Researches in Engineering: F
Electrical and Electronics Engineering
Volume 16 Issue 2 Version 1.0 Year 2016
Type: Double Blind Peer Reviewed International Research Journal
Publisher: Global Journals Inc. (USA)
Online ISSN: 2249-4596 & Print ISSN: 0975-5861

From Hertz-Heaviside Electrodynamics to the Trans-Coordinate Electrodynamics

By A. S. Dubrovin & F. F. Mende
B.I. Verkin Institute, Ukraine

Abstract- The conclusion about the absence in them of the mathematical means of the adequate description of passage from one inertial reference system to another because of the use by them of particular derived field functions on the time, which completely tie electrodynamic process to one concrete frame of reference, is made on the basis of the critical analysis of extraction from the equations of the electrodynamics of ideas about the space and period. Is proposed new approach to the development of the mathematical apparatus for electrodynamics in the direction of the more adequate description of passage from one inertial reference system to another due to the introduction into the examination of the trans-coordinate equations, which use new Galilean and trans-coordinate derivatives of field functions. This generalization of electrodynamics assumes the dependence of electromagnetic field and electric charge on the speed of the motion of observer, caused not by the geometry of space-time, but by physical nature of the very field within the framework of gipercontinual ideas about the space and the time. Is obtained the new trans-coordinate formulation of Maxwell equations for the case of isotropic homogeneous medium without the dispersion, which generalizes the traditional formulation of Hertz-Heaviside for the same case. Are given Maxwell equations in the integral and differential forms in the idea of Hertz-Heaviside and in the transcoordinate idea.

Keywords: maxwell equation, galileo's derivative, trans-coordinate derived, time-spatial gipekontinuum, transcoordinate electrodynamics.

GJRE-F Classification : *FOR Code: 020302*

FROMHERTZHEAVISIDEELECTRODYNAMICSTOTHETRAN-COORDINATEELECTRODYNAMICS

Strictly as per the compliance and regulations of :

From Hertz-Heaviside Electrodynamics to the Trans-Coordinate Electrodynamics

A. S. Dubrovin [α] & F. F. Mende [σ]

Abstract- The conclusion about the absence in them of the mathematical means of the adequate description of passage from one inertial reference system to another because of the use by them of particular derived field functions on the time, which completely tie electrodynamic process to one concrete frame of reference, is made on the basis of the critical analysis of extraction from the equations of the electrodynamics of ideas about the space and period. Is proposed new approach to the development of the mathematical apparatus for electrodynamics in the direction of the more adequate description of passage from one inertial reference system to another due to the introduction into the examination of the trans-coordinate equations, which use new Galilean and trans-coordinate derivatives of field functions. This generalization of electrodynamics assumes the dependence of electromagnetic field and electric charge on the speed of the motion of observer, caused not by the geometry of space-time, but by physical nature of the very field within the framework of gipercontinual ideas about the space and the time. Is obtained the new trans-coordinate formulation of Maxwell equations for the case of isotropic homogeneous medium without the dispersion, which generalizes the traditional formulation of Hertz-Heaviside for the same case. Are given Maxwell equations in the integral and differential forms in the idea of Hertz-Heaviside and in the transcoordinate idea.

Keywords: maxwell equation, galileo's derivative, trans-coordinate derived, time-spatial gipekontinuum, transcoordinate electrodynamics.

I. Introduction

In the initial form the system of equations of classical electrodynamics was recorded by Maxwell in his famous treatise [1] with the use of quaternion calculation within the framework of classical ideas about the space and time, that allow the Galileo conversions upon transfer from the examination of electromagnetic field in one inertial reference system to the examination of the same field in another inertial reference system. However, it was immediately explained that the apparatus for quaternion calculation in mathematics was developed not so well so that physics they could it successfully apply to the wide circle of the tasks of electrodynamics. In order to draw into the electrodynamics the simpler and more effective means of mathematical physicists, Hertz and Heaviside reformulated Maxwell equations from the language of quaternion calculation to the language of vector analysis.

Authorσ: e-mail: mende_fedor@mail.ru

At that time it seemed that the formulation of Hertz-Heaviside is equivalent to the initial formulation of Maxwell, but now already it is possible to establish that the equations, obtained by Hertz and Heaviside, are essential simplification in Maxwell equations in the quaternions, moreover this simplification relates not only to their mathematical form, but also (that most important!) to their physical content, since in this case equations were deprived naturally Galileo- invariance of inherent in them. Nevertheless for the concretely undertaken inertial reference system (but not their totality) the equivalence of formulations occurred, by virtue of which the formulation of Hertz-Heaviside it obtained the deserved acknowledgement of scientific association it extruded in the theoretical and applied research the formulation of Maxwell himself.

Despite the fact that Maxwell equations both in the formulation of Maxwell himself and in the formulation of Hertz- Heaviside, are obtained within the framework classical ideas about the space and of time, who use Galileo conversions, subsequently precisely of Maxwell equation they became the theoretical prerequisite of the creation of the special theory of relativity (SR). As convincingly shown, for example, in [2], be SR it consists of the identification of the natural geometry of the electromagnetic field, described by Maxwell equations, with the geometry of world physical space-time. And now already in the contemporary works on the electrodynamics (typical example – the work [3]) of Maxwell equation they are examined in the four-dimensional pseudo-Riemann space-time).

Is it possible to return to Maxwell equations the original Galileo- invariance within the framework of certain new, its kind of neoclassical ideas about the space and the time, without rejecting the use of an apparatus of vector analysis during writing of equations? In this work we will show that the answer to this question is affirmative.

II. Conceptual Approach

In the classical mechanics particle dynamics is described by the differential equations for its radius-vector, which use usual derivative of the second order on the time. Specifically, its use ensures the Galileo-invariance of equations. If we connect the set of massive material points by weightless elastic threads into the united string, i.e. fluctuation will be described by the Galileo- invariant system of differential equations. But if we complete passage to the limit, after fixing the number of material points to infinity, and their mass and the length of separate threads – to zero, then we will obtain the one-dimensional wave equation (equation of vibrations of string), not invariant relative to the Galileo conversions, but invariant relative to the group of pseudo-orthogonal conversions (hyperbolic turnings, which preserve pseudo-Euclidean certificate). The culprit of this strange and unexpected metamorphosis upon transfer from "material- point mechanics to continuous medium – this passage to the limit with the substitution by usual derivative to the quotient, which, generally speaking, is analytically legal 4], but it narrows the region of the physical applicability of equation. The real wave process of mechanical vibrations of string remains Galileo- invariant, but its equation is already deprived of the mathematical means of the description of passage from one inertial reference system to another, and completely ties process to one concrete frame of reference, attaching in it the ends of the string. So classics- field natural-science paradigm revealed fundamental contradiction between the continuity and the discretion [5-6], not overcome, until now, but led to the celebration in theoretical physics of the doubtful principle of the geometrization [7].

The discovery wave equation in the mechanics did not lead to the revision of ideas about the space and the time, but to this led the discovery the same equation in the electrodynamics. In the theory of relativity the corresponding group of pseudo-orthogonal conversions for the electromagnetic waves in the vacuum (Lorenz conversion) obtained status of the subgroup of the motion of the certificate of united world physical space-time. But appears doubt about the justification of the use of traditional equations of electrodynamics, in particular, wave equation, for the adequate extraction of them of ideas about the space and the time. Easily to assume that these equations, using partial derivatives of field functions on the time, similar to the equation of mechanical fluctuations, are simply deprived of the mathematical means of the adequate description of passage from one inertial reference system to another and so completely they tie process to one concrete frame of reference. The question of the possibility of the suitable refinement or generalizing the equations of electrodynamics so arises, beginning from the equations of the induction of electric field by magnetic and magnetic – electrical. The thorough study of this problem in [8] led to the appearance of an idea about the fact that this improvement of electrodynamics must assume existence of the dependence of electro-magnetic field on the speed of the motion of observer, caused not by the geometry of space-time, but by physical nature of field.

In the theory of relativity the electromagnetic field also depends on the speed of the motion of observer, but it is only defined by example through the dependence on it of the intervals of time and spatial distance (Lorenz conversion), the relativistic invariance of electric charge occurs result of which. However, the more fundamental (direct) dependence of field on the speed is cmbined with the dependence even absolute value of electric charge. Until recently this not invariance of charge was confirmed only by indirect empirical data, which were being consisted in the appearance of an electric potential on the superconductive windings and the tori during the introduction in them of direct current, or in the observation of the electric pulse of nuclear explosions [9].

In particular, 9 July 1962 with the explosion in space above Pacific Ocean of H-bomb with the TNT equivalent 1,4 Mt. according to the program of the USA «*Starfish* » the tension of electrical pour on she exceeded those forecast by Nobel laureate Bethe in 1000 once. with the explosion of nuclear charge according to the program "*Program K*", which was realized into the USSR, the radio communication and the radar installations were also blocked at a distance to 1000 km. It was discovered, that the registration of the consequences of space nuclear explosion was possible at the large (to 10 thousand kilometers) distances from the point of impact. The electric fields of pulse led to the large focusings to the power cable in the lead shell, buried at the depth about 1 m, which connects power station in Akmola with Alma-Ata. Focusings were so great that the automation opened cable from the power station.

However, 2015 was marked by the already direct experimental confirmation of this phenomenon as a result of detection and study of the pulse of the electric field, which appears with the warming-up of the plasma as a result of the discharge through the dischargers of the capacitors of great capacity [9]. It turned out that in the process of the warming-up of plasma with an equal quantity in it of electrons and positive ions in it the unitary negative charge of free electrons, not compensated by slower positive ions, is formed.

This fact contradicts not only the classical, but also relativistic conversions of electromagnetic field upon transfer from one inertial reference system to another, testifying about the imperfection not only of classical, but also relativistic ideas about the space and the time. Idea about the fact that the promising electrodynamics must assume existence of the dependence of electromagnetic field on the speed of the motion of observer, caused not by the geometry of space-time, and by physical nature of field, which does not assume the invariance of electric charge, was developed in a number of the work of F. F. Mende, beginning [8]. In these works, in particular, in [8, 9] is given the substantiation of introduction into the electrodynamics instead of the classical and relativistic new conversions of electromagnetic field, which was called the Mende conversions.

However, the sequential development of this radical idea, as not the invariance of charge, requires the deep revision of the mathematical apparatus for electrodynamics, called to the creation of the mathematical means of the more adequate description of passage from one inertial reference system to another. Approach to precisely this development of the mathematical apparatus for electrodynamics was proposed by A. S. Dubrovin in [10]. This approach lies within the framework the sequential revision of ideas about the space and the time with the failure of the relativistic and the passage to the new ideas, which we call gipercontinual.

The concept of time-spatial gipercontinuum is introduced in [11] as a result the joint study of the algebraic and geometric structures of the commutative algebras with one, elements of which are the functions of sine waves. The hypothesis of gipercontinuum (about the hierarchical gipercontinual structure of world physical space-time) is starting point of scientific studies, directed toward the generalization of ideas about the structure of space and time in the course of passage from the contemporary quantum scientific paradigm to the new system, that simultaneously structurally connecting up its framework continuity and the discretion, dynamicity and static character, and also globality and the locality [5, 6, 12]. The hierarchical quality of gipercontinuum limits the applicability of the conventional principle of geometrization in physics and the connected with it ideas of symmetry in the geometry due to the introduction into theoretical physics of the ideas of hierarchical quality [7,13], effectiveness of which have approved we with the creation of the standard model of the protected automated system (EMZAS) and the mathematical apparatus of the EMZAS- networks [14].

In [10] is proposed new approach to the development of the mathematical apparatus for electrodynamics in the direction of the more adequate description of passage from one inertial reference system to another on the basis of giperkontinualnykh ideas about the space and in the time due to the improvement of differential calculus of the field functions under the assumption of their dependence on the speed of the motion of observer. Let us accept for the basis this approach.

