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Highlights

Bite Controller for ESM

Modelling of Radar Antennas

ECG Arryhthmia Classifier

Empirical Mode Decomposition

Discovering Thoughts, Inventing Future

VOLUME 16 ISSUE 3 VERSION 1.0

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Implementation of Complete Ensemble Empirical Mode Decomposition to Analyze EOG Signals for Eye Blink Detection

By Md. Sakib Galib Sourav
Khulna University of Engineering & Technology, Bangladesh

Abstract- This paper reports on application of Complete Ensemble Empirical Mode Decomposition (CEEMD) technique to pre-process Electro-Oculogram (EOG) signals before eye blink detection technique is implemented. EOG is a non-stationary signal which is affected by different kinds of interferences. During the time of recording EOG signal gets contaminated by Electromyography (EMG) signal. In this paper CEEMD is used to decompose the EOG signal into several intrinsic mode functions (IMFs). After thresholding each IMF the signal is reconstructed using all of the IMFs. The resulting denoised signal is then used to detect eye blink.

Keywords: EOG, complete ensemble empirical mode decomposition, eyelid movement.

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Strictly as per the compliance and regulations of :

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Keywords: EOG, complete ensemble empirical mode decomposition, eyelid movement.

I. Introduction

The EOG signal is an electrical measurement of the potential difference between the front of the eye (cornea) and the back of the eye (retina). This potential varies from 0.4 to 1.0 mV (Malmivuo & Plonsey, 1995). EOG signal can be measured in horizontal channel and vertical channel. The eye movements in horizontal directions are recorded by horizontal channel and vertical channel records the eye movements in vertical direction. In addition to eye movements vertical channel also records eyelid movements i.e. eye blinks. An EOG signal is shown in Figure 1 which includes eyeball rotation, movements and eyelid movements. The muscles of the eye, eye blinks, electrode placement and head movements produce EMG signals [1]. To eliminate unwanted signals from EOG signal Empirical Mode Decomposition (EMD) has been used [2]. EMD algorithm is sensitive to noise. This can cause mode mixing. Mode mixing is defined as an IMF that includes oscillations of dramatically disparate scales or a component of similar scale residing in different IMFs [3]. To eliminate the mode mixing problem an extension to EMD algorithm was proposed [4] which is called Ensemble EMD (EEMD).It performs EMD over an ensemble of Gaussian white noise assisted data. But the reconstructed signal contains residual noise and different realizations produce different modes. To overcome these limitations variation of EEMD has been proposed [5] which is called Complete-EEMD (CEEMD). CEEMD algorithm provides an exact reconstruction of the original EOG signal which can be used to detect eye blinks precisely.

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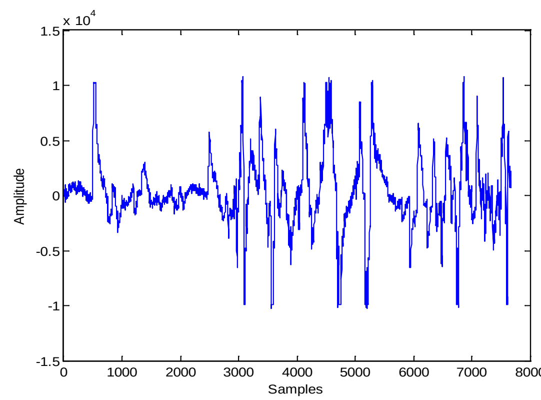

Figure 1 : Original EOG signal

II. Complete Ensemble Empirical Mode Decomposition

EMD [6] decomposes a signal into a number of IMFs. An IMF has two properties : (i) number of extrema and number of zero crossing are equal or differ by one; and (ii) at any point the average value of upper and lower envelop is zero. EEMD algorithm adds different realizations of white noise to the original data x[n]. Thus an ensemble of data sets is generated. To cancel out white noise ensemble average of different trials is calculated. EEMD algorithms can be described as [4]:

1. Add series of white Gaussian noise $w_i[n]$ (i=1,…….L) to the original signal x[n] and generate $x_i[n] = x[n] + w_i[n]$;
2. Derive a set of IMFs $d_{i\ j}$ (j=1,…….,k) and residues r_i (i=1,…….L) by decomposing each of $x_i[n]$ applying EMD; where, $d_{i\ j}$ is the jth IMF of the ith trial.
3. Repeat the above steps until i>L.
4. Average over the ensemble to obtain the final IMF.

The CEEMD algorithm can be described as [5]:

1. Add white noise to the original signal x[n]
2. Obtain the first decomposed component applying EMD.

3. Repeat the decomposition and add white noise of different realizations.
4. Average over the ensemble to obtain the IMF1: $IMF_1 = \frac{1}{L}\sum_{i=1}^{L} E_1[x[n] + \delta w_i[n]]$ L= number of realizations, δ= ratio coefficient, E_i computes ith IMF.
5. Compute the residue, $r_1[n]=x[n]-IMF_1$.
6. Compute the second IMF component IMF_2: $IMF_2 = \frac{1}{L}\sum_{i=1}^{L} E_1[[x[n] + \delta E_1[w_i[n]]]$
7. Repeat the above steps to obtain the (m+1)th IMF component IMF_{m+1}: $IMF_{m+1} = \frac{1}{L}\sum_{i=1}^{L} E_1[x[n] + \delta E_m[w_i[n]]]$

III. EOG Signal Denoising

Generally EOG signals are affected by the noises of power-line interference and EMG interference during data acquisition. In this paper CEEMD has been used to eliminate the interferences from EOG signals collected from Physionet database. The EOG signal is considered to be corrupted by additive white noise during the process of signal acquisition. CEEMD decomposes the EOG signal into 11 IMFs shown in Figure. 2. It can be seen that see that most of the noise information are distributed to the 1st intrinsic mode functions [7]. Suppressing the insignificant components we can reconstruct the signal as follows:

$$X_T = \sum_{n=1}^{N} I_n$$

where I is the set of N IMFs. The noisy EOG signal and the corresponding denoised signal is shown in Figure. 3

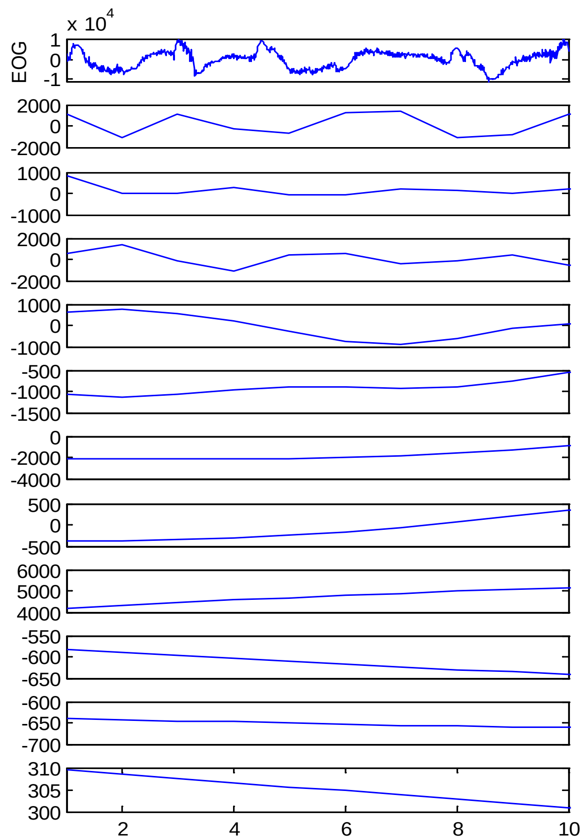

Figure 2 : Intrinsic mode functions

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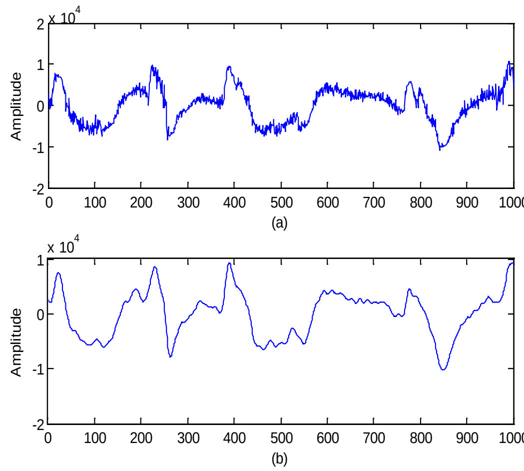

Figure 3 : (a) Noisy EOG signal (b) Denoised EOG signal

IV. Blink Detection

The algorithm [8] used here to detect the blinks includes the following steps:

1. Locating some 'events' in the EOG velocity data that have EOG velocity increase above the threshold of eyelid downward velocity and followed by a period below the threshold of eyelid upward velocity.
2. Identification of the events which have duration longer than 0.5 seconds and amplitude of closing and opening phase greater than a threshold value. These events will be considered as valid blinks.
3. Merging the contiguous events together causing double blinks which will be checked again. This algorithm has been applied on the denoised signal obtained by CEEMD. The results have been shown in Table. 1.

Table 1 : Results from different data set

Data set	SNRo	Blink Detection		
		Blinks	FP	FN
sc4002e0	35.00	04	00	00
sc4012e0	32.02	03	01	00
sc4102e0	30.08	03	01	00
Sensitivity=83%				
Specificity=100%				

V. Results and Discussion

EOG signals have been collected from Physionet databases [9]. EOG signals are taken from Physionet database [11].The original EOG signal is shown in Figure. 1 and the noisy EOG signal is shown in Figure. 3(a). This noisy signal is decomposed into 11 Intrinsic Mode Functions using CEEMD after which discarding insignificant components a denoised signal has been obtained which is shown in Figure. 3(b). MIT-BIH data sets are used for the investigation of the denoising performance of CEEMD and also the detection performance. The obtained results are shown in Table. 1. We calculate sensitivity and specificity has been calculated as [2]:

$$\text{Sensitivity}=\frac{TP}{TP+FP}\times 100$$

$$\text{Specificity}=\frac{TP}{TP+FN}\times 100$$

False Positive (FP) corresponds to detection of a blink where there is no blink, False Negative (FN) corresponds to failure to detect a blink and True Positive (TP) corresponds to properly detected valid blinks. We can see from the table that the performance of detection is better in case of specificity compared to sensitivity. The signal to noise ratio has been calculated as [2]:

$$\text{SNRo}=\frac{\sum_i [x_{de}(i)]^2}{\sum_i [x_{de}(i)-x(i)]^2}$$

where x_{de} (i) is the denoised EOG signal and x(i) is the original EOG signal.