III. Mathematical Apparatus for the Transcoordinate Electrodynamics

Two inertial reference systems with the time united for them will examine $t \in \mathbb{R}$. one of them (with the system of rectangular Cartesian space coordinates $OXYZ$) let us name laboratory (not shtrikhovannoy) and we will interpret it as relatively fixed. The second (with the system of rectangular Cartesian space coordinates $O'X'Y'Z'$) let us name substantive (shtrikhovannoy) and we will interpret it as connected with the certain moving real or imaginary medium. Let us assume that with $t = 0$ the system of space coordinates of both frame of references they coincide. Let us introduce the indices $\alpha = \overline{1,3}$ $\beta = \overline{1,3}$. Coordinates along the axes OX, OY OZ $O'X'$ $O'Y'$, $O'Z'$ we will assign by variables x^{α} and x'^{α} respectively. Unit vectors along the axes OX and $O'X'$, the axes OY and $O'Y'$, the axes OZ $O'Z'$ let us designate through $\mathbf{e}_{\beta} = \left(e_{\beta}^{\alpha}\right)$, moreover $e_{\beta}^{\alpha} = \delta_{\alpha\beta}$, where $\delta_{\alpha\beta}$ – Kronecker's symbol. Through $\mathbf{v} = \left(v^{\alpha}\right)$ v let us designate the velocity vector of the motion of substantive frame of reference relative to laboratory and the module of this vector. Directing a unit vector $\mathbf{e}_1$ $\mathbf{v}$, we lengthwise have: $\mathbf{v} = v\mathbf{e}_1 = \left(v^{\alpha}\right)$, $v^{\alpha} = v\delta_{\alpha 1}$. Event in the data two frame of references takes the form $\mathbf{x} = (\mathbf{r}, t) = \left(x^{\alpha},\ t\right)$; $\mathbf{x}' = (\mathbf{r}', t) = \left(x'^{\alpha}, t\right)$, where $\mathbf{r} = \left(x^{\alpha}\right)$, $\mathbf{r}' = \left(x'^{\alpha}\right)$ – the radius-vectors. We will consider that the physical equivalence of events $\mathbf{x}$ $\mathbf{x}'$ indicates the validity of the Galileo conversion

$$\mathbf{r} = \mathbf{r}' + t\mathbf{v}, \tag{1}$$

or, otherwise, substituting vector idea by the component,

$$x^{\alpha} = x'^{\alpha} + tv\delta_{\alpha 1} \tag{2}$$

Classical physical field is described in the laboratory and substantive frame of references by its field functions $\Phi(\mathbf{r}, t)$ and $\Phi'(\mathbf{v}, \mathbf{r}', t)$, moreover $\Phi'(\mathbf{0}, \mathbf{r}', t) = \Phi(\mathbf{r}', t)$, and equality $\mathbf{v} = \mathbf{0}$ indicates $v^{\alpha} = 0$. Their values are called field variables. For pour on different physical nature they can be suitable the different mathematical ideas of field functions, so that field variables can be, for example, scalar or vector with the material or complex values of their most variable or vector components. If in the role of this field electric field comes out, then in this role can come out the functions of its tension $\mathbf{E} = \Phi(\mathbf{r}, t)$, $\mathbf{E}' = \Phi'(\mathbf{v}, \mathbf{r}', t)$, and in the case of magnetic field we have functions of the magnetic induction $\mathbf{B} = \Phi(\mathbf{r}, t)$,

$$\mathbf{B}' = \Phi'(\mathbf{v}, \mathbf{r}', t).$$

In the classical nonrelativistic field theory it is considered that the equality occurs

$$\Phi(\mathbf{r}' + t\mathbf{v}, t) = \Phi'(\mathbf{v}, \mathbf{r}', t), \quad (3)$$

mathematically expressing the physical concept of the invariance of field relative to the speed of the motion of observer. In the theory of relativity (3) no longer it is carried out, but the Lorenz conversions are used instead of the Galileo conversions. But this not invariance of field does not have fundamental, that not connected with the geometry of the space-time of physical nature, but it occurs simply the consequence of the effects of the reduction of lengths and time dilation in the moving frame of references. The proposed by us gipercontinual ideas about the space and the time [11] provide for the great possibilities of the invariance of various physical processes relative to various transformation groups of coordinates with the fact that special role in time-spatial gipercontinuum play the Galileo conversions (1), since they in this case they treat as the level Lorenz conversions of infinitely high level and, thus, they make it possible in a united manner to synchronize all events in all separate continua, hierarchically structure into united gipercontinuum. Natural to consider that in giperkontinuume the field also not is invariant relative to the speed of the motion of observer, but to explain this by the already fundamental properties of field, not connected with the geometry of separate continua.

A rises the question about the possible versions of complete differentiation concerning the time of field function in the laboratory frame of reference $\Phi(\mathbf{r}, t)$, of that produced depending on substantive frame of reference. In fluid mechanics and classical mechanics widely is used the derivative of Lagrange (the substantional derivative), which has the same arguments as the initial field function:

$$\frac{d\,\Phi(\mathbf{r}', t)}{dt} = \frac{d\,\Phi(\mathbf{r}' + t\mathbf{v}, t)}{dt} = \lim_{\Delta t \to 0} \frac{\Phi(\mathbf{r}' + (t + \Delta t)\mathbf{v}, t + \Delta t) - \Phi(\mathbf{r}' + t\mathbf{v}, t)}{\Delta t} \quad (4)$$

But it is possible to examine also the derivative (let us name its Galileo derivative), whose arguments will coincide with the arguments of field function no longer in the laboratory, but in the substantive frame of reference:

$$\frac{\partial'\Phi}{\partial t}(\mathbf{v}, \mathbf{r}', t) = \frac{d\,\Phi(\mathbf{r}' + t\mathbf{v}, t)}{dt} = \lim_{\Delta t \to 0} \frac{\Phi(\mathbf{r}' + (t + \Delta t)\mathbf{v}, t + \Delta t) - \Phi(\mathbf{r}' + t\mathbf{v}, t)}{\Delta t} \quad (5)$$

If the arguments of the Lagrange and Galileo derivatives are connected with equality (1), that their corresponding values are equal and are decomposed into one and the same sum of quotient on the time and the convective derivative of field function in the laboratory frame of reference:

$$\frac{\partial'\Phi}{\partial t}(\mathbf{v}, \mathbf{r}', t)' = \frac{d\,\Phi(\mathbf{r}, t)}{dt} = \frac{\partial\,\Phi(\mathbf{r}' + t\mathbf{v}, t)}{\partial t} + (\mathbf{v} \cdot \nabla)\Phi(\mathbf{r}' + t\mathbf{v}, t) \quad (6)$$

Let us explain a difference in the physical sense of the Lagrange and Galilean derivatives of field function. Lagrange's derivative (4) is complete time derivative of the function of field in the laboratory frame of reference, measured at the point of space, which in the laboratory frame of reference at the moment of time t has a radius-vector $\mathbf{r}$, determined by the equality (1). But Galileo derivative (5) is complete time derivative of the function of field in the laboratory frame of reference, measured at the point of space, which in the substantive frame of reference has a radius- vector $\mathbf{r}'$. The concepts of Lagrange and Galilean derivatives (4)-(6) naturally are generalized to the case derivative of higher order ($n = \overline{1, \infty}$):

$$\frac{d^1\,\Phi(\mathbf{r}, t)}{dt^1} = \frac{d\,\Phi(\mathbf{r}, t)}{dt}; \quad \frac{d^{n+1}\,\Phi(\mathbf{r}, t)}{dt^{n+1}} = \frac{d}{dt}\,\frac{d^n\,\Phi(\mathbf{r}, t)}{dt^n};$$

$$\frac{\partial'^1\Phi}{\partial t^1}(\mathbf{v}, \mathbf{r}', t) = \frac{\partial'\Phi}{\partial t}(\mathbf{v}, \mathbf{r}', t); \quad \frac{\partial'^n\Phi}{\partial t^n}(\mathbf{v}, \mathbf{r}', t) = \frac{d^n\,\Phi(\mathbf{r}, t)}{dt^n}.$$

.Within the framework concepts of the invariance of field relative to the speed of the motion of observer, i.e., with fulfillment condition (3), we have:

$$\frac{\partial'\Phi}{\partial t}(\mathbf{v}, \mathbf{r}', t) = \frac{d\,\Phi(\mathbf{r}' + t\mathbf{v}, t)}{dt} = \frac{d\,\Phi'(\mathbf{v}, \mathbf{r}', t)}{dt} = \frac{\partial\,\Phi'(\mathbf{v}, \mathbf{r}', t)}{\partial t} \quad (7)$$

i.e., Galileo derivative of field in the laboratory frame of reference is not distinguished from the particular time derivative of the function of field in the substantive frame of reference. Therefore introduction within the framework to this concept of the Galileo derivative as some new mathematical object with its independent physical sense, is superfluous. However, within the framework relativistic ideas examination by Galileo's derivative is empty because of the emptiness of very Galileo conversions (in contrast to the Lorenz conversions). But giperkontinual ideas about the space and the time make Galilean derived completely by that claimed, and equality (7) – to false.

This view on the space, the period and the electromagnetic field in conjunction with the application of Galileo's derivative leads to the new, trans-coordinate formulation of the electrodynamics 10. It generalizes the conventional formulation of Hertz- Heaviside, which will be examined below.

IV. Mathematical Models of the Electromagnetic Field

Electromagnetic field in the isotropic homogeneous medium without the dispersion is described in the laboratory and substantive frame of references by its variables (tension of electric field $\mathbf{E}=\left(E^{\alpha}\right)$, $\mathbf{E}'=\left(E'^{\alpha}\right)$ and magnetic induction $\mathbf{B}=\left(B^{\alpha}\right)$, $\mathbf{B}'=\left(B'^{\alpha}\right)$), by constants (electrical ε_0 and magnetic μ_0, and also expressed as them speed of light in the vacuum $c=1\big/\sqrt{\varepsilon_0\mu_0}$), by the parameters (dielectric and magnetic constant ε and μ, and also the density of strange electric charge ρ, ρ' the electric current density of conductivity $\mathbf{j}=\left(j^{\alpha}\right)$, $\mathbf{j}'=\left(j'^{\alpha}\right)$, electric charge Q, Q', electric current I, I'), by field functions $\mathbf{E}=\mathbf{E}(\mathbf{r},t)=\left(E^{\alpha}(\mathbf{r},t)\right)$, $\mathbf{B}=\mathbf{B}(\mathbf{r},t)=\left(B^{\alpha}(\mathbf{r},t)\right)$, $\mathbf{E}'=\mathbf{E}'(v,\mathbf{r}',t)=\left(E'^{\alpha}(v,\mathbf{r}',t)\right)$, $\mathbf{B}'=\mathbf{B}'(v,\mathbf{r}',t)=\left(B'^{\alpha}(v,\mathbf{r}',t)\right)$, moreover

$$\mathbf{E}'(0,\mathbf{r}',t)=\mathbf{E}(\mathbf{r}',t);\ \mathbf{B}'(0,\mathbf{r}',t)=\mathbf{B}(v,\mathbf{r}',t). \tag{8}$$

In the classical nonrelativistic electrodynamics it is relied:

$$\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)=\mathbf{E}'(v,\mathbf{r}',t);$$
$$\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)=\mathbf{B}'(v,\mathbf{r}',t), \tag{9}$$

what is the application of a general formula (3) of the invariance of field relative to the speed of the motion of observer for the case of electromagnetic field. The proposed by us giperkontinualnye ideas about the space and the time [11] exceed the scope of this concept, but is explained nature of this not invariance not by the geometry of united space-time similar to the theory of relativity, but by the fundamental properties of field.

The integral form of Maxwell equations in the idea of Hertz-Heaviside with the above-indicated conditions (isotropy, the uniformity of medium, the absence in it of dispersion) is the following system of four integral equations of the electrodynamics:

$$\oint_s \mathbf{E}\cdot ds=\mathrm{Q}/(\varepsilon\varepsilon_0);\ \oint_s \mathbf{B}\cdot ds=0;\ \oint_l \mathbf{E}\cdot dl=-\frac{d}{dt}\int_s \mathbf{B}\cdot ds;\ \frac{c^2}{\varepsilon\mu}\oint_l \mathbf{B}\cdot dl=\frac{\mathrm{I}}{\varepsilon\varepsilon_0}+\frac{d}{dt}\int_s \mathbf{E}\cdot ds, \tag{10}$$

where s, l – the arbitrary two-dimensional closed (for the first two equations) or open (for the second two equations) surface and its limiting locked outline, which not not compulsorily coincides with the electric circuit.
If we on Wednesday put the even additional condition of the absence of free charges and currents, then last two equations (10) will take the form:

$$\oint_l \mathbf{E}\cdot dl=-\frac{d}{dt}\int_s \mathbf{B}\cdot ds,\ \oint_l \mathbf{B}\cdot dl=\frac{\varepsilon\mu}{c^2}\frac{d}{dt}\int_s \mathbf{E}\cdot ds. \tag{11}$$

They are the integral form of the law of the induction of Faraday and circulation theorem of magnetic field in the laboratory frame of reference for this special case of medium.

These two laws take the mutually symmetrical form with an accuracy to of scalar factor, by virtue of which their analysis it is identical. Let us examine the first law in more detail, for example. In Faraday experiences it is experimentally established that in the outline the identical currents appear regardless of the fact, this outline relative to the current carrying outline does move or it rests, and the current carrying outline moves, provided their relative motion in both cases was identical (Galilean invariance of Faraday law). Therefore the flow through the outline can change as a result of a change of the magnetic field with time, and the position of its boundary also because with the displacement of outline changes [15]. The corresponding generalization of laws (11) to the case of the outline, which moves in the laboratory and which is rested in the substantive frame of reference, takes the form:

$$\oint_l \mathbf{E}'\cdot dl=-\frac{d}{dt}\int_s \mathbf{B}\cdot ds,\ \oint_l \mathbf{B}'\cdot dl=\frac{\varepsilon\mu}{c^2}\frac{d}{dt}\int_s \mathbf{E}\cdot ds, \tag{12}$$

where $\mathbf{E}'$ $\mathbf{B}'$ are described fields in the element dl in the substantive frame of reference, i.e., in such inertial

Global Journal of Researches in Engineering (F) Volume XVI Issue II Version I Year 2016

reference system, in which dl it rests; specifically, such electric field causes the appearance of a current in the case of the presence of real electric circuit in this place. Equations (12) are completely interesting and uncommon from a mathematical point of view, since they mutually connect field variables in the different inertial reference systems (let us name such equations trans-coordinate). Specifically, the use of trans-coordinate equations makes it possible to adequately describe physical fields in giperkontinuume. At the same time in this case the discussion deals not simply about the trans-coordinateawn of equations (12), and with their global trans-coordinateawn, ensured by use by the Galilean derivative (connected by them inertial reference systems they can move relative to each other with the arbitrary speed, and not compulsorily with infinitely small).

Returning to the system of equations (10), it is possible to establish that the region of its applicability is limited by the requirement of the state of rest of outline l in the laboratory frame of reference. If we remove this limitation, after requiring only the states of rest of outline l in the substantive frame of reference, then will come out the known idea of Maxwell equations (we we call his trans-coordinate 10), integral form of which will be in it the system of the generalizing (10) four integral equations of the electrodynamics of the moving media:

$$\oint_s \mathbf{E}\cdot d\mathbf{s} = \mathrm{Q}/(\varepsilon\varepsilon_0);\quad \oint_s \mathbf{B}\cdot d\mathbf{s} = 0;\quad \oint_l \mathbf{E}'\cdot d\mathbf{l} = -\frac{d}{dt}\int_s \mathbf{B}\cdot d\mathbf{s};\quad \frac{c^2}{\varepsilon\mu}\oint_l \mathbf{B}'\cdot d\mathbf{l} = \frac{\mathrm{I}'}{\varepsilon\varepsilon_0} + \frac{d}{dt}\int_s \mathbf{E}\cdot d\mathbf{s} \tag{13}$$

If the transcoordinate idea of the equations of Maxwell (both in that examined by integral and in that examined lower than the differential forms) to interpret in the context of the description of electromagnetic field in time-spatial gipercontinuum, then it is necessary to consider that the equalities (8) are always carried out, but (9) – in the general case no.

Equations (12) (13) are known in the classical electrodynamics [15, 16]. Arises question, as to pass from the equations in the integral form (12) and (13) to the corresponding to equations in the differential form adequate of physical reality by means.

The differential form of Maxwell equations in the idea of Hertz- Heaviside is following system of four of those corresponding to the integral equations (10) of the differential equations of electrodynamics, which relate to the laboratory frame of reference:

$$\nabla\cdot\mathbf{E} = \rho/(\varepsilon\varepsilon_0);\ \nabla\cdot\mathbf{B} = 0;\ \nabla\times\mathbf{E} = -\partial\mathbf{B}/\partial t;\ \nabla\times\mathbf{B} = \mu\mu_0\mathbf{j} + (\varepsilon\mu/c^2)(\partial\mathbf{E}/\partial t) \tag{14}$$

. Equations (14) traditionally successfully are used in the electrodynamics, but, as it will be shown below, they have essential deficiency – the region of their applicability it is limited by the case of agreeing the laboratory and substantive frame of references $(v = 0)$, i.e. these equations are deprived of the mathematical means of the adequate description of passage from one inertial reference system to another, completely tying process to one (laboratory) frame of reference.

In [15] based on the example of Faraday law is formulated the following approach to the passage from the integral to the differential form of equations electrodynamics: “Faraday law can be written down also in the differential form, if we use ourselves the Stokes' theorem and to consider outline as that being resting in the selected frame of reference (so that $\mathbf{E}$ and $\mathbf{B}$ they would be determined in one and the same frame of reference)”. This approach answers the concept of the invariance of physical field relative to the speed of the motion of observer, assuming simple failure of the trans-coordinateawn of equations by means of the application (9). But, rejecting this concept, it is necessary to reject this approach. Thus, the differential form of the corresponding equations must be the same trans-coordinate as integral (12), (13).

In accordance with the given traditional approach, in [16] is introduced the operation of differentiation with respect to time in the moving (substantive) frame of reference, designated there through $\partial'/\partial t$. In this case it is secretly assumed that at the point of space, which in the substantive frame of reference has a radius-vector $\mathbf{r}'$, measurement by field variable in the laboratory frame of reference equivalent to its measurement in the same substantive frame of reference. But these measurements are not equivalent out of the concept of the invariance of physical field relative to the speed of the motion of observer. Therefore measurement must be limited by laboratory frame of reference, not perenosya its results for the substantive. Thus, we come to the Galileo derivative (5), of the electrodynamics in the differential form leaving equations globally transcoordinate.

Unknown globally transcoordinate differential equations of electrodynamics, which correspond to integral equations (12) and which use the Galileo derivative:

$$\nabla\times\mathbf{E}' = -\frac{\partial'\mathbf{B}}{\partial t},\ \nabla\times\mathbf{B}' = \frac{\varepsilon\mu}{c^2}\frac{\partial'\mathbf{E}}{\partial t}. \tag{15}$$

They are generalization to the case of the noncoincidence of the laboratory and substantive frame of references ($\mathbf{v} \neq \mathbf{0}$) of the known differential equations of Maxwell

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t}, \nabla \times \mathbf{B} = \frac{\varepsilon\mu}{c^2}\frac{\partial \mathbf{E}}{\partial t}. \quad (16)$$

The differential form of Maxwell equations in the trans-coordinate idea for the case of isotropic, homogeneous medium without the dispersion is the following system of four new globally trans-coordinate differential equations of the electrodynamics:

$$\nabla \cdot \mathbf{E}(\mathbf{r},t) = \frac{\rho(\mathbf{r},t)}{\varepsilon\varepsilon_0}; \nabla \cdot \mathbf{B}(\mathbf{r},t) = 0; \quad (17)$$

$$\nabla \times \mathbf{E}'(v,\mathbf{r}',t) = -\frac{\partial' \mathbf{B}}{\partial t}(v,\mathbf{r}',t);$$

$$\nabla \times \mathbf{B}'(v,\mathbf{r}',t) = \mu\mu_0 \mathbf{j}'(v,\mathbf{r}',t) + \frac{\varepsilon\mu}{c^2}\frac{\partial' \mathbf{E}}{\partial t}(v,\mathbf{r}',t), \quad (18)$$

where $\partial'\mathbf{E}/\partial t$, $\partial'\mathbf{B}/\partial t$ – the Galileo derivatives of field functions, expressed as particular time derivatives and convective derivatives of the same field functions in the laboratory frame of reference by the following equalities:

$$\frac{\partial' \mathbf{E}}{\partial t}(v,\mathbf{r}',t) = \frac{\partial \mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)}{\partial t} + (v\mathbf{e}_1 \cdot \nabla)\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t) \quad (19)$$

$$\frac{\partial' \mathbf{B}}{\partial t}(v,\mathbf{r}',t) = \frac{\partial \mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)}{\partial t} + (v\mathbf{e}_1 \cdot \nabla)\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t) \quad (20)$$

With $v = 0$ (17)-(18) it passes in (14).

In the particular case the absences of free charges and currents of equation (17)-(18) will take the form:

$$\nabla \cdot \mathbf{E}(\mathbf{r},t) = 0; \nabla \cdot \mathbf{B}(\mathbf{r},t) = 0; \quad (21)$$

$$\nabla \times \mathbf{E}'(v,\mathbf{r}',t) = -\frac{\partial' \mathbf{B}}{\partial t}(v,\mathbf{r}',t)\ \nabla \times \mathbf{B}'(v,\mathbf{r}',t) = \frac{\varepsilon\mu}{c^2}\frac{\partial' \mathbf{E}}{\partial t}(v,\mathbf{r}',t) \quad (22)$$

With $v = 0$ (21)-(22) it passes into the well-known system of equations of Maxwell:

$$\nabla \cdot \mathbf{E}(\mathbf{r},t) = 0;\ \nabla \cdot \mathbf{B}(\mathbf{r},t) = 0;\ \nabla \times \mathbf{E}(\mathbf{r},t) = -\frac{\partial \mathbf{B}(\mathbf{r},t)}{\partial t};\ \nabla \times \mathbf{B}(\mathbf{r},t) = \frac{\varepsilon\mu}{c^2}\frac{\partial \mathbf{E}(\mathbf{r},t)}{\partial t}. \quad (23)$$

By the vector product of nabla to both parts of the equations (16) with their mutual substitution into each other obtains the known wave differential equations

$$c^2\nabla^2\mathbf{E} = \varepsilon\mu\frac{\partial^2 \mathbf{E}}{\partial t^2}, c^2\nabla^2\mathbf{B} = \varepsilon\mu\frac{\partial^2 \mathbf{B}}{\partial t^2} \quad (24)$$

The absence of trans-coordinateawn is their drawback, they are valid only in the case of agreeing the laboratory and substantive frame of references ($\mathbf{v} = \mathbf{0}$). It is analogous, i.e., by the vector product of nabla to both parts of the equations (15) with their mutual substitution into each other, we will obtain the new equations of electrodynamics – the globally trans-coordinate wave differential equations, which use Galilean derivative of field functions and generalizing equations (24) in the case $\mathbf{v} \neq \mathbf{0}$:

$$c^2\nabla^2\mathbf{E}' = \varepsilon\mu\frac{\partial'^2 \mathbf{E}}{\partial t^2}, c^2\nabla^2\mathbf{B}' = \varepsilon\mu\frac{\partial'^2 \mathbf{B}}{\partial t^2}. \quad (25)$$

We investigate in more detail the equation of form (25) in connection with to arbitrary field functions $\Phi(x,t)$, also, $\Phi'(v,x',t)$ for the case of plane wave with the wave vector, collinear to vector $\mathbf{v} = (v,0,0)$ and to axes OX , $O'X'$, coordinates along which are assigned by the variables x, x'. In this case the equation proves to be one-dimensional, and field functions – scalar:

$$c^2\frac{\partial^2}{\partial x'^2}\Phi'(v,x',t) = \varepsilon\mu\frac{\partial'^2\Phi}{\partial t^2}(v,x',t) = \varepsilon\mu\frac{d^2}{dt^2}\Phi(x'+vt,t) \quad (26)$$

If we differentiate in the right side (26), this equation of signs the form:

$$\frac{c^2}{\varepsilon\mu}\frac{\partial^2}{\partial x'^2}\Phi'(v,x',t) = \left(\frac{\partial^2}{\partial t^2} + 2v\frac{\partial^2}{\partial t\partial x} + v^2\frac{\partial^2}{\partial x^2}\right)\Phi(x'+vt,t) = \left(\frac{\partial}{\partial t} + v\frac{\partial}{\partial x}\right)^2\Phi(x'+vt,t) \quad (27)$$

With $v=0$ (26) (27) it degenerates into the one-dimensional version of the wave equation of the form (24):

$$c^2 \frac{\partial^2}{\partial x^2}\Phi(x,t)=\varepsilon\mu\frac{\partial^2}{\partial t^2}\Phi(x,t). \qquad (28)$$

Any solution (28) is determined by the proper superposition of the simple harmonic waves

$$\Phi(x,t)=A\cos(\omega t-k_x x+\varphi) \qquad (29)$$

with the approximate values of the parameters $A\geq 0$, $\omega>0$, $k_x\neq 0$, $\varphi\in\mathbb{R}$ – amplitude, angular frequency, the projection of wave vector on the axis OX and the initial phase of wave. In this case all waves (29) must have one and the same phase speed $\omega/k=c/\sqrt{\varepsilon\mu}$, where $k=|k_x|$ – wave number. We will search for function $\Phi'(v,x',t)$, satisfying (26)-(29), also in the form of simple harmonic wave, but with those depending on v by the parameters $A'(v)$, $\omega'(v)$ $k'_x(v)$, $\varphi'(v)$:

$$\Phi'(v,x',t)=A'(v)\cos(\omega'(v)t-k'_x(v)x'+\varphi'(v)) \qquad (30)$$

$\Phi'(0,x',t)=\Phi(x',t)$, $A'(0)=A$, $\omega'(0)=\omega$, $k'_x(0)=k_x$, $\varphi'(0)=\varphi$. Let us substitute (29)-(30) in

$$c^2k'^2_x(v)A'(v)\cos(\omega'(v)t-k'_x(v)x'+\varphi'(v))=\varepsilon\mu(\omega-k_xv)^2A\cos(\omega t-k_x(x'+vt)+\varphi). \qquad (31)$$

Equalizing the similar parameters of wave on the left side (31) and in the right, we have:

$$A'(v)=\left(\operatorname{sgn}k_x-\frac{\sqrt{\varepsilon\mu}}{c}v\right)^2A,\ \omega'(v)=|\omega-k_xv|=\left|1-\frac{\sqrt{\varepsilon\mu}}{c}v\operatorname{sgn}k_x\right|\omega \qquad (32)$$

$$k'_x(v)=k_x\operatorname{sgn}(\omega-k_xv),\ k'(v)=|k'_x(v)|=k,\ \varphi'(v)=\varphi\operatorname{sgn}(\omega-k_xv),\ |\varphi'(v)|=|\varphi|. \qquad (33)$$

Thus, upon transfer from the laboratory to the substantive frame of reference change amplitude and frequency (32) of simple harmonic wave, and its wave number and module of initial phase (33) remain constant. In this case the frequency changes in such a way that phase wave velocity in the substantive frame of reference is obtained according to the classical summation rule of speeds from its phase speed in the laboratory frame of reference and speed of substantive frame of reference relative to the laboratory:

$$\omega'(v)/k'_x(v)=\omega'(v)/k_x=\omega/k_x-v,\ \omega'(v)/k'(v)=|\omega/k-v\operatorname{sgn}k_x|=\left|c/\sqrt{\varepsilon\mu}-v\operatorname{sgn}k_x\right|. \qquad (34)$$

From (32)-(34) it is evident that if the vector of phase wave velocity in the laboratory frame of reference coincides with the velocity vector of substantive frame of reference in it ($k_x>0$, $v=\omega/k$), that in the substantive frame of reference wave generally disappears ($A'(v)=0$). Thus, in contrast to the theory of relativity, in the theory of gipercontinuum this wave always can be destroyed by the suitable selection of frame of reference. But if relative to laboratory frame of reference substantial frame of reference outdistances wave, then upon transfer from the laboratory frame of reference to the substantive the direction of propagation of wave changes by the opposite. If in the laboratory frame of reference wave is propagated in the positive direction, then upon transfer into the substantive it will satisfy wave equation (35), while if in the negative, then to the equation (36):

$$\left(c/\sqrt{\varepsilon\mu}-v\right)^2\partial^2\Phi'(v,x',t)/\partial x'^2=\partial^2\Phi'(v,x',t)/\partial t^2 \qquad (35)$$

$$\left(c/\sqrt{\varepsilon\mu}+v\right)^2\partial^2\Phi'(v,x',t)/\partial x'^2=\partial^2\Phi'(v,x',t)/\partial t^2 \qquad (36)$$