VI. Conclusion

The performance of Complete Ensemble Empirical Mode Decomposition to denoise noisy EOG signals is quite satisfactory as it can be seen from the signal to ratio calculated for different datasets. The results reveal that the blink detection technique used here has more specificity compared to sensitivity as it detects some extra blinks (False Positive). This blink detection procedure may also ignore the long blink that has very slow eyelid movement velocity. There is scope to design more reliable blink detection technique to detect blinks.

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Microwave Principles in the Modelling of Radar Antennas for Automotive Applications

By Michael Asieni
University of Genoa, Italy

Abstract- In this paper we devise a general model in determining several salient parameters that have an effect on the 24 GHz radar antenna. This method is also applicable to several antenna design areas such as the satellite communication in the Ku band and C-band but our focus is mainly on the 24 GHz and 77GHz radar.

Keywords: antenna radiation patterns; radio frequency; radar.

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Microwave Principles in the Modelling of Radar Antennas for Automotive Applications

Michael Asieni

Abstract- **In this paper we devise a general model in determining several salient parameters that have an effect on the 24 GHz radar antenna. This method is also applicable to several antenna design areas such as the satellite communication in the Ku band and C-band but our focus is mainly on the 24 GHz and 77GHz radar.**

Keywords: antenna radiation patterns; radio frequency; radar.

I. Introduction

Radars have been developed for several applications and frequency ranges. High frequency radars such as the 24Ghz and 77Ghz radars are mostly used in the ground vehicle applications, radars in the Ku and Ka band are known to be used mainly for satellite applications while marine radars, usually in the X, S and Ku bands are mainly used in research (which includes weather monitoring) and navigation in marine environment.

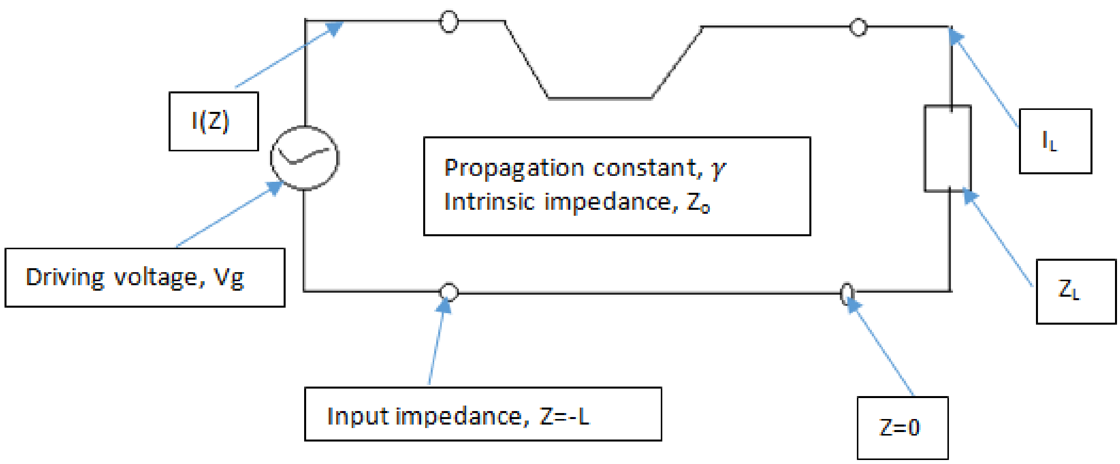
In this research, our focus is mainly on high frequency radars in the 24 GHz and the 77 GHz region. These radars are mainly used in these applications because of their detecting range, low cost of circuit components and light weight (recent advances in solid-state semi-conductors) and the amount of driving power required. The radars used in these applications are generally known to consist of the following components: Power amplifier, band pass filter, control and frequency detection unit, Analog-to-digital converter, mixer, low pass filter, a floating point computation unit and an antenna unit.

These radars mostly concerned with traffic safety parameters and the protection of vulnerable road users due to their ability to detect pedestrian in the dangerous scenarios of the vehicle.

The performance of such radar units are affected by the following parameters: gain of the antennas used, the signal-to-noise ratio of the detected low frequency (LF) radar return signal, the polarisation of the antenna, the floating point algorithms, bandwidth, the side-lobe and the main-beam width lobe of the beam forming unit.

II. Circuit Model of Antenna

The electronic engineer views the antenna as part of the electronic system, in which case it is just another circuit element with the properties of conductivity, resistance or admittance and can take on complex values due to the presence of reactive elements.



III. Proposed General Model

The propagation constant relates the different Field patterns or modes (usually denoted as the TM_{mn} where either m or n can be zero) Hence the propagation constant is denoted as:

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$\gamma = \sqrt{-(k^2) + \frac{m\pi}{a} + \frac{n\pi}{b}}$ Where a and b are the dimensions of the waveguide $k = \omega\sqrt{\varepsilon\mu}$ [1]

The attenuation of this nature and the circuit model provides us a way of determining what happens even when there is no current in the circuit. It is possible to deduce from our circuit model the possibility of obtaining non-trivial solutions assuming the circuit model has wave reflections (in which case, the VSWR parameter becomes prominent) inherent in them which of course results to zero due to non-excitation.

Therefore this leads to the reinforcement of the generally accepted principle and a further iteration that there is no solution at all frequencies but solutions are obtained at a particular frequency specification (we obtain the cut-off frequency for the existence of a certain TM, TEM or TE mode).

At microwave frequencies we may need our resonator to work with other types of resonators because at high frequency, the losses become important in the transmission line.

Waveguides are an instance of our circuit model with regards to the transmission line theory. Though the same concept of application the transmission line differs from the waveguides in the following respect:

1. While the transmission lines support only transverse electromagnetic (i.e TEM) wave, the waveguides are able to support several operating modes based on specifications.
2. Waveguides are employed in specialized frequency ranges for specialized applications while transmission lines are usually inefficient at microwave frequencies usually due to skin effect. Metallic enclosures are a classic example as frequently used in most antenna applications.

IV. Discussion of Model Parameters

Considering the basic circuit model the important parameters are the voltage standing wave ratio, the reflection coefficient and the input impedance.

The input impedance [1] of the circuit model in I can be written as:

$$Z_{in} = z(-l) = \frac{V(z=-l)}{I(z=-l)} ohms$$

The input impedance also provides Behavioral modelling of the circuit: open circuit and short circuit (z=∞) at various lengths (wavelengths) of the transmission line.

The reflection coefficient [1] of the circuit model in I can be written as:

$$\Gamma(z) = \frac{V_o^- e^{+\gamma z}}{V_o^+ e^{-\gamma z}}$$

Here we measure how the electromagnetic wave has been reflected by an impedance inconsistent with the desired frequency. The voltage standing wave ratio [1] of the circuit model in I can be written as:

$$VSWR = \frac{|1+\Gamma|}{|1-\Gamma|}$$

It is function of the reflection coefficient which describes the power reflected from the antenna. The VSWR has a profound effect on the antenna power and the bandwidth with a minimum of 1 indicating no reflection by the antenna.

For directional antennas such as the pin antenna, the flag antenna and the circular antenna, the direction of emission corresponds to the direction where maximum power is received. The excitation of antennas such as the Ferrite rod antennas, cylindrical antenna, segmented dipole, center-fed dipole and the yagi-uda antennas rely very much on the discussed parameters for maximum power gain.

A good automotive radar antenna should possess the following qualities:

1. A reasonable wide scan angle (excellent scan rate and faster update time, antenna with a 360 degree field view are prominent candidates) and easy integration into vehicle.
2. Small size and affordable to the consumer after integration.
3. Good antenna performance in terms of radiation patterns main beams and side lobes and excitation voltages.

The gain of the antenna is also an important parameter in determining the size of the antenna whilst the wavelength is crucial in the determining the frequency and the range of coverage. In the case of the automotive radar, the range in which an obstacle can be detected is also of great importance.The gain of the antenna [1] can be represented by the following equation:

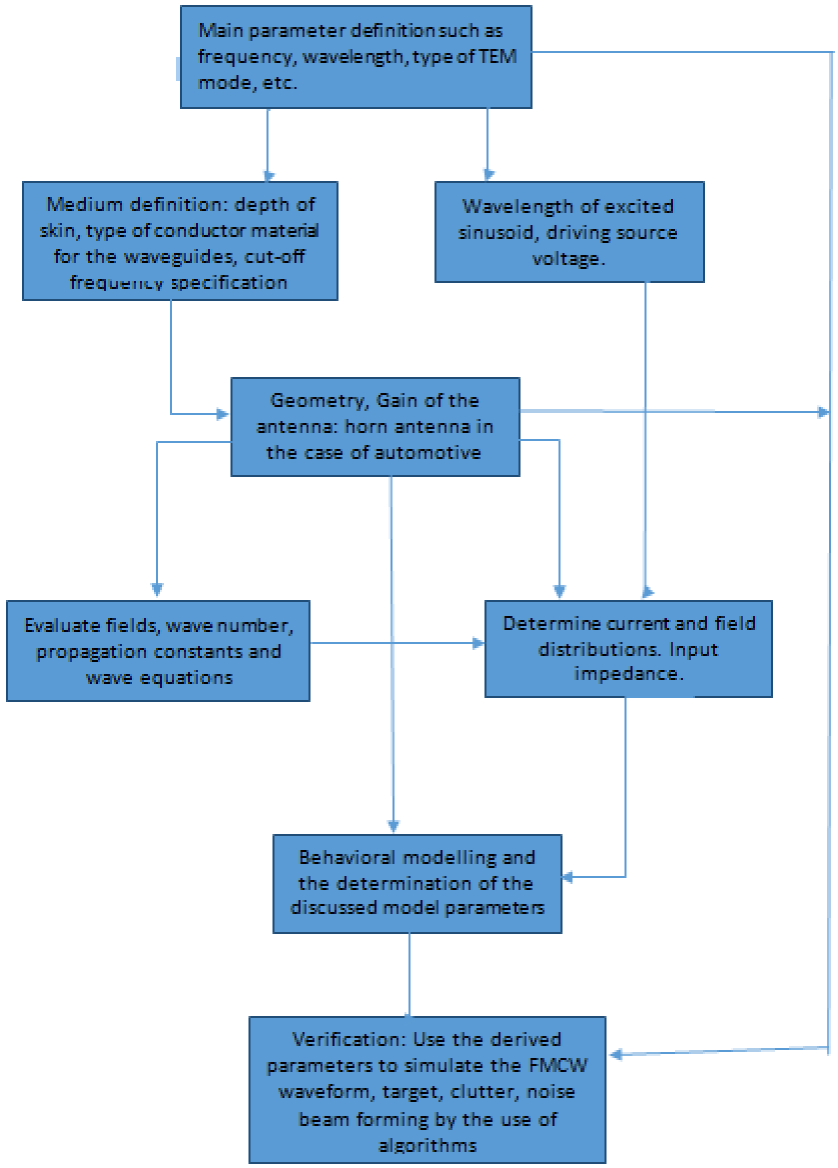
$$G = \frac{4\pi}{\lambda^2} A_{eff}$$

The impedance of the antenna [1] is determined by applying the following formula:

$$P_r = H^2 Z_o \quad in \quad \frac{watts}{meter^2}$$

Where H is the rms magnetic field intensity and Z_o is the intrinsic impedance (being calculated) of the medium.

IV. Analytical Model for Antenna Evaluation



[2] does an impressive work by the use of the analytical model in simulating the Forward Moving Collision Warning system (FMCW) for a 77 GHz radar system by the using MATLAB phase array tool box. The system parameters enabled behavioural modelling in line with our discussed model parameters by the use of the MATLAB software. A complete system simulation of the radio frequency (RF) elements of the antenna is done and the verification step is also achieved.

V. Conclusion

In this paper, we put together some general salient parameters that affect antennas generally with our focus on the automotive radar antennas. This method have a profound effect on the design parametersneeded for simulation (and antenna design). It has effect on the beam forming unit and the polarisation of the antenna. We provide an analytical framework model for the computation and determination of some of the discussed parameters and more. The discussed parameters also play a major role in the excitation (driving power) of the antenna.

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ECG Arryhthmia Classifier

By Md. Nasir Uddin, MM Rashid MG Mostafa, Belayet H, SM Salam, NA Nithe, MW Rahman & A Aziz
International Islamic University, Malaysia

Abstract- ECG (electrocardiograph) is test that measures the electrical activity of the heart. In an ECG test, the electrical impulses were made while the heart is beating and then it records any problems with the heart's rhythm and the conduction of the heart beat through the heart which may be affected by underlying heart disease. In this project different signal processing techniques which are in Time-Frequency Domain and Auto-Correlation will be analyze and later, it will be classify to predict the patient's heart condition whether it is healthy or not Apart of that, this project also used three types of method for automatic classifications which are Signal Analysis Technique, Pattern Recognition and Automatic Classification. MATLAB will be used as a computerized of ECG problems. In MATLAB, the data were analyzed and classified.

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ECGARRYHTHMIACLASSIFIER

ECG Arryhthmia Classifier

Md. Nasir Uddin [α], MM Rashid [σ], MG Mostafa [ρ], Belayet H [Ѡ], SM Salam [¥], NA Nithe [§], MW Rahman [χ] & A Aziz [v]

Abstract- ECG (electrocardiograph) is test that measures the electrical activity of the heart. In an ECG test, the electrical impulses were made while the heart is beating and then it records any problems with the heart's rhythm and the conduction of the heart beat through the heart which may be affected by underlying heart disease. In this project different signal processing techniques which are in Time-Frequency Domain and Auto-Correlation will be analyze and later, it will be classify to predict the patient's heart condition whether it is healthy or not Apart of that, this project also used three types of method for automatic classifications which are Signal Analysis Technique, Pattern Recognition and Automatic Classification. MATLAB will be used as a computerized of ECG problems. In MATLAB, the data were analyzed and classified.

Chapter 1

I. Introduction

a) Background

Any processes that happen in the human body have some sort of bioelectricity associated with tem even the heart beats. Each time the heart beats it produces electrical currents. These currents are responsible for the rate and pattern of contraction of the heart. The ECG device capture these currents through the electrodes and record them. The signal consists of five main components: the P, Q, R, S and T wave. The P wave is responsible for depolarization of the left and right atrium. The RS complex is composed of the q, R and S waves and represents left and right ventricular depolarization. At this same time, the QRS complex masks the P wave depolarization. The T wave is responsible for the depolarization of the left and right ventricles. (R H, John, Adlam F, Hampton JR, 2008). In 1d903, The first electrocardiogram measurement device was developed by willem Einthoven when he invented a new instrument called the string galvanometer. (R H, John, Adlam D, Hampton JR, 2008). Using that device, he developed an improved method for measuring the electrical changes that take plae in the human body upon the contractions and electrical changes in the atria of the heart and others from contractions and electrical changes in the ventricles. The string galvanometer made possible the first valid and reliable electrocardiogram, thus giving doctors one of the most valuable tools for the study of heart disease. (R H, John, Adlam D, Hampton JR, 2008).

Variations in a patient ECG signal, particularly changes in the size and appearance of the QRS complex and the t/s waves will inform a trained professional what condition the heart is in. Also these changes give the required information to diagnose the patient's aliment. One could apply the knowledge of the professional to an artificial system so that it can make the same insights and diagnosis. This concept has been explored since the early 70's with the use of large computer databases and algorithms but not until recently has it been done with great successes. (Lippincott Williams & wilkins, 2005). There are systems already on the market for use by veterinarians, but how they are implemented has not been disclosed. No such system has been designed yet that is widely used in human healthcare because doctors feel that they can still diagnosis with greater success then the systems.

b) Problem statement

Presently, many cardiologists face difficulty in making a continuous and correct diagnosis for heart diseases. An addition to this also, conventional technique of visual analysis is more complicated and requires experienced and time. Thus, the information obtained from an electrocardiogram can be used to discover different types to heart diseases. In order in ensure patients safety this information must be accurate, precise and automatic monitoring. Therefore by doing this project, the patient treatment process can be monitored all the time without the need of an expert cardiologist analysis the signal.

c) Objectives

The objectives of this project are:

- To develop the electronic circuitry for the previously developed ECG classifier algorithm.
- To develop the interface between the ECG monitoring system and the developed classifier.
- To evaluate the performance of developed electronic ECG classifier system.

d) Methodology

e) Scope of the project

The ECG Arrhythmia classifier project ill focus on the requirements for the acquisition of an ECG signal from a patient, amplifying and filtering the signal to follow the medical requirements of an ECG system and classify the signal. The acquisition of the signal

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component of the project will involve selecting appropriate electrodes and placing them correctly to achieve the best signal possible. It will also include appropriate selection of amplification circuitry to apply gain to the low voltage ECG signal. As the ECG Analyzer is connected to a patient and a computer at the same time there is a need to isolate the patients from the computer so they will not get shocked. Throughout this project the theory will be tested and implement the circuit using breadboards and implement the arrhythmia algorithm in MATLAB software. Then feature extraction of the parameters of the signal and detecting R-Peak in QRS complex. After extracting the parameters of the signal and detecting Heart beats, Neural Network is to be used to compare between the ECG signal acquired form the patient and MIT-BIH Database of ECG waveforms. The Analyzer must be cost effective and inexpensive to create, to market this to third world countries where doctors are in a very short supply. By making it inexpensive does not mean the hardware is allowed to have poor signal reproduction it is the goal of the project to have a high level of signal reproduction and a cardiologist is going to verify the output results of this project.

Chapter 2

II. Literature Review

a) Electrocardiograph (ECG)

Electrocardiogram (ECG) is the recording of the heart's electrical activity over time via skin electrodes. The deviations in the normal electrical patterns indicate various cardiac disorders and abnormalities. Cardiac cells, in the normal state are electrically polarized. Their inner sides are negativity through a process called depolarization, which is the fundamental electrical activity of the heart. This process is propagated current and it can be detected by from cell to cell, producing a wave of depolarization that can be transmitted across the entire heart. This wave of depolarization produces a flow of electric current and it can be detected by keeping the electrodes on the surface of the body (skin). Once the depolarization is complete, the cardiac cells are able to restore their normal polarity by another process named re-plarization. This process also sensed by electrodes 13. (Cromwell & Wibell, 2005)

b) Electrocardiograph Interpretation

The ECG records the electrical activity of the heart over time, where each heart beat is displayed as a series of electrical waves characterized by peaks and valleys. Any ECG gives two kinds of information. First, the duration of the electrical activity is normal or slow or irregular while the second is the amount of electrical activity passing through the heart the heart muscle which enables to find whether the parts of the heart are too large or overworked. (Saritha & Sukanya, 2008) Normally, the frequency range of an ECG signal is of 0.05C, 100Hz and its dynamic range of IC, 10mV. (Carlos, Amercas & Cuadalajara, 2010. Where the significant features of the waveform are the P, Q, R, S and T waves, the duration of each wave and certain time intervals such as the P-R, S-T and Q-T intervals.