The selection of inertial reference system to the role of laboratory is, generally speaking, conditional. Thus, substantial frame of reference it is possible in turn to accept for the laboratory, and in the role of substantial to examine certain by third (twice prime) inertial reference system with that directed to the same side, that also OX, $O'X'$, by attitude reference $O''X''$, the coordinate along which is assigned by the variable

x'' .Let, for example, the point O'' move in the positive direction of axis $O'X'$ with the speed Δv . Wave in the new laboratory and substantive frame of references will have an identical wave number and a module of initial phase and will be described by field functions $\Phi'(v,x',t)$ and $\Phi'(v+\Delta v,x'',t)$ respectively. The role of equation (28) plays (35) or (36), the role of the function of wave (29) – function (30), while the role of equations (35), (36) – the following wave equations:

$$\left(c/\sqrt{\varepsilon\mu}-(v+\Delta v)\right)^2 \partial^2\Phi'(v+\Delta v,x'',t)/\partial x''^2=\partial^2\Phi'(v+\Delta v,x'',t)/\partial t^2 \tag{37}$$

$$\left(c/\sqrt{\varepsilon\mu}+(v+\Delta v)\right)^2 \partial^2\Phi'(v+\Delta v,x'',t)/\partial x''^2=\partial^2\Phi'(v+\Delta v,x'',t)/\partial t^2 \tag{38}$$

For (37) the role of equalities (32), (33) play the following transformations of the parameters of the wave:

$$A''(v+\Delta v)=\left(\operatorname{sgn}k'_x(v)-\frac{\sqrt{\varepsilon\mu}\cdot\Delta v}{c-\sqrt{\varepsilon\mu}\cdot v}\right)^2 A'(v),\ \omega''(v+\Delta v)=\left|\omega'(v)-k'_x(v)\right|\Delta v, \tag{39}$$

$$k''_x(v+\Delta v)=k'_x(v)\operatorname{sgn}(\omega'(v)-k'_x(v)\Delta v),\ \varphi''(v+\Delta v)=\varphi'(v)\operatorname{sgn}(\omega'(v)-k'_x(v)\Delta v) \tag{40}$$

For (38) the corresponding (39)-(40) conversions of the parameters are determined analogously.

Sequential passage from not shtrikhovannoy to shtrikhovannoy and is further to the twice shtrikhovannoy frame of reference equivalent to direct passage from not shtrikhovannoy to twice shtrikhovannoy. For example, with $\operatorname{sgn}k'_x(v)=\operatorname{sgn}k_x=1$ from (32), (39) it is possible to obtain

$$A''(v+\Delta v)=\left(1-\sqrt{\varepsilon\mu}\,(v+\Delta v)/c\right)^2 A, \tag{41}$$

which is obtained also upon direct transfer to the twice shtrikhovannoy frame of reference, since (41) it is obtained from (32) by replacement v on $v+\Delta v$. In this case the role of equation (27) plays

$$\left(\frac{c}{\sqrt{\varepsilon\mu}}-v\right)^2\frac{\partial^2\Phi'(v+\Delta v,x'',t)}{\partial x''^2}=\frac{\partial^2\Phi'(v,x''+\Delta vt,t)}{\partial t^2}+\left(2\Delta v\frac{\partial^2}{\partial t\partial x'}+\Delta v^2\frac{\partial^2}{\partial x'^2}\right)\Phi'(v,x''+\Delta vt,t). \tag{42}$$

For the derivatives of arbitrary n of order $\partial^n\Phi'(v+\Delta v,x'',t)/\partial x''^n$ $\partial^n\Phi'(v,x',t)/\partial x'^n$ it is possible to use a united designation $\partial^n\Phi'(v+\Delta v,x,t)/\partial x^n$ and $\partial^n\Phi'(v,x,t)/\partial x^n$ $n=\overline{1,\infty}$), respectively indicating simply derived on the second argument. In accordance with this, after substitution (35) in (42) we will obtain:

$$\left(\frac{c}{\sqrt{\varepsilon\mu}}-v\right)^2\frac{\partial^2}{\partial x^2}\left(\frac{\Phi'(v+\Delta v,x,t)-\Phi'(v,x+\Delta vt,t)}{\Delta v}\right)=\left(2\frac{\partial^2}{\partial t\partial x}+\Delta v\frac{\partial^2}{\partial x^2}\right)\Phi'(v,x+\Delta vt,t) \tag{43}$$

Let $\Delta v\to 0$. Let us introduce one additional new derivative, which let us name trans-coordinate, and which in the case of the one-dimensional system of space coordinates takes the form:

$$\frac{\partial'\Phi'(v,x,t)}{\partial' v}=\lim_{\Delta v\to 0}\frac{\Phi'(v+\Delta v,x,t)-\Phi'(v,x+\Delta vt,t)}{\Delta v}. \tag{44}$$

In the determination (44) of value $\Phi'(v,x+\Delta vt,t)$ $\Phi'(v+\Delta v,x,t)$ is described physical field at one and the same point of space, but in the different frame of references (shtrikhovannoy and moving relative to it with speed Δv twice prime respectively). Within the framework they are equal to the concept of the invariance of field relative to the speed of the motion of observer:

$$\Phi'(v,x+\Delta vt,t)=\Phi'(v+\Delta v,x,t) \tag{45}$$

the equalities (3) (45) making identical physical sense, but in connection with to the different pairs of frame of references. However, out of the framework of the indicated concept upon transfer from shtrikhovannoy to the twice shtrikhovannoy frame of reference the field function at the particular point of space experiences the increase, the limit of relation of which k Δv with $\Delta v\to 0$ gives the trans-coordinate derivative (44). It is possible to generalize it to the case of the higher orders ($n=\overline{1,\infty}$):

$$\frac{\partial'^1 \Phi'(v,x,t)}{\partial' v^1}=\frac{\partial' \Phi'(v,x,t)}{\partial' v};\qquad \frac{\partial'^{n+1} \Phi'(v,x,t)}{\partial' v^{n+1}}=\lim_{\Delta v\to 0}\frac{\dfrac{\partial'^n \Phi'(v+\Delta v,x,t)}{\partial' v^n}-\dfrac{\partial'^n \Phi'(v,x+\Delta vt,t)}{\partial' v^n}}{\Delta v} \tag{46}$$

Using trans-coordinate derivatives of the first two orders (46), it is possible to represent increase in the field function of in the form corresponding partial summation of series of Taylor:

$$\Phi'(v+\Delta v,x,t)-\Phi'(v,x+\Delta vt,t)\approx \frac{\partial' \Phi'(v,x,t)}{\partial' v}\Delta v+\frac{1}{2}\frac{\partial'^2 \Phi'(v,x,t)}{\partial' v^2}\Delta v^2 \tag{47}$$

Substituting (47) in (43), equalizing between themselves members with the identical degrees Δv in the left and right sides of the received equality, fixing $\Delta v\to 0$, taking into account that the fact that in this case $\Phi'(v,x+\Delta vt,t)\to\Phi'(v,x,t)$ and by adding equality (35) in the new form of record (with the use by variable x instead of x' , we will obtain the following system of three equations:

$$\begin{cases}\left(\dfrac{c}{\sqrt{\varepsilon\mu}}-v\right)^2\dfrac{\partial^2 \Phi'(v,x,t)}{\partial x^2}=\dfrac{\partial^2 \Phi'(v,x',t)}{\partial t^2},\\[2ex] \left(\dfrac{c}{\sqrt{\varepsilon\mu}}-v\right)^2\dfrac{\partial\partial' \Phi'(v,x,t)}{\partial x\partial' v}=2\dfrac{\partial \Phi'(v,x',t)}{\partial t},\\[2ex] \left(\dfrac{c}{\sqrt{\varepsilon\mu}}-v\right)^2\dfrac{\partial'^2 \Phi'(v,x,t)}{\partial' v^2}=2\Phi'(v,x',t)\end{cases} \tag{48}$$

System of equations (48) can be written down in following that indexed on α the form:

$$\left(\left(\frac{c}{\sqrt{\varepsilon\mu}}-v\right)^2\frac{\partial^{2-\alpha}\partial'^{\alpha}}{\partial x^{2-\alpha}\partial' v^{\alpha}}-2^{\operatorname{sgn}\alpha}\frac{\partial^{2-\alpha}}{\partial t^{2-\alpha}}\right)\Phi'(v,x',t)=0,\qquad \alpha=\overline{0,2} \tag{49}$$

or in the operator form

$$\circledast\Phi'(v,x',t)=0 \tag{50}$$

where $\circledast=(\circledast^{\alpha});\ \circledast^{\alpha}=\left(\left(\dfrac{c}{\sqrt{\varepsilon\mu}}-v\right)^2\dfrac{\partial^{2-\alpha}\partial'^{\alpha}}{\partial x^{2-\alpha}\partial' v^{\alpha}}-2^{\operatorname{sgn}\alpha}\dfrac{\partial^{2-\alpha}}{\partial t^{2-\alpha}}\right)$

– the suitable version of the one-dimensional (case of one axis of space coordinates) differential Dubrovin operator, which generalizes d'Alembert's operator □, who occurs one of his three (zero) components for the laboratory frame of reference, i.e., $\alpha=0$, $v=0$. Differential equation (49) or (50) is the gipercontinual one-dimensional homogeneous wave equation, which generalizes, similar to differential equation (26) or (27), the known one-dimensional homogeneous wave equation (28). The vital difference between them (26)-(27) is lies in the fact that the globally trans-coordinate form of gipercontinual wave equation, and (49)-(50) – by its locally trans-coordinate form. Local transcoordinate means that the equation connects the inertial reference systems, which move relative to each other with the infinitely low speed.

The transcoordinate of giperkontinualnykh wave equations is ensured by the use in them of the suitable derived field functions. Namely, use by Galileo's derivative reports to equation global trans-coordinate, and by trans-coordinate derivative – local.

Thus, is proposed the new approach to the development of the mathematical apparatus for electrodynamics in the direction of the more adequate description of passage from one inertial reference system to another on the basis of gipercontinual ideas about the space and in the time due to the introduction into the examination of the globally and locally trans-coordinate equations, which use new Galilean and trans-coordinate derivatives of field functions, and also the new differential of

Dubrovin operator, which generalizes d'Alember operator. This approach leads to the reformulation of electrodynamics with the passage from the traditional formulation of Hertz-Heaviside to the new trans-coordinate. In this case immediately arise the question about what form they have conversions of electromagnetic field upon transfer from one inertial reference system to another, and will be these conversions the Mende conversions [17].

The convective derivatives of field functions in (19)-(20) can be written down in the form:

$$(v\mathbf{e}_1\cdot\nabla)\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)=v(\nabla\cdot\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t))\mathbf{e}_1-\nabla\times(v\mathbf{e}_1\times\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)) \tag{51}$$

$$(v\mathbf{e}_1\cdot\nabla)\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)=v(\nabla\cdot\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t))\mathbf{e}_1-\nabla\times(v\mathbf{e}_1\times\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)) \tag{52}$$

We have in view of the first two (22) equations taking into account (1)-(2) :

$$\nabla\cdot\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)=0\,;\ \nabla\cdot\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)=0\,. \tag{53}$$

After substituting (53) in (51)-(52), we will obtain equalities for the convective derivatives:

$$(v\mathbf{e}_1\cdot\nabla)\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)=-\nabla\times(v\mathbf{e}_1\times\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)) \tag{54}$$

$$(v\mathbf{e}_1\cdot\nabla)\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)=-\nabla\times(v\mathbf{e}_1\times\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)). \tag{55}$$

After substitution (54)-(55) in (19)-(20) we take another form of the Galilean derivatives:

$$\frac{\partial'\mathbf{E}}{\partial t}(v,\mathbf{r}',t)=\frac{\partial\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)}{\partial t}-\nabla\times(v\mathbf{e}_1\times\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)) \tag{56}$$

$$\frac{\partial'\mathbf{B}}{\partial t}(v,\mathbf{r}',t)=\frac{\partial\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)}{\partial t}-\nabla\times(v\mathbf{e}_1\times\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)) \tag{57}$$

The substitution of Galilean derivatives (56)-(57) into the last two equalities (22) gives:

$$\nabla\times\mathbf{E}'(v,\mathbf{r}',t)=-\partial\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)/\partial t+\nabla\times(v\mathbf{e}_1\times\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)), \tag{58}$$

$$\nabla\times\mathbf{B}'(v,\mathbf{r}',t)=(\varepsilon\mu/c^2)(\partial\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)/\partial t-\nabla\times(v\mathbf{e}_1\times\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t))). \tag{59}$$

After substituting last two equations (23) in (58)-(59), we will obtain:

$$\nabla\times\mathbf{E}'(v,\mathbf{r}',t)=\nabla\times\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)+\nabla\times(v\mathbf{e}_1\times\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)), \tag{60}$$

$$\nabla\times\mathbf{B}'(v,\mathbf{r}',t)=\nabla\times\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)-(\varepsilon\mu/c^2)\nabla\times(v\mathbf{e}_1\times\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)). \tag{61}$$

Let us omit the operation of rotor both parts of the equalities (60)-(61):

$$\mathbf{E}'(v,\mathbf{r}',t)=\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)+v\mathbf{e}_1\times\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t), \tag{62}$$

$$\mathbf{B}'(v,\mathbf{r}',t)=\mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)-(\varepsilon\mu/c^2)(v\mathbf{e}_1\times\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)) \tag{63}$$

Besides the shtrikhovannoy frame of reference, which moves relative to laboratory with speed v let us introduce also relatively mobile frame of reference – twice shtrikhovannuyu, that moves in the same direction with another speed $v+\Delta v$ relative to laboratory. Thus, the twice shtrikhovannaya frame of reference moves with relatively shtrikhovannoy with speed Δv , the so that shtrikhovannuyu frame of reference can be accepted for the new laboratory (relatively fixed), and twice shtrikhovannuyu – for the new substantive.