In ECG signal, the heart muscles generate different voltages. The P wave represents the atrium contraction, QRS complex and the T wave represents the ventricles actions. Each time that this signal is present, a heartbeat is generated. For this reason it is important to develop analog and digital signal conditioning. First, it is necessary to amplify the signal and filter the noise and then extract the QRS complex (Carlos, Americas & Guadalajara, 2010)

Noise and interference signals acquired in this type of system are caused by the electric installation. The small electrical signal from the heart generates a common-mode voltage and noise in the system. The signals from the heart are too small and it is necessary to amplify the signal and reduce the common-mode voltage on the system. Other aspects that generate noise are muscle contractions, respiration, electromagnetic interference and electromagnetic emissions from electronic components (Carlos, Americas & Guadalajara, 2010).

In the normal sinus rhythm (normal state of the heart) the P-R interval is in the range of 0.12 to 0.2 seconds. The QRS interval is from 0.04 to 0.12 seconds. The Q-T interval is less than 0.42 seconds and the normal rate of the heart beat is form 60 to 100 beats per minute. (Saritha & Sukanya, 2008).

So, from the recorded shape of the ECG, the author can conclude whether the heart activity is normal or abnormal. The electrocardiogram is a graphic recording or display of the time variant voltages produced by the myocardium during the cardiac cycle. The P, QRS and T waves reflect the rhythmic electrical depolarization and repolarization of the myocardium associated with the contractions of the atria and ventricles and very useful in diagnosing various abnormalities conditions associated with the heart. Table 2.1 shows ECG waveform details and the duration of each segment of the PQRST waves.

Table 2.1 : EGG waveform(Saritha & Sukanya ,2008)

Amplitude	Durations
P-wave-0.25 mV	P-R interval: 0.12 to 0.20
R-wave-1.60	Q-T interval: 0.35 to 0.44 s
Q-wave-25%R wave	S-T interval:0.05 to 0.15 s
T-wave-0.1 to 0.5 mV	P-wave interval: 0.11s
	QRS interval: 0.09s

The horizontal segment of EGG waveform preceding the P-wave is indicate as the baseline or the is potential line. The P-wave represents depolarization of the atrial musculature and the QRS complex si the combined result of the repolarization of the atria and depolarization of the ventricles, which occur almost simultaneously. The T wave is the wave of ventricular repolarization. Consequently, the duration amplitude and morphology of the QRS complex is useful in diagnosing cardiac arrhythmias, abnormalities, ventricular hypertrophy, myocardial infection and other disease or abnormalities (Li & Zheng, 1995).

c) Electrocardiograph Electrode

Electrode is not the same concept as lead. An electrode is a physical patch which connects to the patient. Meanwhile, a lead s a specific vector in which voltage is measured. ECG electrodes are used for sensing bioelectric potential (electrical activity) as caused by cardiac muscle. The electrical activity can be seen as a constant DC electric field or a constant flux of charge –carrying particles or current. The electrodes work as transducers converting ionic current flow from the body into the electron flow of the metallic wire and consequentially ECG signal can be diagnosed after amplified and processed. A high ionic concentration gel is therefore normally used in the skin electrode interface to increase conductivity.

The choice of material is important as well because the small electrical charge at the skin-electrode interface varies with different electrode materials. The best currently available materials are gold, platinum, stainless steel, while the most commonly used is the silver chloride electrode. (Aily, 2009).

Another sensor that was considered was the piezoelectric sensor. Piezoelectric materials generate an electric potential when mechanically strained. During a heartbeat the pressure in the blood vessels is higher than when the heart is in its resting stage.

This higher blood pressure causes a physical deformation in the skin and thus a piezoelectric sensor can produce an eclectic potential during every heartbeat. The principal reason why the piezoelectric sensor is less than ideal is that it is pressure sensitive. (Aily, 2009) In order to pick up a signal the user (elderly, family members, etc) would have to press the sensor hard against the patient which could cause a permanent deformation of the piezoelectric material. Thus, the silver chloride electrode (inert, cheap, biocompatible) is used in this project rather than the piezoelectric electrode to give best performance of ECG waveform and avoid for possible complications occur if the author use the piezoelectric sensor.

d) Electrocardiograph Interference source

In order to design an effective wireless electrocardiograph, one needs to consider the possible interferences that might exist when undergoes the data capturing on the patient. The interference sources can be divided into 3 distinct groups:

1) Noise originating from sources external to the patient.
2) Interference originating from the patient.
3) Unwanted Potential as well as interference originating from patient- electrode contact.

e) Heart and Heart-Electrical Activities

The heart is the organ responsible for pumping blood throughout the body. It is located in the middle of the thorax, slightly offset to the left and surrounded by the lungs. The heart is composed of four chambers; two atriums and two ventricles. The right atrium receives blood returning to the heart from the whole body. That blood passes through the right ventricle and is pumped to the lungs where it is oxygenated and goes back to the heart through the left atrium., then the blood passes through the left ventricle and is pumped again to be distributed to the entire body through the arteries (Carlos, Americas & Gyadalajara, 2010). Figure 2.4 shows the blood circulation scheme.

Electrical heart activity is based on depolarization and re-polarization of myocardial cells. The electrical impulse starts in the senatorial node (natural pacemaker) flowing through the atriums to reach the atrio ventricular node and generating the atrium contraction. The current then flows through the His Bundle reaches the ventricles and flows through them generating the ventricular contractions. Finally, the current reaches the Purkinje fibers and re-polarization of the heart tissue occurs (Carlos, Americas & Guadalajara, 2010).

The electrical potentials generated by the heart can be represented as vector quantity. For understanding purposes, the heart is represented as a dipole located in the thorax with a specific polarity at a certain moment and an inverted polarity the next moment. The potential in a specific moment is defined by the amount of charge and the separation between charges. Figure 2.6 show the list of events that occur in the heart on each heart beat.

1) Atrium begins to depolarize
2) Atrium depolarizes
3) Ventricles begin to depolarize at apex. Atrium repolarizes
4) Ventricles depolarize
5) Ventricles begin to repolarize at apex
6) Ventricles repolarize

Each pair of electrodes or an electrodes combination is defined as lead. There are three basic leads used for cardiology. Lead I is at 0°, lead II is at 60° and lead III is at 120°. The three basic electrode leads make-up the frontal-plane. Electrodes are placed on the limbs; left arm (LA), right arm (RA) and left leg (LL). Those connections are due to the legs and arms being used as a "wire" to detect the bio-potentials that occur in the chest (Carlos, Americas & Guadalajara, 2010). The graphic representation of each lead is shown in Figure 2.7.

Einthoven's triangle is known as the "three lead" ECG, with measurements taken from three points on the body. If two leads are connected between two points on the body will forming vector between them, electrical voltage observed between the two electrodes is given by the dot product of the two vectors. Another lead connected at the body acting as ground to protect human body. (Patrick et al 2002) Figure 2.7 shows the triangle that formed around the heart which refers to as the Einthoven's triangle. The top of triangle is formed by lead I, the left side is formed by lead II and at the right side is formed by lead III (Brenda, Beasley &Michael 2003). Table 2.2 shows the placement of the electrode on the three lead ECG. The most significant among these is lead II because their ability to visualize p wave.

Table 2.2 : The placement of the electrode on the three lead ECG

Leads	Positive Electrode	Negative Electrode
I	Left arm	Right arm
II	Left leg	Right arm
III	Left leg	Left arm

f) Arrhythmias

An arrhythmia is disturbance of the normal rhythm of the heart, Arrhythmias are very common and affect over 7,00,000 people in the worlds today. Arrhythmia may occur naturally, or be due to heart disease or other causes, such as reaction to medicine. An arrhythmia may occur continuously or just occasionally. The heart rate can become abnormally rapid, slow and/or irregular.

i. *Types of Arrhythmias*

There are a number of different types of arrhythmia including those listed below(Brenda, Beasley & Michale, 2003):

i. Atrial fibrillation (AF)
ii. Atrial tachycardia (AT)
iii. Ventricular tachycardia (VT)
iv. Ventricular fibrillation (VF)
v. Heart block

ii. *Symptoms*

If someone does have symptoms, it will depend on the type of arrhythmia he/she have and how severe it is. Symptoms mat include:

i. Palpitations
ii. Dizziness
iii. Fainting or collapsing
iv. Breathlessness
v. Chest pain
vi. Angina Pain

g) Standard 12 lead ECG

The 12-lead electrocardiogram (ECG) is a diagnostic test that helps identify pathologic conditions, especially ischemia and acute myocardial infarction. It provides a more complete view of the heart's electrical activity than a rhythm strip and can be used to assess left ventricular function more effectively. Patients with conditions that affect the heart's electrical system may also benefit from a 12-lead ECG consists of six limb leads and six chest leads. The electrodes to be attached on the limbs are connected to the wrists and the ankles in rest ECG recording.(W M, Peter, Lawrie TD, 1979). During the exercise ECG the electrode positions are at the ends of the collarbone and the ridges of the iliac bone. The locations for the chest electrodes to the recommendation of the American Heart Association are as follows and can be viewed in Figure 2.9:

- V1: Fourth intercostals space, at the right margin of the sternum.
- V2: The same space, at the left margin of the sternum.
- V3: Midway between V2 and V4.
- V4: Intersection of left mid-clavicular line and fifth intercostals space.
- V5: At the intersection of left anterior auxiliary line with a horizontal line through V4.
- V6: At the intersection of left mid-auxilary line with a horizontal line through V4 and V5.

This type of ECG will oftern be used as a one-off recording of an ECG, typically printed out as a paper copy.

Chapter 3

III. Methodology

a) Overview

An electrocardiograph is a device that can measure the electrical signals produced by the heat. Each event during a cardiac cycle produces a waveform that forms the ECG, physician then can analyze this signal to access the state of the cardiac tissue. The ECG implores surface electrodes to acquire the minuscule voltages produced by the heart during the cardiac cycle. Pairs of electrodes are placed on different parts of the heart to measure the ECG from different angles. Electrodes are required for acquisition of the ECG signal from the body. The body acts like a giant resistor and therefore the ECG signal produced in the heart has a smaller amplitude (0.5~4mV) at the surface of the body as compared to the surface of the heart. This means that the electrodes have to be sensitive enough to pick up the signal produced and ensure that the signal is not lost during transmission to the amplifier. There are certain requirements for the amplifiers so they provide enough amplification to the signal so that it can be analyzed by the other components of the circuit. As well it must have very high input impedance, a large CMRR and low power consumption. There is also a need to remove the line noise out of the signal, as this will be used in a hospital setting where electric current is running. The power supply used in the design of the ECG has to be able to support a current draw of 1.1 mA and needs to be able to supply power to all other components of the ECG, which could require voltage in the range of +/-5 to 15 volts. There is also a need to protect the patient, as this ECG will need to be attached to a computer so the software can analyze the signal. This can be done successfully by isolating the patient from the computer by imploring an isolation amplifier. After acquiring ECG signal from the patient, the signal will be processed through classifier that classify the signal of Electrocardiogram waveforms with the intention of assisting in the detection of abnormalities and therefore facilitate the early detection of cardiac problems. The algorithm of the classifier based on MIT-BIH database. The signal are examined with Pan-Tompkins algorithm to detect the parameters of the signal and then classification of the signal.

b) Electrode theory

In order to measure and record the potentials from the heart it is necessary to provide some interface between the body and the hardware. The electrodes are this interface. Electrodes must have the capability of conducting a current across the interface between the body and the hardware. The electrode has to serve as a transducer to change an ionic current into an electronc current, which greatly complicates the operation of the electrode. (R H, John, Adlam D, Hampton JR, 2008). The type and size of the electrode is determined by the signal being measured, the location on the body and the dimensions of the generator of the signal. In the case of the ECG the signal range is from 0.5~4mV and the frequency range of the signal is from 0.01~250Hz. Given these values modern ECG systems can implore a number of different electrodes. One common electrode implored by most ECG systems is the silver chloride electrode and this electrode has been chosen to be used for the project. The choice of the electrode and how it interacts with the patient's body determines what type of amplification hardware that will be used. The way the electrode interacts with the patients can be shown as an equivalent circuit and can been seen in Figure 3.1. The ECG signal produced by the cardiac tissue loses signal strength because it must travel through bone and muscle and therefore the signal faces an iternal resistance .9R H, John, Adlam D, Hampton JR, 2008).

The ECG is only acquired by measuring the difference in half-cell potentials between electrode I and electrode II to give the potential difference (in mV). The dermis and subcutaneous layers are modeled as resistance since they are mainly composed of fat and have no electrical properties. The epidermis specifically the stratum corneum is a membrane that is semi-permeable to ions, so if there is a difference in ionic concentration across this membrane, there is a potential difference of Ese created. To minimize the effect of the stratum corneum it must be removed, or least part it, from under the electrode. This can be done by abrading the skin by vigorous rubbing of an alcohol swab in the area that the electrode is being placed. The rest of the epidermal layer is found to have an electric impendence that behaves as a parallel RC circuit. The sweat glands and ducts secrete fluid that contain Na+, K+ and Cl- ions, which create a potential difference between them and subcutaneous layer (Ep). There is also a parallel RC combination in series with the potential, which is acquired from the walls of the sweat glands and ducts. If conductive gel is used it is represented as a resistance and it will improve the conductive properties of the skin. The last part of electrode theory will focus on motion artifacts and how they are created. The silver electrode develops a double layer of charges when it is in contact with the electrolyte. When the electrode/electrolyte contact is disturbed during generates a sudden potential difference between the electrodes, which results in motion artifacts in the ECG signal. When the motion of the electrode stops the double layer is re-established and the initial half-cell potential is obtained again. But the danger is in the fact that a sudden spike in voltage can saturate the instrumentation amplifiers. Variations in the skin/electrolyte interface can cause motion artifacts as well. To prevent motion artifacts ensure that the skin is prepared properly and the electrodes are placed correctly.

c) Amplification theory

An ECG signal has a range of $8x10^{-5}$ about $5x10^{-3}$ V in amplitude which means that this signal must be amplified. (Scanlon VC, 2008). For the system to be able to correctly produce the signal a gain of about 1000 is necessary. To successfully produce the required gain instrumentation amplifiers are the best choice. An instrumentation amplifier is a type of differential amplifier that has been outfitted with input buffers that eliminate the need for input impedance matching and thus make the amplifier particularly suitable for use in measurement and test equipment. Additional characteristics include veyry low DC offset, low drift, low noise, very high open-loop gain, very high common-mode rejection ratio and very high input impedances. They also have the benefit of being able to adjust the gain of the amplifier circuit without having to change more than one resistor value. Instrumentation amplifiers are used where great accuracy and stability of the circuit is needed for both short- and long-term. when acquired from the silver electrode the very small ECG signal will be accompanied by a large ac common-mode component (up to 1.5V) and a large variable dc common-mode component (300mV).

To deal these components it is imperative that they are met by an amplifier with a High CMRR. The common –mode rejection ratio specified by the Association for the Advancement of Medical Instrumentation (AAMI) is 89 dB minimum for a clinical ECG and 60 dB for an ambulatory ECG. (Scanlon VC, 2008). As stated above the choice of an instrumentation amplifier will allow for a high CMRR and meet or surpass

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these requirements. The electrode/skin interface has impedances that can range from 1K to 1M Ω. (Scanlon VC, 2008). This impedance is made up of the equivalent impedance of the electrodes, the fat volume underneath the skin which has an impedance associated with it and the resistance of the body. Also there is a dependence on the skin condition. Its preparation will contribute to the impedence and if the system is worn for a long period of time the skin will change and therefore the impedance will also chage. Finally if the signal is in the frequency range of 0.01 Hz to 1 Hz an increase in the electrode/skin impedance is expected as the capacitive component of the skin would be much higher in this range. If the wrong amplifier is chosen a voltage divider will appear between the electrodes and input of the amplifier, which will lead to signal loss. High input impedance on the amplifier would prevent the formation of voltage dividers.

d) Isolation theory

As this system will be interfacing with a computer there must be a barrier set up between the computer and the patient. This will keep voltage from the computer that could potential hurt the patient away from them but also endure the safety of the internal components of the computer. This can be done by using an isolation amplifier. Isolation amplifiers are devices that break the ohmic continuity of electric signals between the input and output of amplifier. They usually consist of an instrumentation amplifier at the input followed by a unity gain isolation and a genera model can be seen in Figure 3.3 (Webster JG, Clark JW, 1998). The isolation can occur in three ways transformer isolation, optical isolation or capacitive isolation. Transformer isolation approach uses either a frequency modulated or pulse modulated carrier signal with a small signal bandwidths to carry the signal. The optical method uses a LED on the source side and a photodiode on the output side, which uses the brightness of the LED to deduce the voltage of the signal at that current point of time. Lastly the capacitive method uses digital encoding of the input voltage and frequency modulation to send the signal across a differential ceramic capacifive barrier. (Webster JG, Clark JW, 1998).

e) Soundcard of Laptop

A sound card also known as an audio card which has facilitates the input and output of audio signals to and from a computer under control of computer programs. Typical uses of sound cards include providing the audio component for multimedia applications such as music composition, editing video or audio, presentation, education and entertainment (games). Many computers have in built sound capabilities, while others require further soundcard expansion cards to provide for audio potentiality. Sound card has usually functioned of analogue to digital converter (ADC), which converts recorded or generated analogue data into a digital format. The output signal is connected to an amplifier, headphones or external device using standard interconnects. For higher data rates and multiple functions, there is more advanced card commonly include more than one chip.

f) MIT-BIH Arrhythmia Database

This project uses the MIT-BIH Database of ECG waveforms, forty seven subjects were studied by the BIH laboratory twenty three recording were picked at random from a set of 4000 and twenty five recording were collected from the same data to include abnormal ECG. 360 samples were digitized per second and each record was independently noted with an explanation, to include background information on the subjects, including their medications.

g) QRS Detection

The QRS complex is the most important complex in the ECG. The duration and amplitude sure be measure as accurate as possible. There are two methods for high light the QRS complex. These are the Pan-Tompkins algorithm and he derivation-based method. This project will use the Pan-Tompkins algorithm: because with the derivation based methods the QRS might not always be the highest wave in a cardiac cycle, this is because atrium relaxation wave inside the QRS wave and this would upset the peak search algorithm.

h) Pan-Tompkins algorithm

It's the algorithm for detection of QRS complex of ECG signals. It reliably recognizes QRS complexes based upon digital analyses of slope, amplitude and width. Special digital band pass filter reduces false detection caused by various types of noises such as muscle noise, artifacts due to electrodes motion, power line interference, base line wander, T wave with high frequency characters tic similar to QRS complex. This algorithm is implemented for detection of QRS complex on normal database.

i) Neural Network

When the ECG waves have been processed, they must be classified into two classes normal or abnormal. In his project the classifier that will be used is the Artificial Neural Network (ANN), AAN is a computer based system based on the Neural Networks in human biology. Neural Networks are useful for pattern recognition and non-linear systems. The function of network depends on the connection between the different elements (neurons). These connections are called weights. The output is compared with the desired target. The weight in the neural network are changed to help achieve the target, these changes are called training a network. ANN will need a lot of training to correctly classify the various features of an ECG wave.