Equalities (62)-(63) for them let us write down taking into account the replacement of radius-vector $\mathbf{r}'$ on $\mathbf{r}''$:

$$\mathbf{E}'(v+\Delta v,\mathbf{r}'',t)=\mathbf{E}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)+\Delta v\mathbf{e}_1\times\mathbf{B}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t), \tag{64}$$

$$\mathbf{B}'(v+\Delta v,\mathbf{r}'',t)=\mathbf{B}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)-(\varepsilon\mu/c^2)\Delta v\mathbf{e}_1\times\mathbf{E}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t). \tag{65}$$

Let us write down equalities (64)-(65) in the following form:

$$\frac{\mathbf{E}'(v+\Delta v,\mathbf{r}'',t)-\mathbf{E}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)}{\Delta v}=\mathbf{e}_1\times\mathbf{B}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t), \tag{66}$$

$$\frac{\mathbf{B}'(v+\Delta v,\mathbf{r}'',t)-\mathbf{B}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)}{\Delta v}=-\frac{\varepsilon\mu}{c^2}\mathbf{e}_1\times\mathbf{E}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t) \tag{67}$$

In (66)-(67) the values $\mathbf{E}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)$, $\mathbf{B}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)$, $\mathbf{E}'(v+\Delta v,\mathbf{r}'',t)$, $\mathbf{B}'(v+\Delta v,\mathbf{r}'',t)$ is described the electromagnetic field at one and the same point of space (medium), but in the different frame of references (shtrikhovannoy and by twice shtrikhovannoy). Within the framework they are equal to the concept of the invariance of field relative to the speed of the motion of observer:

$$\mathbf{E}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)=\mathbf{E}'(v+\Delta v,\mathbf{r}'',t),\ \mathbf{B}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)=\mathbf{B}'(v+\Delta v,\mathbf{r}'',t), \tag{68}$$

the equalities (9) (68) making identical physical sense, but in connection with to the different pairs of frame of references. However, out of the framework of the indicated concept upon transfer from shtrikhovannoy to the twice shtrikhovannoy frame of reference the field function at the particular point of space experiences the increase, the limit of relation of which k Δv with $\Delta v\to 0$ gives that for the first time introduced into 10 the trans-coordinate derivative of the field function:

$$\frac{\partial'\mathbf{E}'(v,\mathbf{r}'',t)}{\partial' v}=\lim_{\Delta v\to 0}\frac{\mathbf{E}'(v+\Delta v,\mathbf{r}'',t)-\mathbf{E}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)}{\Delta v}, \tag{69}$$

$$\frac{\partial'\mathbf{B}'(v,\mathbf{r}'',t)}{\partial' v}=\lim_{\Delta v\to 0}\frac{\mathbf{B}'(v+\Delta v,\mathbf{r}'',t)-\mathbf{B}'(v,\mathbf{r}''+t\Delta v\mathbf{e}_1,t)}{\Delta v}. \tag{70}$$

Equalities (66)-(67) with $\Delta v\to 0$ taking into account (69)-(70) after replacement $\mathbf{r}''$ on $\mathbf{r}$ take the form:

$$\frac{\partial'\mathbf{E}'(v,\mathbf{r}',t)}{\partial' v}=\mathbf{e}_1\times\mathbf{B}'(v,\mathbf{r}',t);\ \frac{\partial'\mathbf{B}'(v,\mathbf{r}',t)}{\partial' v}=-\frac{\varepsilon\mu}{c^2}\mathbf{e}_1\times\mathbf{E}'(v,\mathbf{r}',t). \tag{71}$$

If equations (22) are the globally trans-coordinate differential equations of electrodynamics for the case of isotropic homogeneous medium without the dispersion in the absence of free charges and currents, then equations (71) are the locally trans-coordinate differential equations of electrodynamics for the same case. The locality of transcoordinate, ensured by use by trans-coordinate derivative, means that the connected by differential equations inertial reference systems (conditionally speaking, prime and twice prime) they move relative to each other with the infinitely low speed Δv Equations (71) form the system, by solving which, it is possible to obtain the conversions of electromagnetic field upon transfer of one inertial reference system into another.

Let us use system of equations (71) for obtaining the conversions of electromagnetic field upon transfer from the laboratory frame of reference to the substantive.

Lowering the arguments of functions, let us write down vector products in (71) in the form:

$$\mathbf{e}_1\times\mathbf{B}'=\mathbf{e}_1\times\left(B'^1\mathbf{e}_1+B'^2\mathbf{e}_2+B'^3\mathbf{e}_3\right)=B'^2\mathbf{e}_3-B'^3\mathbf{e}_2 \tag{72}$$

$$\mathbf{e}_1\times\mathbf{E}'=\mathbf{e}_1\times\left(E'^1\mathbf{e}_1+E'^2\mathbf{e}_2+E'^3\mathbf{e}_3\right)=E'^2\mathbf{e}_3-E'^3\mathbf{e}_2 \tag{73}$$

Taking into account (72)-(73) the system of equations (71) is divided off into two independent systems of two equations each and two additional independent equations:

$$\begin{cases}\dfrac{\partial' E'^2}{\partial' v}=-B'^3, \\ \dfrac{\partial' B'^3}{\partial' v}=-\dfrac{\varepsilon\mu}{c^2}E'^2;\end{cases} \quad \begin{cases}\dfrac{\partial' E'^3}{\partial' v}=B'^2, \\ \dfrac{\partial' B'^2}{\partial' v}=\dfrac{\varepsilon\mu}{c^2}E'^3;\end{cases} \quad \frac{\partial' E'^1}{\partial' v}=0; \quad \frac{\partial' B'^1}{\partial' v}=0 \tag{74}$$

We differentiate the first equations of systems (74) and will substitute them the secondly:

$$\frac{\partial'^2 E'^2}{\partial' v^2}=\frac{\varepsilon\mu}{c^2}E'^2; \quad \frac{\partial'^2 E'^3}{\partial' v^2}=\frac{\varepsilon\mu}{c^2}E'^3; \quad \frac{\partial'^2 B'^2}{\partial' v^2}=\frac{\varepsilon\mu}{c^2}B'^2; \quad \frac{\partial'^2 B'^3}{\partial' v^2}=\frac{\varepsilon\mu}{c^2}B'^3 \tag{75}$$

The general solution of equations (75) is expressed as the arbitrary constants $C_1,\ldots,C_{10}$:

$$E'^1=C_1; E'^2=C_2\cosh\frac{\sqrt{\varepsilon\mu}v}{c}+C_3\sinh\frac{\sqrt{\varepsilon\mu}v}{c}; E'^3=C_4\cosh\frac{\sqrt{\varepsilon\mu}v}{c}+C_5\sinh\frac{\sqrt{\varepsilon\mu}v}{c}; \tag{76}$$

$$B'^1=C_6; B'^2=C_7\cosh\frac{\sqrt{\varepsilon\mu}v}{c}+C_8\sinh\frac{\sqrt{\varepsilon\mu}v}{c}; B'^3=C_9\cosh\frac{\sqrt{\varepsilon\mu}v}{c}+C_{10}\sinh\frac{\sqrt{\varepsilon\mu}v}{c}. \tag{77}$$

Since we search for the conversions of electromagnetic field upon transfer from the laboratory frame of reference, then the desired particular solutions of equations (75) must with $v=0$ describe electromagnetic field in the laboratory frame of reference, i.e., satisfy equalities (8) and (74), and the, which means, following totality of the equalities:

$$E'^1(0,\mathbf{r}',t)=E^1(\mathbf{r}',t) \quad E'^2(0,\mathbf{r}',t)=E^2(\mathbf{r}',t)\ E'^3(0,\mathbf{r}',t)=E^3(\mathbf{r}',t); \tag{78}$$

$$B'^1(0,\mathbf{r}',t)=B^1(\mathbf{r}',t); \ B'^2(0,\mathbf{r}',t)=B^2(\mathbf{r}',t); \ B'^3(0,\mathbf{r}',t)=B^3(\mathbf{r}',t); \tag{79}$$

$$\frac{\partial' E'^2(0,\mathbf{r}',t)}{\partial' v}=-B^3(\mathbf{r}',t); \ \frac{\partial' E'^3(0,\mathbf{r}',t)}{\partial' v}=B^2(\mathbf{r}',t); \tag{80}$$

$$\frac{\partial' B'^2(0,\mathbf{r}',t)}{\partial' v}=\frac{\varepsilon\mu}{c^2}E^3(\mathbf{r}',t), \ \frac{\partial' B'^3(0,\mathbf{r}',t)}{\partial' v}=-\frac{\varepsilon\mu}{c^2}E^2(\mathbf{r}',t). \tag{81}$$

By substitution (76)-(77) in (78)-(81) let us find the values of constants $C_1,\ldots,C_{10}$, as a result what after the substitution of these constants in (76)-(77) we will obtain the resultant expression in the component form for the desired conversions of electromagnetic field upon transfer from the laboratory frame of reference to the substantive:

$$E'^1(v,\mathbf{r}',t)=E^1(\mathbf{r}',t)\ , B'^1(v,\mathbf{r}',t)=B^1(\mathbf{r}',t) \tag{82}$$

$$E'^2(v,\mathbf{r}',t)=E^2(\mathbf{r}',t)\cosh\frac{\sqrt{\varepsilon\mu}v}{c}-\frac{c}{\sqrt{\varepsilon\mu}}B^3(\mathbf{r}',t)\sinh\frac{\sqrt{\varepsilon\mu}v}{c}; \tag{83}$$

$$E'^3(v,\mathbf{r}',t)=E^3(\mathbf{r}',t)\cosh\frac{\sqrt{\varepsilon\mu}v}{c}+\frac{c}{\sqrt{\varepsilon\mu}}B^2(\mathbf{r}',t)\sinh\frac{\sqrt{\varepsilon\mu}v}{c} \tag{84}$$

$$B'^2(v,\mathbf{r}',t)=B^2(\mathbf{r}',t)\cosh\frac{\sqrt{\varepsilon\mu}v}{c}+\frac{\sqrt{\varepsilon\mu}}{c}E^3(\mathbf{r}',t)\sinh\frac{\sqrt{\varepsilon\mu}v}{c} \tag{85}$$

$$B'^3(v,\mathbf{r}',t)=B^3(\mathbf{r}',t)\cosh\frac{\sqrt{\varepsilon\mu}v}{c}-\frac{\sqrt{\varepsilon\mu}}{c}.E^2(\mathbf{r}',t)\sinh\frac{\sqrt{\varepsilon\mu}v}{c} \tag{86}$$

In the vector form the same conversions take the following form:

$$\mathbf{E}'(v,\mathbf{r}',t)=\mathbf{E}(\mathbf{r}',t)\cosh\frac{\sqrt{\varepsilon\mu}v}{c}+\frac{c}{\sqrt{\varepsilon\mu}}\mathbf{e}_1\times\mathbf{B}(\mathbf{r}',t)\sinh\frac{\sqrt{\varepsilon\mu}v}{c} \tag{87}$$

$$\mathbf{B}'(v,\mathbf{r}',t)=\mathbf{B}(\mathbf{r}',t)\cosh\frac{\sqrt{\varepsilon\mu}v}{c}-\frac{\sqrt{\varepsilon\mu}}{c}\mathbf{e}_1\times\mathbf{E}(\mathbf{r}',t)\sinh\frac{\sqrt{\varepsilon\mu}v}{c}. \tag{88}$$

It is easy to see that the conversions (82)-(88) are known Mende conversions.

V. Conclusion

Thus, the Mende conversions obtain a sufficient theoretical substantiation within the framework of the trans-coordinate formulation of electrodynamics, connected with the gipercontinual ideas about the space and the time, and also with the concept not of the invariance of electric charge relative to the speed of the motion of observer. Together with that been in [9] direct experimental confirmation of the concept not of the invariance of electric charge, this is convincing evidence of their larger adequacy of physical reality on the comparison not only with the classical, but also with the relativistic conversions of electromagnetic field, or the convincing evidence of the justification of the transfer of electrodynamics from the traditional formulation of Hertz-Heaviside to the trans-coordinate. The sequential development of transcoordinate electrodynamics is capable of not only deriving on the new qualitative level of idea about the space and the time, but also of opening the fundamentally new horizons of the development engineering and technologies due to the discovery and the mastery of new physical phenomena and effects.