Chapter 4

IV. Design Procedure and Results

a) Overview

The design of the hardware for the ECG analyzer was broken up into three individual sections. These sections are electrode and amplification and finally isolation. Designing and testing of each of these sections will be described in the following sections. It is to be noted when testing the circuit two power sources were used. The first was a +/-15V source from a test board and the second was a +/-5V battery source.

b) Electrode and Amplification

The first part of the hardware and probably the most important as they acquire the signal are the electrodes. The electrodes that were used for this project were the 3M™ Red Dot™ Wet Gel Monitoring Electrodes. Red Dot Wet Gel electrode is a round –style 3M™ Micropore™ Surgical Tape-backed electrode designed for long –term use. The electrodes have wet gel conductive columns and 3M™ SureSeal moisture vapour barrier caps to ensure product freshness. Each electrode also has a border adhesive that works well for all types of skin conditions. The electrodes were placed on both the wrists and one on the right ankle. To prepare the skin as outlined in the theory alcohol wipes were used and the skin was rubbed until a slight redness appeared. The lead connected to the right wrist was attached to the positive input of the instrumentation amplifier and the lead connected to the left wrist was attached to the negative input. Lastly the lead connected to the left ankle was connected to ground. This set-up allowed us to view the heart at two different angles. The ECG signal has a range of 0.5~4mV which is a very low voltage signal. With this signal being such a low voltage it needed to be amplified by a gain of 1000 to provide good signal reproduction. The INA126 is precision instrumentation amplifier for accurate, low noise differential signal acquisition. Their two op-amp design provides excellent performance with very low quiescent current (175μA/Channel). This, combined with a wide operating voltage range of $\pm$1.35V to $\pm$18V, makes them ideal for portable instrumentation and data acquisition systems. Gain can be set from 5V/V to 10000V/V with a single external resistor. Laser trimmed input circuitry provides low offset voltage (250μV max), low offset voltage drift (3 μV/ °C max) and excellent common-mode rejection.

c) Isolation Amplifier

When the ECG hardware connect to a computer there is a need to isolate the patient from the computer to ensure patient safety. To perform this task I implored the use of an isolation amplifier, which performs the required task with ease. The isolation amplifier I chose to use was the ISo124 by Texas instruments. This isolation amplifier was a high precision low cost version, which again helps me maintain our goal of creating a precise low cost ECG analyzer. It is 100% tested for high voltage breakdown and is rated for upto 1500Vrms, which is more then enough to protect the patient. This isolation amplifier uses the capacitive method of isolation that was described in the theory section. By imploring the use of this isolation amplifier, patient safety can be ensured.

d) Microphone Pin Configuration

Figure 4.1 illustrates how to configure a standard stereo microphone plug. The tip of the pin is the left channel, the ring type metal protion is the right channel and the rest of the rest of the pin is the ground. There is one plastic ring between two channel s which separates the channel and ground. Use a multi meter or continuity tester to determine the channel identifications of the solder logs.

The next step is derivative filter, helps in identifying a change in direction in the slope of the signal which is indicative of a peak in the signal.

The next step is simple Squaring function which makes all the signal values positive but also amplifies the output of the previous stage in a nonlinear manner thus emphasizing the R peaks in the signal.

In next step Thresholding of the obtained signal is done which identifies threshold peaks in the ECG signal under the threshold value signal will be zero. If a peak exceeds threshold 1 during the first step of analysis, it is classified as a QRS peak. In next step moving window summation of the previous N samples of the output of the previous stage is done. N is decided based on the sampling rate of the signal being analyzed. It performs smoothing of output of the preceding operatins through a moving –window integration filter. For a single QRS a window width of N=30 was found to be suitable for fs = 500Hz. The choice of the window width N is to be made with the following considerations: too large a value will result in the outputs due to the QRS and T waves being merged, whereas too small a value could yield several peaks. In next step again the sholding of obtained signal is done. Peak should be above threshold2 to be called a QRS. In next step peak detection at rising edge of waveform is done. Final step is QRS peak detection which is implemented on main ECG signal to be analyzed for arrhythmia. In this step horizontal window of +20 samples from peak of previous step and -20 samples from peak of previous step is selected and for that horizontal window maximum amplitude is find out which indicated as QRS peak.

e) Neural Network classification

In the classification phase MLP neural network have been used. The best architecture of the MLP NN is usually obtained using a trial-and-error process. Therefore, after running many simulations, MLP NN with

24 input neurons, one hidden layer and one output neurons. The performance of the proposed MLP NN was tested using the Mean-Squared Error (MSE) parameter. This error is computed using the differences between the actual outputs and the outputs obtained by the trained by the trained NN. Training performance: Given by variation of mean square error with number of epochs.

It can be observed that the mean square error decreases till epoch 300. A total number of 300 epochs are shown in the above figure. Mean squared error plot shows the achieved error value. Lower value means the less probability of false predictions. Here network has achieved quite low error probability.

Fewer epochs mean network learns in small repetitions. Less time means network achieved goal easily and shortly. Performance indicates the final MSE achieved. Lower value is associated with higher network accuracy.

Other performance parameters and training state the following training state parameters are also obtained during the Neural Network analysis.

Chapter 5

V. Conclusion and Recommendations

a) Conclusion

The ECG analyzer has been successful in achieving the major objectives set out at the beginning of the project. The circuit design gave successful results. The signal is amplified to a useful range and it's going to be used in software to analyze it. The results obtained using MATLAB for ECG analysis and detection of arrhythmial is very fast and useful, as the ECG can be easily read, saved in a fle and the filtering, derivation , squaring, thresholding, applying the moving window integration, peak detection can be done accurately. The peak detection is very important in diagnosis arrhythmia Using minimal amount of parts and ensuring they were low cost allowed for the ECG Analyzer to be affordable for any country. This was done without lowering the standards for correct ECG signal reproduction.

b) Recommendations

As with most projects undertaken there is always room for improvement. The first improvement that can be suggested is to eliminate the need for a computer to run the software. The other improvement for the ECG signal and the classification to appear on a small LED screen. Lastly the patient must be still when attached to the analyzer.

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The Charge is Not the Invariant of the Speed

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Abstract- According to the program "Starfish" in1962 USA exploded in space above Pacific Ocean H-bomb. Explosion was accompanied by the appearance of electric pulse with the large the tension of electric field and by short duration. In the work the experiments on detection and study of the electric pulse, which appears with the discharges through the dischargers of the capacitors of great capacity, are carried out. It is shown that also with such discharges appears the pulse of electric field, whiches indicate appearance in the heated plasma of unitary charge. This fact contradicts not only the classical, but also relativistic conversions of electromagnetic field upon transfer from one inertial reference system to another and can attest to the fact that the absolute value of electric charge, in contrast to its polarity, is not the invariant of speed.

Keywords: H-bomb, the electric pulse of nuclear explosion, explosion, plasma, the ionosphere, trotyl.

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The Charge is Not the Invariant of the Speed

F. F. Mende [α] & A. S. Dubrovin [σ]

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I. Introduction

Specialists (and first of all, by experimenters) discovered, that the classical electrodynamics and the special theory of relativity (SR), in spite of already more than 100- summer myth, are located in the contradiction to each other [1-4].

According to the program "Starfish" in1962 USA exploded in space above Pacific Ocean H-bomb. This event placed before the scientific community many questions [5-7]. It is earlier into 1957 future Nobel laureate doctor Hans Albrecht Bethe, being based on the theory of dipole emission, predicted that with a similar explosion will be observed the electromagnetic pulse (EMP), the strength of field of which on the earth's surface will comprise not more than 100 V/m. But with the explosion of bomb discomfiture occurred, pour on the tension of electrical, beginning from the epicentre of explosion, and further for the elongation of more than 1000 km of it reached several ten thousand volt per meters. Electric pulse had not only very large amplitude, but also very short duration on the order 150 ns (Fig. 1).

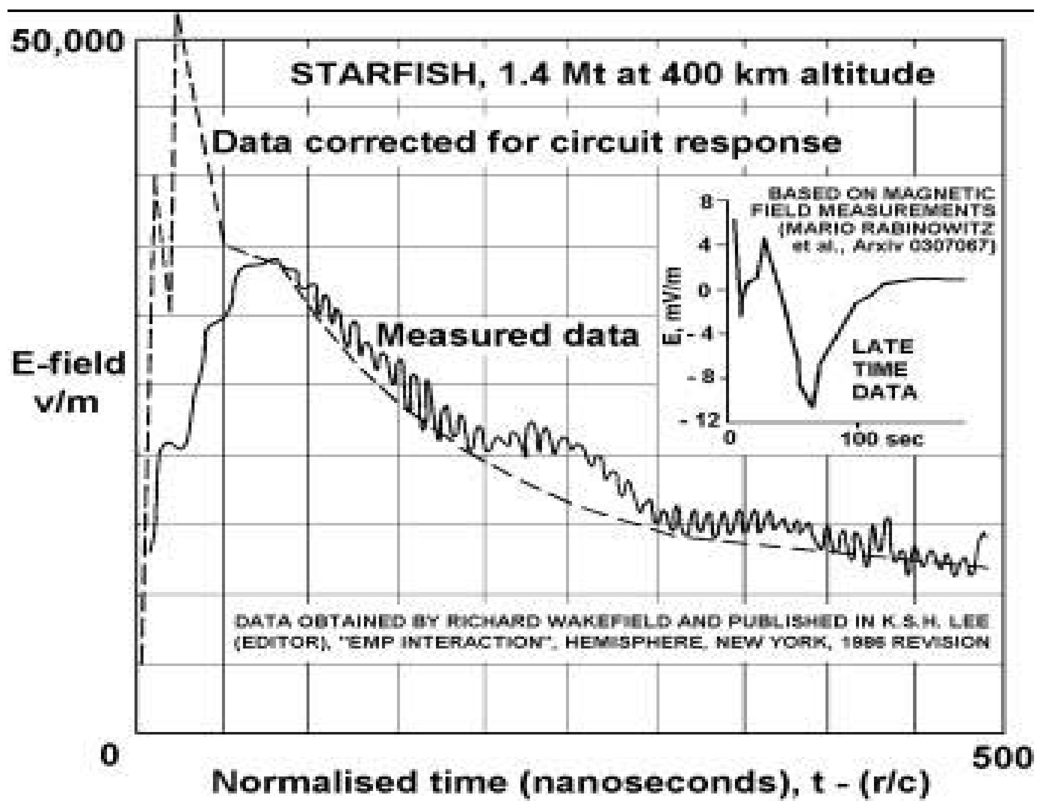

Fig. 1 : Experimental dependence of amplitude EMI on the time, obtained with the tests according to the program "Starfish"

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Thus, after explosion in the course of several ten minutes there is no radio communication with Japan and Australia, and even at a distance into 3200 km of from the epicentre of explosion were fixed ionospheric disturbances, which several times exceeded those, which are caused by the most powerful solar flares. Explosion influenced also the automatic spacecraft. Three satellites were immediately disabled. The charged particles, which were appeared as a result explosion, were seized by the magnetosphere of the Earth, as a result of which their concentration in the artificial Earth radiation belt it increased by 2-3 orders. The action of radiation belts led to the very rapid degradation of solar batteries and electronics in seven more satellites, including in the first commercial telecommunication satellite Telestar 1. On the whole explosion derived from system third of the automatic spacecraft, which were being found in low orbits at the moment of explosion.

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 of. 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.

Is known that the problem of this phenomenon attempted together with his students to solve and academician Zeldovich [7]. However, in the existing sources there is no information about the fact that this problem was solved by it. Exponential is the fact that more than fifty years in the official scientific journals there are no publications on the explanation of the phenomenon indicated, which attests to the fact that the scientists lacks the substantiated point of view on the explanation of the physical causes for this phenomenon.

The first article, dedicated to this explanation, appeared in the journal Engineering physics only in 2013 the year [8]. For this was used the represented in the works [9-13] formalism of scalar- vector potential, developed within the framework of the concept of the dependence of electric charge on the speed (not the invariance of charge). InSR electric fields of charge they depend on speed, but component, its normal and parallel to direction motions change in such a way that the flow of the electric field through the surface, which surrounds charge, remains constant, i.e., charge is the invariant of speed. This dependence is obtained from the analysis of the laws of the induction of electric field by magnetic and the magnetic field electrical, recorded with the use by the substantional derivative of field functions in the form, invariant not relative to the group of Poincare, but relative to the transformations of coordinates of classical physics, which include the conversions of Galileo. Then the theoretical and practical results of concept were published in a number of the foreign periodicals [14-22].

The sequential development of so radical a concept required the deep revision of the mathematical apparatus for electrodynamics. New approach to its development is proposed in [23]. It is directed toward the more adequate description of passage from one inertial reference system to another on the basis of giperkontinualnykh ideas about the space and time [24] due to the improvement of differential calculus of the field functions under the assumption of their dependence on the speed of motion. This new approach led to the replacement of the conventional formulation of Hertz-Heaviside of Maxwell equations for the new trans-coordinate formulation, represented in [25].

Up to now there are only indirect experimental data, which confirm the validity of the concept of scalar vector potential, which consisted in the observation of the electric pulse of nuclear explosions [5, 8, 11, 19, 22], and also in the appearance of an electric potential on the superconductive windings and the tori during the introduction in them of the direct current, [26-30]. Are in this article given experimental results on the detection of the pulse of the external electric field, which appears with the warming-up of plasma, and also possible explanation of this phenomenon on the basis of the trans-coordinate formulation of the Maxwell equations (trans-coordinate electrodynamics).

II. Experimental Detection and a Study of the Pulse of the Electric Field, Caused by the Warming-up of the Plasma

In the experiments for the warming-up of plasma the micro-bursts with the discharge of the chemical capacitors of the great capacity through the discharger or with the discharge of such capacitors through the lamp of photoflash were used. In the discharger was used the copper wire, with the connection to which the charged capacitors it was melted and evaporated, being converted into the plasma. the diagram of experiment is shown in Fig. 2 and Fig. 3. In Faraday cage, which serves the continuous metal screen (on the figures it is depicted as dotted line) are placed the chemical capacitors of great capacity, the discharger and the key, which makes it possible to connect to the discharger the charged capacitors. The chains of outline, which include capacitor, key and discharger did not have galvanic contact with the screen of Faraday cage. Faraday cage surrounds one (Fig. 2) or two (Fig. 3) metallic of screen. Characteristic measurement of electric pulse it

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was achieved with the aid of the digital memory oscillograph SIGLENT SDS 1072CNL. In the first case (Fig. 2) oscillograph was connected between the screen of the Faraday cage and the external screen.

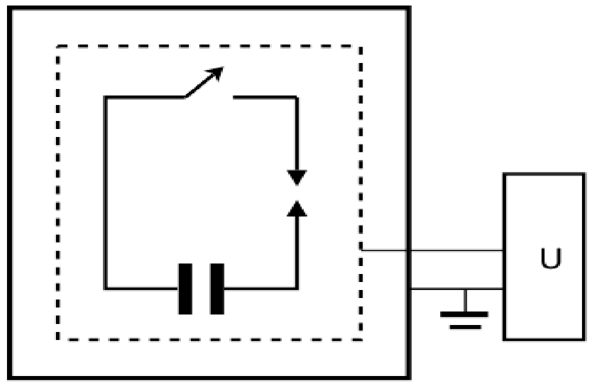

Fig. 2 : Diagram of experiment with one external screen

In the second case (Fig.3) the oscillograph was connected between the external screen and the intermediate scrin, located between the screen of the Faraday cage and the external screen.

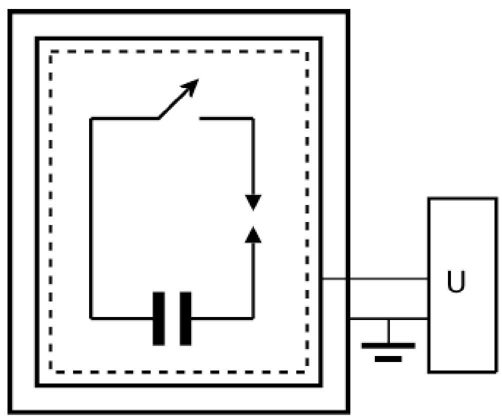

Fig. 3 : Diagram of experiment with the intermediate scrin

The schematic of experimental installation is shown in Fig. 4.

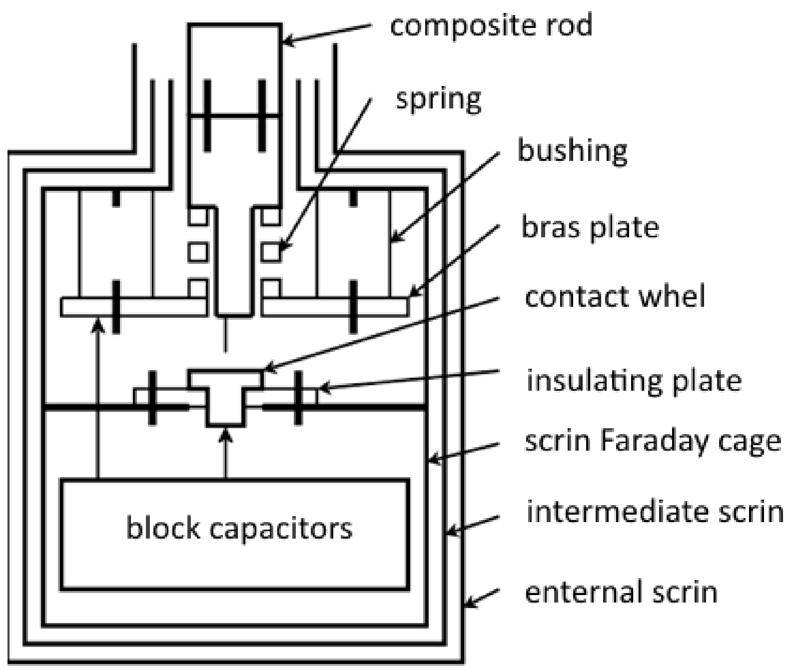

Fig. 4 : The schematic of experimental installation

The composite stock, which forms part of installation, consists of two parts. Its upper part is made from textolit, the lower part, made from brass, is fastened to it with the aid of the fastening pin. Between the lower part of the stock and the brass plate there is a spring, which ensures the electrical contact between the brass part of the stock and the brass plate. Inside the screen of Faraday cage is a partition, to which is attached the insulating plate. Contact washer is located on this plate. The unit of capacitors is connected between the brass plate and the contact washer. To the lower part of the stock are attached thin copper wire, gauge 0.2 mm, its length, which comes out from the stock – 10 mm. During lowering of stock the wire concerns contact washer, and the charged capacitors are connected to it: wire is melted and evaporates, being converted into the plasma. In the installation they were used the collection of the chemical capacitors with a total capacity 3000 μF , which were charged up to the voltage 300 v.

Fastening bolts and pins are shown in the figure by the fatty sections of lines. The joints, which make it possible to connect the oscillograph between the screen of the Faraday cage and the external screen, and also between the external and intermediate scrin in the diagram are not shown. Are not shown also the joints, through which is achieved the charge of capacitor With the measurements the cable, through which is achieved the charge of capacitor, from Faraday cage is disconnected.

The photograph of the screen of Faraday cage it is shown in Fig. 5.

Fig. 5 : The photograph of the screen of Faraday cage

Diameter of the upper and lower part of the screen of the Faraday cage 180 mm and 220 mm respectively. Height of the upper part 80 mm, and lower – 220 mm. The upper part of the screen is capped, to which is attached the tube, into which is put composite stock. Length of tube 100 mm. The screen of Faraday cage is covered with three layers of acrylic auto-enamel.