References Références Referencias

1. Maxwell J.C. Selected works on the theory of the electric field. M.: State publishing technical and theoretical literature, 1954.
2. Logunov A.A. Lectures on the theory of relativity and gravitation: a modern analysis of the problem. Moscow: Nauka, 1987. 272 p.
3. Kocik J. Relativistic observer and Maxwell's equations: an example of a non-principal Ehresmann connection. Preprint P-98-10-029, Department of Physics, UIUC, Urbana, IL61801, 1998.
4. Boss V. Mathematical physics equations. Moscow: LIBROKOM, 2009. 224 p.
5. Dubrovin A.S. From the protected system standard model to the common space-time theory // Proceedings of Voronezh Institute of High Technologies. 2010, no. 7, pp. 37-41.
6. Proceedings of Voronezh Institute of High Chernyshova E.V., Glazkova E.V. Protected system standard model creation in the context of natural science paradigm shift // Modern problems of science and education. 2015, no. 1; URL: www.science-education.ru/121-18620.
7. Dubrovin A.S., Khabibulina S.Yu. Space-time and the information science: from criticism of the continuum to criticism of the geometrization principle // The Fundamental Researches. 2014, no. 6, part 4, pp. 714-718.
8. Mende F.F. On the question of the origin of the secondary electric fields while flowing through superconductors direct currents. Kharkiv, 1988. – 33 p. Number 774-B88 Dep. VINITI.
9. Mende F.F. Mechanical and Thermal Electrization Metal, Dielectrics and Plasma // International Journal of Modern Physics and Application. 2015. Vol. 2, no. 6, pp. 73-99.
10. Dubrovin A.S. Transcoordinate electrodynamics in the space-time hypercontinuum // International Journal of Applied and Fundamental Research. 2015, no. 12, pp. 34-41.
11. Dubrovin A.S. Algebraic properties of the functions of the one-dimensional sine waves and the space-time // Proceedings of Voronezh State University. Series: Physics. Mathematics. 2013, no. 1, pp. 5-19.
12. Dubrovin A.S., Skrypnikov A.V., Lyutova T.V., Glazkova E.V., Chernyshova E.V. General scientific results of protected system standard model creation // The Fundamental Researches. 2015, no. 2, part 15, pp. 3247-3251.
13. Dubrovin A.S. Application of the principle of hierarchy in computer science to representations about space-time in the theoretical physics // International Journal Of Applied And Fundamental Research. 2014, no. 1 – URL: www.science-sd.com/456-24490.
14. Dubrovin A.S. Models and methods of information processes reliability complex maintenance in critical application systems: dissertation for the degree of Doctor of Technical Sciences. Voronezh, VSU Publ., 2011. 433 p.

15. Jackson J. Classical electrodynamics. Moscow: Mir, 1965. 703 p.
16. Shimoni K. Theoretical electrical Engineering. Moscow: Mir, 1964. 775 p.
17. Dubrovin A.S. Mende transformations in the transcoordinate electrodynamics // International Journal of Applied and Fundamental Research. 2015, no. 12, pp. 1006-1012.

Global Journals Inc. (US) Guidelines Handbook 2016

www.GlobalJournals.org

Fellows

FELLOW OF ASSOCIATION OF RESEARCH SOCIETY IN ENGINEERING (FARSE)

Global Journals Incorporate (USA) is accredited by Open Association of Research Society (OARS), U.S.A and in turn, awards "FARSE " title to individuals. The 'FARSE' title is accorded to a selected professional after the approval of the Editor-in-Chief /Editorial Board Members/Dean.

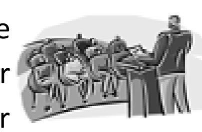
- The "FARSE" is a dignified title which is accorded to a person's name viz. Dr. John E. Hall, Ph.D., FARSE or William Walldroff, M.S., FARSE.

FARSE accrediting is an honor. It authenticates your research activities. After recognition as FARSE, you can add 'FARSE' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, and Visiting Card etc.

The following benefits can be availed by you only for next three years from the date of certification:

FARSE designated members are entitled to avail a 40% discount while publishing their research papers (of a single author) with Global Journals Incorporation (USA), if the same is accepted by Editorial Board/Peer Reviewers. If you are a main author or co-author in case of multiple authors, you will be entitled to avail discount of 10%.

Once FARSE title is accorded, the Fellow is authorized to organize a symposium/seminar/conference on behalf of Global Journal Incorporation (USA).The Fellow can also participate in conference/seminar/symposium organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent.

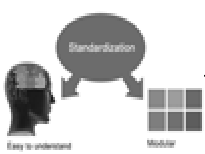


You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The FARSE can go through standards of OARS. You can also play vital role if you have any suggestions so that proper amendment can take place to improve the same for the benefit of entire research community.

As FARSE, you will be given a renowned, secure and free professional email address with 100 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.



The FARSE will be eligible for a free application of standardization of their researches. Standardization of research will be subject to acceptability within stipulated norms as the next step after publishing in a journal. We shall depute a team of specialized research professionals who will render their services for elevating your researches to next higher level, which is worldwide open standardization.

The FARSE member can apply for grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A. Once you are designated as FARSE, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria. After certification of all your credentials by OARS, they will be published on your Fellow Profile link on website https://associationofresearch.org which will be helpful to upgrade the dignity.

The FARSE members can avail the benefits of free research podcasting in Global Research Radio with their research documents. After publishing the work, (including published elsewhere worldwide with proper authorization) you can upload your research paper with your recorded voice or you can utilize chargeable services of our professional RJs to record your paper in their voice on request.

The FARSE member also entitled to get the benefits of free research podcasting of their research documents through video clips. We can also streamline your conference videos and display your slides/ online slides and online research video clips at reasonable charges, on request.

The FARSE is eligible to earn from sales proceeds of his/her researches/reference/review Books or literature, while publishing with Global Journals. The FARSE can decide whether he/she would like to publish his/her research in a closed manner. In this case, whenever readers purchase that individual research paper for reading, maximum 60% of its profit earned as royalty by Global Journals, will be credited to his/her bank account. The entire entitled amount will be credited to his/her bank account exceeding limit of minimum fixed balance. There is no minimum time limit for collection. The FARSE member can decide its price and we can help in making the right decision.

The FARSE member is eligible to join as a paid peer reviewer at Global Journals Incorporation (USA) and can get remuneration of 15% of author fees, taken from the author of a respective paper. After reviewing 5 or more papers you can request to transfer the amount to your bank account.

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN ENGINEERING (MARSE)

The ' MARSE ' title is accorded to a selected professional after the approval of the Editor-in-Chief / Editorial Board Members/Dean.

The “MARSE” is a dignified ornament which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., MARSE or William Walldroff, M.S., MARSE.

MARSE accrediting is an honor. It authenticates your research activities. After becoming MARSE, you can add 'MARSE' title with your name as you use this recognition as additional suffix to your status. This will definitely enhance and add more value and repute to your name. You may use it on your professional Counseling Materials such as CV, Resume, Visiting Card and Name Plate etc.

The following benefitscan be availed by you only for next three years from the date of certification.

MARSE designated members are entitled to avail a 25% discount while publishing their research papers (of a single author) in Global Journals Inc., if the same is accepted by our Editorial Board and Peer Reviewers. If you are a main author or co-author of a group of authors, you will get discount of 10%.

As MARSE, you will be given a renowned, secure and free professional email address with 30 GB of space e.g. johnhall@globaljournals.org. This will include Webmail, Spam Assassin, Email Forwarders,Auto-Responders, Email Delivery Route tracing, etc.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time.This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.

The MARSE member can apply for approval, grading and certification of standards of their educational and Institutional Degrees to Open Association of Research, Society U.S.A.

Once you are designated as MARSE, you may send us a scanned copy of all of your credentials. OARS will verify, grade and certify them. This will be based on your academic records, quality of research papers published by you, and some more criteria.

It is mandatory to read all terms and conditions carefully.

Auxiliary Memberships

Institutional Fellow of Open Association of Research Society (USA)-OARS (USA)

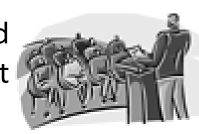
Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as “Institutional Fellow of Open Association of Research Society” (IFOARS).

The “FARSC” is a dignified title which is accorded to a person’s name viz. Dr. John E. Hall, Ph.D., FARSC or William Walldroff, M.S., FARSC.

The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as “Institutional Board of Open Association of Research Society”-(IBOARS).

The Institute will be entitled to following benefits:

The IBOARS can initially review research papers of their institute and recommend them to publish with respective journal of Global Journals. It can also review the papers of other institutions after obtaining our consent. The second review will be done by peer reviewer of Global Journals Incorporation (USA) The Board is at liberty to appoint a peer reviewer with the approval of chairperson after consulting us.
The author fees of such paper may be waived off up to 40%.



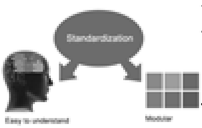
The Global Journals Incorporation (USA) at its discretion can also refer double blind peer reviewed paper at their end to the board for the verification and to get recommendation for final stage of acceptance of publication.

The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

The Board can also play vital role by exploring and giving valuable suggestions regarding the Standards of “Open Association of Research Society, U.S.A (OARS)” so that proper amendment can take place for the benefit of entire research community. We shall provide details of particular standard only on receipt of request from the Board.

The board members can also join us as Individual Fellow with 40% discount on total fees applicable to Individual Fellow. They will be entitled to avail all the benefits as declared. Please visit Individual Fellow-sub menu of GlobalJournals.org to have more relevant details.

We shall provide you intimation regarding launching of e-version of journal of your stream time to time. This may be utilized in your library for the enrichment of knowledge of your students as well as it can also be helpful for the concerned faculty members.



After nomination of your institution as “Institutional Fellow” and constantly functioning successfully for one year, we can consider giving recognition to your institute to function as Regional/Zonal office on our behalf.

The board can also take up the additional allied activities for betterment after our consultation.

The following entitlements are applicable to individual Fellows:

Open Association of Research Society, U.S.A (OARS) By-laws states that an individual Fellow may use the designations as applicable, or the corresponding initials. The Credentials of individual Fellow and Associate designations signify that the individual has gained knowledge of the fundamental concepts. One is magnanimous and proficient in an expertise course covering the professional code of conduct, and follows recognized standards of practice.

Open Association of Research Society (US)/ Global Journals Incorporation (USA), as described in Corporate Statements, are educational, research publishing and professional membership organizations. Achieving our individual Fellow or Associate status is based mainly on meeting stated educational research requirements.

Disbursement of 40% Royalty earned through Global Journals : Researcher = 50%, Peer Reviewer = 37.50%, Institution = 12.50% E.g. Out of 40%, the 20% benefit should be passed on to researcher, 15 % benefit towards remuneration should be given to a reviewer and remaining 5% is to be retained by the institution.

We shall provide print version of 12 issues of any three journals [as per your requirement] out of our 38 journals worth $ 2376 USD.

Other:

The individual Fellow and Associate designations accredited by Open Association of Research Society (US) credentials signify guarantees following achievements:

- The professional accredited with Fellow honor, is entitled to various benefits viz. name, fame, honor, regular flow of income, secured bright future, social status etc.

- In addition to above, if one is single author, then entitled to 40% discount on publishing research paper and can get 10%discount if one is co-author or main author among group of authors.
- The Fellow can organize symposium/seminar/conference on behalf of Global Journals Incorporation (USA) and he/she can also attend the same organized by other institutes on behalf of Global Journals.
- The Fellow can become member of Editorial Board Member after completing 3yrs.
- The Fellow can earn 60% of sales proceeds from the sale of reference/review books/literature/publishing of research paper.
- Fellow can also join as paid peer reviewer and earn 15% remuneration of author charges and can also get an opportunity to join as member of the Editorial Board of Global Journals Incorporation (USA)
- • This individual has learned the basic methods of applying those concepts and techniques to common challenging situations. This individual has further demonstrated an in–depth understanding of the application of suitable techniques to a particular area of research practice.

Note :

"

- In future, if the board feels the necessity to change any board member, the same can be done with the consent of the chairperson along with anyone board member without our approval.
- In case, the chairperson needs to be replaced then consent of 2/3rd board members are required and they are also required to jointly pass the resolution copy of which should be sent to us. In such case, it will be compulsory to obtain our approval before replacement.
- In case of "Difference of Opinion [if any]" among the Board members, our decision will be final and binding to everyone. "

Process of submission of Research Paper

The Area or field of specialization may or may not be of any category as mentioned in 'Scope of Journal' menu of the GlobalJournals.org website. There are 37 Research Journal categorized with Six parental Journals GJCST, GJMR, GJRE, GJMBR, GJSFR, GJHSS. For Authors should prefer the mentioned categories. There are three widely used systems UDC, DDC and LCC. The details are available as 'Knowledge Abstract' at Home page. The major advantage of this coding is that, the research work will be exposed to and shared with all over the world as we are being abstracted and indexed worldwide.

The paper should be in proper format. The format can be downloaded from first page of 'Author Guideline' Menu. The Author is expected to follow the general rules as mentioned in this menu. The paper should be written in MS-Word Format (*.DOC,*.DOCX).

The Author can submit the paper either online or offline. The authors should prefer online submission.Online Submission: There are three ways to submit your paper:

(A) (I) First, register yourself using top right corner of Home page then Login. If you are already registered, then login using your username and password.

(II) Choose corresponding Journal.

(III) Click 'Submit Manuscript'. Fill required information and Upload the paper.

(B) If you are using Internet Explorer, then Direct Submission through Homepage is also available.

(C) If these two are not conveninet , and then email the paper directly to dean@globaljournals.org.

Offline Submission: Author can send the typed form of paper by Post. However, online submission should be preferred.

MANUSCRIPT STYLE INSTRUCTION **(Must be strictly followed)**

Page Size: 8.27" X 11'"

- Left Margin: 0.65
- Right Margin: 0.65
- Top Margin: 0.75
- Bottom Margin: 0.75
- Font type of all text should be Swis 721 Lt BT.
- Paper Title should be of Font Size 24 with one Column section.
- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, “Abstract” word in Italic Bold.
- Main Text: Font size 10 with justified two columns section
- Two Column with Equal Column with of 3.38 and Gaping of .2
- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
- Large Images must be in One Column
- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
- Numbering of Second Main Headings (Heading 2) must be in Alphabets, Italic, and Font Size of 10.

You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

Before submitting your research paper, one is advised to go through the details as mentioned in following heads. It will be beneficial, while peer reviewer justify your paper for publication.

Scope

The Global Journals Inc. (US) welcome the submission of original paper, review paper, survey article relevant to the all the streams of Philosophy and knowledge. The Global Journals Inc. (US) is parental platform for Global Journal of Computer Science and Technology, Researches in Engineering, Medical Research, Science Frontier Research, Human Social Science, Management, and Business organization. The choice of specific field can be done otherwise as following in Abstracting and Indexing Page on this Website. As the all Global

Journals Inc. (US) are being abstracted and indexed (in process) by most of the reputed organizations. Topics of only narrow interest will not be accepted unless they have wider potential or consequences.

2. ETHICAL GUIDELINES

Authors should follow the ethical guidelines as mentioned below for publication of research paper and research activities.

Papers are accepted on strict understanding that the material in whole or in part has not been, nor is being, considered for publication elsewhere. If the paper once accepted by Global Journals Inc. (US) and Editorial Board, will become the copyright of the Global Journals Inc. (US).

Authorship: The authors and coauthors should have active contribution to conception design, analysis and interpretation of findings. They should critically review the contents and drafting of the paper. All should approve the final version of the paper before submission

The Global Journals Inc. (US) follows the definition of authorship set up by the Global Academy of Research and Development. According to the Global Academy of R&D authorship, criteria must be based on:

1) Substantial contributions to conception and acquisition of data, analysis and interpretation of the findings.

2) Drafting the paper and revising it critically regarding important academic content.

3) Final approval of the version of the paper to be published.

All authors should have been credited according to their appropriate contribution in research activity and preparing paper. Contributors who do not match the criteria as authors may be mentioned under Acknowledgement.

Acknowledgements: Contributors to the research other than authors credited should be mentioned under acknowledgement. The specifications of the source of funding for the research if appropriate can be included. Suppliers of resources may be mentioned along with address.

Appeal of Decision: The Editorial Board’s decision on publication of the paper is final and cannot be appealed elsewhere.

Permissions: It is the author's responsibility to have prior permission if all or parts of earlier published illustrations are used in this paper.

Please mention proper reference and appropriate acknowledgements wherever expected.

If all or parts of previously published illustrations are used, permission must be taken from the copyright holder concerned. It is the author's responsibility to take these in writing.

Approval for reproduction/modification of any information (including figures and tables) published elsewhere must be obtained by the authors/copyright holders before submission of the manuscript. Contributors (Authors) are responsible for any copyright fee involved.

3. SUBMISSION OF MANUSCRIPTS

Manuscripts should be uploaded via this online submission page. The online submission is most efficient method for submission of papers, as it enables rapid distribution of manuscripts and consequently speeds up the review procedure. It also enables authors to know the status of their own manuscripts by emailing us. Complete instructions for submitting a paper is available below.

Manuscript submission is a systematic procedure and little preparation is required beyond having all parts of your manuscript in a given format and a computer with an Internet connection and a Web browser. Full help and instructions are provided on-screen. As an author, you will be prompted for login and manuscript details as Field of Paper and then to upload your manuscript file(s) according to the instructions.

To avoid postal delays, all transaction is preferred by e-mail. A finished manuscript submission is confirmed by e-mail immediately and your paper enters the editorial process with no postal delays. When a conclusion is made about the publication of your paper by our Editorial Board, revisions can be submitted online with the same procedure, with an occasion to view and respond to all comments.

Complete support for both authors and co-author is provided.

4. MANUSCRIPT'S CATEGORY

Based on potential and nature, the manuscript can be categorized under the following heads:

Original research paper: Such papers are reports of high-level significant original research work.

Review papers: These are concise, significant but helpful and decisive topics for young researchers.

Research articles: These are handled with small investigation and applications

Research letters: The letters are small and concise comments on previously published matters.

5.STRUCTURE AND FORMAT OF MANUSCRIPT

The recommended size of original research paper is less than seven thousand words, review papers fewer than seven thousands words also.Preparation of research paper or how to write research paper, are major hurdle, while writing manuscript. The research articles and research letters should be fewer than three thousand words, the structure original research paper; sometime review paper should be as follows:

Papers: These are reports of significant research (typically less than 7000 words equivalent, including tables, figures, references), and comprise:

(a)Title should be relevant and commensurate with the theme of the paper.

(b) A brief Summary, "Abstract" (less than 150 words) containing the major results and conclusions.

(c) Up to ten keywords, that precisely identifies the paper's subject, purpose, and focus.

(d) An Introduction, giving necessary background excluding subheadings; objectives must be clearly declared.

(e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition; sources of information must be given and numerical methods must be specified by reference, unless non-standard.

(f) Results should be presented concisely, by well-designed tables and/or figures; the same data may not be used in both; suitable statistical data should be given. All data must be obtained with attention to numerical detail in the planning stage. As reproduced design has been recognized to be important to experiments for a considerable time, the Editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned un-refereed;

(g) Discussion should cover the implications and consequences, not just recapitulating the results; conclusions should be summarizing.

(h) Brief Acknowledgements.

(i) References in the proper form.

Authors should very cautiously consider the preparation of papers to ensure that they communicate efficiently. Papers are much more likely to be accepted, if they are cautiously designed and laid out, contain few or no errors, are summarizing, and be conventional to the approach and instructions. They will in addition, be published with much less delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and to make suggestions to improve briefness.

It is vital, that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

Format

Language: The language of publication is UK English. Authors, for whom English is a second language, must have their manuscript efficiently edited by an English-speaking person before submission to make sure that, the English is of high excellence. It is preferable, that manuscripts should be professionally edited.

Standard Usage, Abbreviations, and Units: Spelling and hyphenation should be conventional to The Concise Oxford English Dictionary. Statistics and measurements should at all times be given in figures, e.g. 16 min, except for when the number begins a sentence. When the number does not refer to a unit of measurement it should be spelt in full unless, it is 160 or greater.

Abbreviations supposed to be used carefully. The abbreviated name or expression is supposed to be cited in full at first usage, followed by the conventional abbreviation in parentheses.

Metric SI units are supposed to generally be used excluding where they conflict with current practice or are confusing. For illustration, 1.4 l rather than 1.4 × 10-3 m3, or 4 mm somewhat than 4 × 10-3 m. Chemical formula and solutions must identify the form used, e.g. anhydrous or hydrated, and the concentration must be in clearly defined units. Common species names should be followed by underlines at the first mention. For following use the generic name should be constricted to a single letter, if it is clear.

Structure

All manuscripts submitted to Global Journals Inc. (US), ought to include:

Title: The title page must carry an instructive title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) wherever the work was carried out. The full postal address in addition with the e-mail address of related author must be given. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining and indexing.

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

Many researchers searching for information online will use search engines such as Google, Yahoo or similar. By optimizing your paper for search engines, you will amplify the chance of someone finding it. This in turn will make it more likely to be viewed and/or cited in a further work. Global Journals Inc. (US) have compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Key Words

A major linchpin in research work for the writing research paper is the keyword search, which one will employ to find both library and Internet resources.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy and planning a list of possible keywords and phrases to try.

Search engines for most searches, use Boolean searching, which is somewhat different from Internet searches. The Boolean search uses "operators," words (and, or, not, and near) that enable you to expand or narrow your affords. Tips for research paper while preparing research paper are very helpful guideline of research paper.

Choice of key words is first tool of tips to write research paper. Research paper writing is an art.A few tips for deciding as strategically as possible about keyword search:

- One should start brainstorming lists of possible keywords before even begin searching. Think about the most important concepts related to research work. Ask, "What words would a source have to include to be truly valuable in research paper?" Then consider synonyms for the important words.
- It may take the discovery of only one relevant paper to let steer in the right keyword direction because in most databases, the keywords under which a research paper is abstracted are listed with the paper.
- One should avoid outdated words.

Keywords are the key that opens a door to research work sources. Keyword searching is an art in which researcher's skills are bound to improve with experience and time.

Numerical Methods: Numerical methods used should be clear and, where appropriate, supported by references.

Acknowledgements: Please make these as concise as possible.

References

References follow the Harvard scheme of referencing. References in the text should cite the authors' names followed by the time of their publication, unless there are three or more authors when simply the first author's name is quoted followed by et al. unpublished work has to only be cited where necessary, and only in the text. Copies of references in press in other journals have to be supplied with submitted typescripts. It is necessary that all citations and references be carefully checked before submission, as mistakes or omissions will cause delays.

References to information on the World Wide Web can be given, but only if the information is available without charge to readers on an official site. Wikipedia and Similar websites are not allowed where anyone can change the information. Authors will be asked to make available electronic copies of the cited information for inclusion on the Global Journals Inc. (US) homepage at the judgment of the Editorial Board.

The Editorial Board and Global Journals Inc. (US) recommend that, citation of online-published papers and other material should be done via a DOI (digital object identifier). If an author cites anything, which does not have a DOI, they run the risk of the cited material not being noticeable.

The Editorial Board and Global Journals Inc. (US) recommend the use of a tool such as Reference Manager for reference management and formatting.

Tables, Figures and Figure Legends

Tables: Tables should be few in number, cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g. Table 4, a self-explanatory caption and be on a separate sheet. Vertical lines should not be used.

Figures: Figures are supposed to be submitted as separate files. Always take in a citation in the text for each figure using Arabic numbers, e.g. Fig. 4. Artwork must be submitted online in electronic form by e-mailing them.

Preparation of Electronic Figures for Publication

Even though low quality images are sufficient for review purposes, print publication requires high quality images to prevent the final product being blurred or fuzzy. Submit (or e-mail) EPS (line art) or TIFF (halftone/photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Do not use pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings) in relation to the imitation size. Please give the data for figures in black and white or submit a Color Work Agreement Form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution (at final image size) ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs) : >350 dpi; figures containing both halftone and line images: >650 dpi.

Figure Legends: Self-explanatory legends of all figures should be incorporated separately under the heading 'Legends to Figures'. In the full-text online edition of the journal, figure legends may possibly be truncated in abbreviated links to the full screen version. Therefore, the first 100 characters of any legend should notify the reader, about the key aspects of the figure.

6. AFTER ACCEPTANCE

Upon approval of a paper for publication, the manuscript will be forwarded to the dean, who is responsible for the publication of the Global Journals Inc. (US).

6.1 Proof Corrections

The corresponding author will receive an e-mail alert containing a link to a website or will be attached. A working e-mail address must therefore be provided for the related author.

Acrobat Reader will be required in order to read this file. This software can be downloaded

(Free of charge) from the following website:

www.adobe.com/products/acrobat/readstep2.html. This will facilitate the file to be opened, read on screen, and printed out in order for any corrections to be added. Further instructions will be sent with the proof.

Proofs must be returned to the dean at dean@globaljournals.org within three days of receipt.

As changes to proofs are costly, we inquire that you only correct typesetting errors. All illustrations are retained by the publisher. Please note that the authors are responsible for all statements made in their work, including changes made by the copy editor.

6.2 Early View of Global Journals Inc. (US) (Publication Prior to Print)

The Global Journals Inc. (US) are enclosed by our publishing's Early View service. Early View articles are complete full-text articles sent in advance of their publication. Early View articles are absolute and final. They have been completely reviewed, revised and edited for publication, and the authors' final corrections have been incorporated. Because they are in final form, no changes can be made after sending them. The nature of Early View articles means that they do not yet have volume, issue or page numbers, so Early View articles cannot be cited in the conventional way.

6.3 Author Services

Online production tracking is available for your article through Author Services. Author Services enables authors to track their article - once it has been accepted - through the production process to publication online and in print. Authors can check the status of their articles online and choose to receive automated e-mails at key stages of production. The authors will receive an e-mail with a unique link that enables them to register and have their article automatically added to the system. Please ensure that a complete e-mail address is provided when submitting the manuscript.

6.4 Author Material Archive Policy

Please note that if not specifically requested, publisher will dispose off hardcopy & electronic information submitted, after the two months of publication. If you require the return of any information submitted, please inform the Editorial Board or dean as soon as possible.

6.5 Offprint and Extra Copies

A PDF offprint of the online-published article will be provided free of charge to the related author, and may be distributed according to the Publisher's terms and conditions. Additional paper offprint may be ordered by emailing us at: editor@globaljournals.org .

You must strictly follow above Author Guidelines before submitting your paper or else we will not at all be responsible for any corrections in future in any of the way.

Before start writing a good quality Computer Science Research Paper, let us first understand what is Computer Science Research Paper? So, Computer Science Research Paper is the paper which is written by professionals or scientists who are associated to Computer Science and Information Technology, or doing research study in these areas. If you are novel to this field then you can consult about this field from your supervisor or guide.

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

1. Choosing the topic: In most cases, the topic is searched by the interest of author but it can be also suggested by the guides. You can have several topics and then you can judge that in which topic or subject you are finding yourself most comfortable. This can be done by asking several questions to yourself, like Will I be able to carry our search in this area? Will I find all necessary recourses to accomplish the search? Will I be able to find all information in this field area? If the answer of these types of questions will be "Yes" then you can choose that topic. In most of the cases, you may have to conduct the surveys and have to visit several places because this field is related to Computer Science and Information Technology. Also, you may have to do a lot of work to find all rise and falls regarding the various data of that subject. Sometimes, detailed information plays a vital role, instead of short information.

2. Evaluators are human: First thing to remember that evaluators are also human being. They are not only meant for rejecting a paper. They are here to evaluate your paper. So, present your Best.

3. Think Like Evaluators: If you are in a confusion or getting demotivated that your paper will be accepted by evaluators or not, then think and try to evaluate your paper like an Evaluator. Try to understand that what an evaluator wants in your research paper and automatically you will have your answer.

4. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

5. Ask your Guides: If you are having any difficulty in your research, then do not hesitate to share your difficulty to your guide (if you have any). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work then ask the supervisor to help you with the alternative. He might also provide you the list of essential readings.

6. Use of computer is recommended: As you are doing research in the field of Computer Science, then this point is quite obvious.

7. Use right software: Always use good quality software packages. If you are not capable to judge good software then you can lose quality of your paper unknowingly. There are various software programs available to help you, which you can get through Internet.

8. Use the Internet for help: An excellent start for your paper can be by using the Google. It is an excellent search engine, where you can have your doubts resolved. You may also read some answers for the frequent question how to write my research paper or find model research paper. From the internet library you can download books. If you have all required books make important reading selecting and analyzing the specified information. Then put together research paper sketch out.

9. Use and get big pictures: Always use encyclopedias, Wikipedia to get pictures so that you can go into the depth.

10. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right! It is a good habit, which helps to not to lose your continuity. You should always use bookmarks while searching on Internet also, which will make your search easier.

11. Revise what you wrote: When you write anything, always read it, summarize it and then finalize it.

12. Make all efforts: Make all efforts to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in introduction, that what is the need of a particular research paper. Polish your work by good skill of writing and always give an evaluator, what he wants.

13. Have backups: When you are going to do any important thing like making research paper, you should always have backup copies of it either in your computer or in paper. This will help you to not to lose any of your important.

14. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several and unnecessary diagrams will degrade the quality of your paper by creating "hotchpotch." So always, try to make and include those diagrams, which are made by your own to improve readability and understandability of your paper.

15. Use of direct quotes: When you do research relevant to literature, history or current affairs then use of quotes become essential but if study is relevant to science then use of quotes is not preferable.

16. Use proper verb tense: Use proper verb tenses in your paper. Use past tense, to present those events that happened. Use present tense to indicate events that are going on. Use future tense to indicate future happening events. Use of improper and wrong tenses will confuse the evaluator. Avoid the sentences that are incomplete.

17. Never use online paper: If you are getting any paper on Internet, then never use it as your research paper because it might be possible that evaluator has already seen it or maybe it is outdated version.

18. Pick a good study spot: To do your research studies always try to pick a spot, which is quiet. Every spot is not for studies. Spot that suits you choose it and proceed further.

19. Know what you know: Always try to know, what you know by making objectives. Else, you will be confused and cannot achieve your target.

20. Use good quality grammar: Always use a good quality grammar and use words that will throw positive impact on evaluator. Use of good quality grammar does not mean to use tough words, that for each word the evaluator has to go through dictionary. Do not start sentence with a conjunction. Do not fragment sentences. Eliminate one-word sentences. Ignore passive voice. Do not ever use a big word when a diminutive one would suffice. Verbs have to be in agreement with their subjects. Prepositions are not expressions to finish sentences with. It is incorrect to ever divide an infinitive. Avoid clichés like the disease. Also, always shun irritating alliteration. Use language that is simple and straight forward. put together a neat summary.

21. Arrangement of information: Each section of the main body should start with an opening sentence and there should be a changeover at the end of the section. Give only valid and powerful arguments to your topic. You may also maintain your arguments with records.

22. Never start in last minute: Always start at right time and give enough time to research work. Leaving everything to the last minute will degrade your paper and spoil your work.

23. Multitasking in research is not good: Doing several things at the same time proves bad habit in case of research activity. Research is an area, where everything has a particular time slot. Divide your research work in parts and do particular part in particular time slot.

24. Never copy others' work: Never copy others' work and give it your name because if evaluator has seen it anywhere you will be in trouble.

25. Take proper rest and food: No matter how many hours you spend for your research activity, if you are not taking care of your health then all your efforts will be in vain. For a quality research, study is must, and this can be done by taking proper rest and food.

26. Go for seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

28. Make colleagues: Always try to make colleagues. No matter how sharper or intelligent you are, if you make colleagues you can have several ideas, which will be helpful for your research.

29. Think technically: Always think technically. If anything happens, then search its reasons, its benefits, and demerits.

30. Think and then print: When you will go to print your paper, notice that tables are not be split, headings are not detached from their descriptions, and page sequence is maintained.

31. Adding unnecessary information: Do not add unnecessary information, like, I have used MS Excel to draw graph. Do not add irrelevant and inappropriate material. These all will create superfluous. Foreign terminology and phrases are not apropos. One should NEVER take a broad view. Analogy in script is like feathers on a snake. Not at all use a large word when a very small one would be sufficient. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Amplification is a billion times of inferior quality than sarcasm.

32. Never oversimplify everything: To add material in your research paper, never go for oversimplification. This will definitely irritate the evaluator. Be more or less specific. Also too, by no means, ever use rhythmic redundancies. Contractions aren't essential and shouldn't be there used. Comparisons are as terrible as clichés. Give up ampersands and abbreviations, and so on. Remove commas, that are, not necessary. Parenthetical words however should be together with this in commas. Understatement is all the time the complete best way to put onward earth-shaking thoughts. Give a detailed literary review.

33. Report concluded results: Use concluded results. From raw data, filter the results and then conclude your studies based on measurements and observations taken. Significant figures and appropriate number of decimal places should be used. Parenthetical remarks are prohibitive. Proofread carefully at final stage. In the end give outline to your arguments. Spot out perspectives of further study of this subject. Justify your conclusion by at the bottom of them with sufficient justifications and examples.

34. After conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print to the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects in your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form, which is presented in the guidelines using the template.
- Please note the criterion for grading the final paper by peer-reviewers.

Final Points:

A purpose of organizing a research paper is to let people to interpret your effort selectively. The journal requires the following sections, submitted in the order listed, each section to start on a new page.

The introduction will be compiled from reference matter and will reflect the design processes or outline of basis that direct you to make study. As you will carry out the process of study, the method and process section will be constructed as like that. The result segment will show related statistics in nearly sequential order and will direct the reviewers next to the similar intellectual paths throughout the data that you took to carry out your study. The discussion section will provide understanding of the data and projections as to the implication of the results. The use of good quality references all through the paper will give the effort trustworthiness by representing an alertness of prior workings.

Writing a research paper is not an easy job no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record keeping are the only means to make straightforward the progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

- Insertion a title at the foot of a page with the subsequent text on the next page
- Separating a table/chart or figure - impound each figure/table to a single page
- Submitting a manuscript with pages out of sequence

In every sections of your document

· Use standard writing style including articles ("a", "the," etc.)

· Keep on paying attention on the research topic of the paper

· Use paragraphs to split each significant point (excluding for the abstract)

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

· Shun familiar wording, don't address the reviewer directly, and don't use slang, slang language, or superlatives

· Shun use of extra pictures - include only those figures essential to presenting results

Title Page:

Choose a revealing title. It should be short. It should not have non-standard acronyms or abbreviations. It should not exceed two printed lines. It should include the name(s) and address (es) of all authors.

Abstract:

The summary should be two hundred words or less. It should briefly and clearly explain the key findings reported in the manuscript--must have precise statistics. It should not have abnormal acronyms or abbreviations. It should be logical in itself. Shun citing references at this point.

An abstract is a brief distinct paragraph summary of finished work or work in development. In a minute or less a reviewer can be taught the foundation behind the study, common approach to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Yet, use comprehensive sentences and do not let go readability for briefness. You can maintain it succinct by phrasing sentences so that they provide more than lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study, with the subsequent elements in any summary. Try to maintain the initial two items to no more than one ruling each.

- Reason of the study - theory, overall issue, purpose
- Fundamental goal
- To the point depiction of the research
- Consequences, including definite statistics - if the consequences are quantitative in nature, account quantitative data; results of any numerical analysis should be reported
- Significant conclusions or questions that track from the research(es)

Approach:

- Single section, and succinct
- As a outline of job done, it is always written in past tense
- A conceptual should situate on its own, and not submit to any other part of the paper such as a form or table
- Center on shortening results - bound background information to a verdict or two, if completely necessary
- What you account in an conceptual must be regular with what you reported in the manuscript
- Exact spelling, clearness of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else

Introduction:

The **Introduction** should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable to comprehend and calculate the purpose of your study without having to submit to other works. The basis for the study should be offered. Give most important references but shun difficult to make a comprehensive appraisal of the topic. In the introduction, describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will have no attention in your result. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here. Following approach can create a valuable beginning:

- Explain the value (significance) of the study
- Shield the model - why did you employ this particular system or method? What is its compensation? You strength remark on its appropriateness from a abstract point of vision as well as point out sensible reasons for using it.
- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
- Very for a short time explain the tentative propose and how it skilled the declared objectives.

Approach:

- Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done.
- Sort out your thoughts; manufacture one key point with every section. If you make the four points listed above, you will need a least of four paragraphs.

- Present surroundings information only as desirable in order hold up a situation. The reviewer does not desire to read the whole thing you know about a topic.
- Shape the theory/purpose specifically - do not take a broad view.
- As always, give awareness to spelling, simplicity and correctness of sentences and phrases.

Procedures (Methods and Materials):

This part is supposed to be the easiest to carve if you have good skills. A sound written Procedures segment allows a capable scientist to replacement your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt for the least amount of information that would permit another capable scientist to spare your outcome but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section. When a technique is used that has been well described in another object, mention the specific item describing a way but draw the basic principle while stating the situation. The purpose is to text all particular resources and broad procedures, so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step by step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

- Explain materials individually only if the study is so complex that it saves liberty this way.
- Embrace particular materials, and any tools or provisions that are not frequently found in laboratories.
- Do not take in frequently found.
- If use of a definite type of tools.
- Materials may be reported in a part section or else they may be recognized along with your measures.

Methods:

- Report the method (not particulars of each process that engaged the same methodology)
- Describe the method entirely
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures
- Simplify - details how procedures were completed not how they were exclusively performed on a particular day.
- If well known procedures were used, account the procedure by name, possibly with reference, and that's all.

Approach:

- It is embarrassed or not possible to use vigorous voice when documenting methods with no using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result when script up the methods most authors use third person passive voice.
- Use standard style in this and in every other part of the paper - avoid familiar lists, and use full sentences.

What to keep away from

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings - save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part a entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Carry on to be to the point, by means of statistics and tables, if suitable, to present consequences most efficiently.You must obviously differentiate material that would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matter should not be submitted at all except requested by the instructor.

Content

- Sum up your conclusion in text and demonstrate them, if suitable, with figures and tables.
- In manuscript, explain each of your consequences, point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation an exacting study.
- Explain results of control experiments and comprise remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or in manuscript form.

What to stay away from

- Do not discuss or infer your outcome, report surroundings information, or try to explain anything.
- Not at all, take in raw data or intermediate calculations in a research manuscript.
- Do not present the similar data more than once.
- Manuscript should complement any figures or tables, not duplicate the identical information.
- Never confuse figures with tables - there is a difference.

Approach

- As forever, use past tense when you submit to your results, and put the whole thing in a reasonable order.
- Put figures and tables, appropriately numbered, in order at the end of the report
- If you desire, you may place your figures and tables properly within the text of your results part.

Figures and tables

- If you put figures and tables at the end of the details, make certain that they are visibly distinguished from any attach appendix materials, such as raw facts
- Despite of position, each figure must be numbered one after the other and complete with subtitle
- In spite of position, each table must be titled, numbered one after the other and complete with heading
- All figure and table must be adequately complete that it could situate on its own, divide from text

Discussion:

The Discussion is expected the trickiest segment to write and describe. A lot of papers submitted for journal are discarded based on problems with the Discussion. There is no head of state for how long a argument should be. Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implication of the study. The purpose here is to offer an understanding of your results and hold up for all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of result should be visibly described. Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved with prospect, and let it drop at that.

- Make a decision if each premise is supported, discarded, or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."
- Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work
- You may propose future guidelines, such as how the experiment might be personalized to accomplish a new idea.
- Give details all of your remarks as much as possible, focus on mechanisms.
- Make a decision if the tentative design sufficiently addressed the theory, and whether or not it was correctly restricted.
- Try to present substitute explanations if sensible alternatives be present.
- One research will not counter an overall question, so maintain the large picture in mind, where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

- When you refer to information, differentiate data generated by your own studies from available information
- Submit to work done by specific persons (including you) in past tense.
- Submit to generally acknowledged facts and main beliefs in present tense.

Please carefully note down following rules and regulation before submitting your Research Paper to Global Journals Inc. (US):

Segment Draft and Final Research Paper: You have to strictly follow the template of research paper. If it is not done your paper may get rejected.

- The **major constraint** is that you must independently make all content, tables, graphs, and facts that are offered in the paper. You must write each part of the paper wholly on your own. The Peer-reviewers need to identify your own perceptive of the concepts in your own terms. NEVER extract straight from any foundation, and never rephrase someone else's analysis.

- Do not give permission to anyone else to "PROOFREAD" your manuscript.

- Methods to avoid Plagiarism is applied by us on every paper, if found guilty, you will be blacklisted by all of our collaborated research groups, your institution will be informed for this and strict legal actions will be taken immediately.)
- To guard yourself and others from possible illegal use please do not permit anyone right to use to your paper and files.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

Index

save our planet

Global Journal of Researches in Engineering

Visit us on the Web at www.GlobalJournals.org | www.EngineeringResearch.org
or email us at helpdesk@globaljournals.org

ISSN 9755861