This layer presents the insulator, above which stuck the aluminum foil, which presents intermediate scrin.

IN Fig. 6 the separate parts of installation are depicted.

Fig. 6 : Photograph is installation in the dismantled form

The lower part of the photograph presents external screen. Its diameter 300 mm, and a height 600 mm. On top on the external screen, closed with cover, stands Faraday cage. In the installation in the assembled form Faraday cage is located inside the external screen on the insulating table.

In the process of experiments it was established that the surge voltage appears with the capacitor discharge through the discharger between the screen of the Faraday cage and the external screen.

In order to be certified in the fact that with the warming-up of plasma in Faraday cage actually is formed the unitary charge, was carried out the following experiment. It is known that with the rubbing by the fur of amber on it is formed the negative charge. After rubbing by the fur of model from the amber it with the aid of the stock, prepared from the Textolite, through the tube in the upper lid of camera was introduced into Faraday cage, and then rapidly was pulled out from it. When oscillograph was connected between the screen of the Faraday cage and the external screen, was registered the pulse, whose oscillogram was shown in Fig. 7.

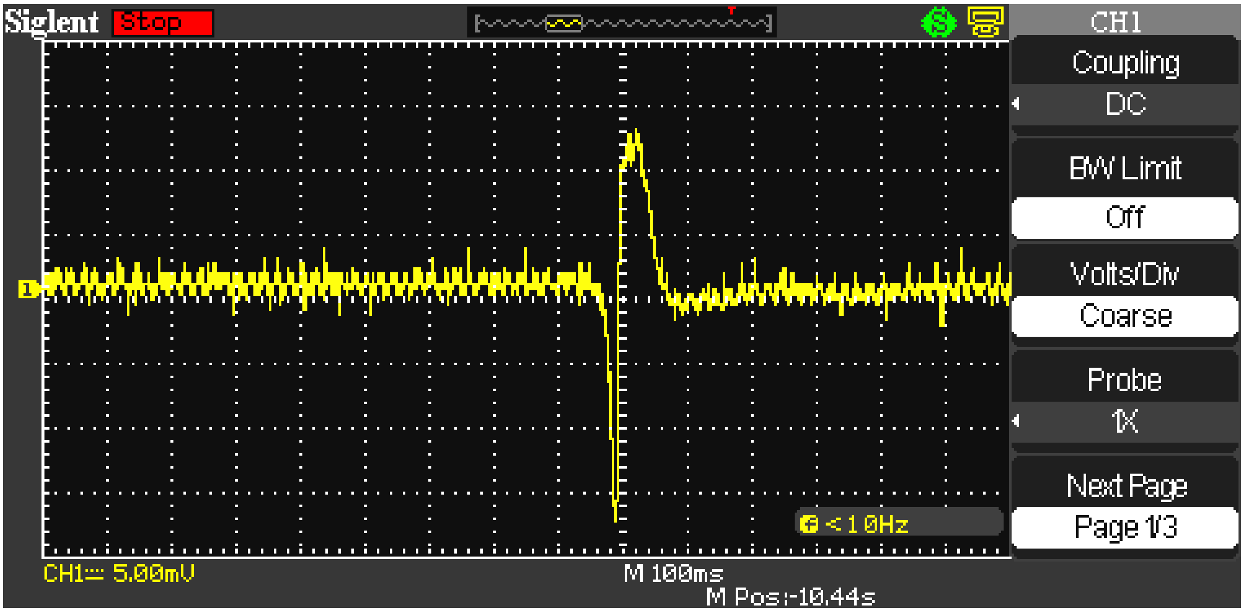

Fig. 7 : Shape of pulse with the rapid withdrawal of the model of the charged amber from Faraday cage

If we model from the amber slowly introduce into the cell, to and then rapidly withdraw it from there, then is observed the pulse, shown in Fig. 8.

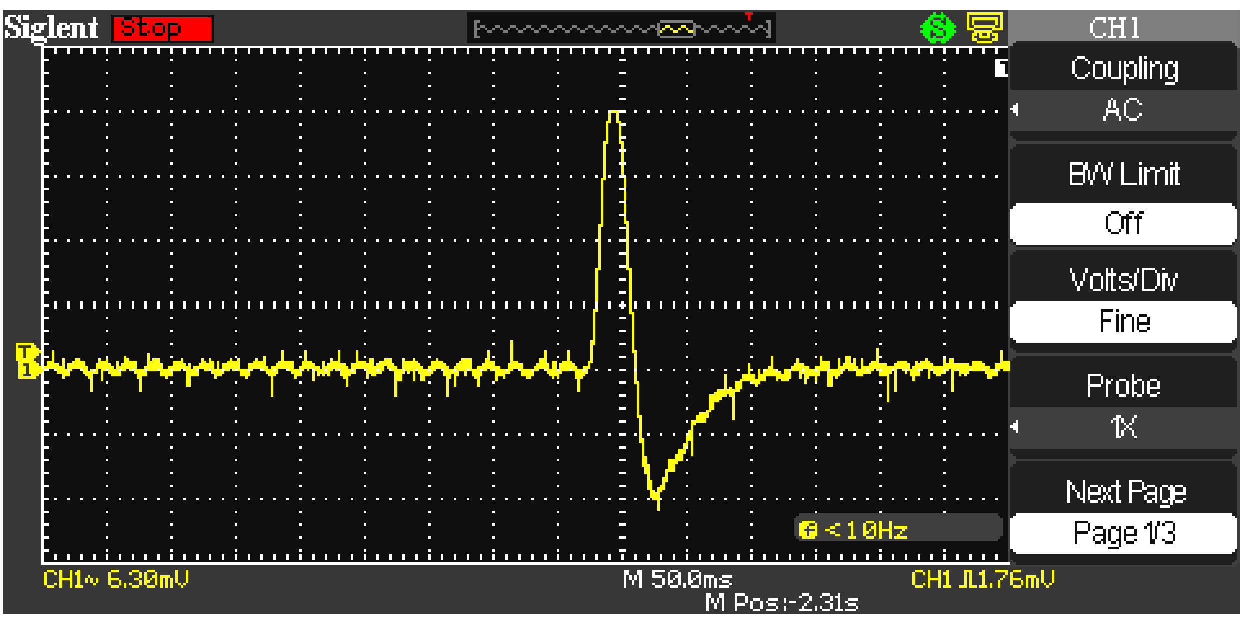

Fig. 8 : Shape of pulse with the rapid withdrawal of the model of the charged amber from Faraday cage

If we the charged model from the amber rapidly introduce into the cell and to immediately just as rapidly withdraw it from there, then is observed pulse shown in Fig. 9.

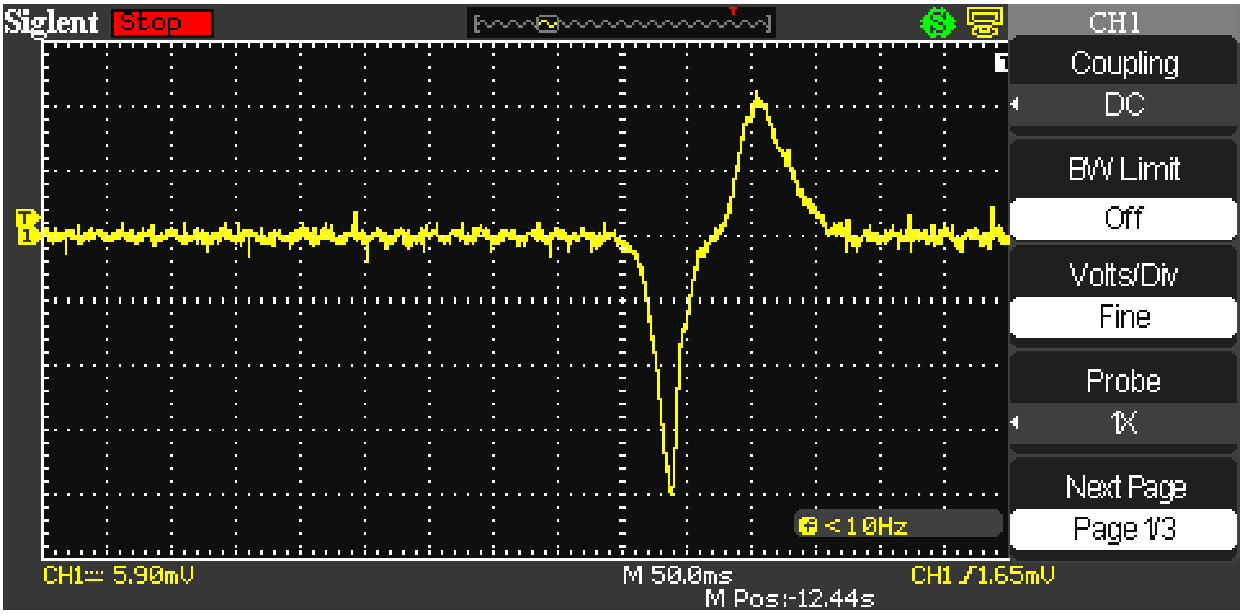

Fig. 9 : Voltage pulse, obtained with the rapid introduction and the subsequent withdrawal from the Faraday cage of the charged model of amber

The process examined can be considered as appearance and subsequent disappearance in the Faraday cage of negative charge. It is evident that between the negative and positive part of the pulse is a region, where the derivative of the pulse amplitude on the time decreases. This is connected with the fact that with the mechanical introduction and the withdrawal of the model of amber from Faraday cage it is not possible to instantly change the speed of stock for the reverse.

In the following stage of studies it was explained, in what time the charged capacitors are discharged through the discharger, and also was written the signal, proportional to current, current in the discharge circuit. Total capacitance of capacitors was 6000 μF , they were charged to the voltage 300 v

The oscillograms of transient process with the capacitor discharge through the discharger with different scanning speeds along the axis X, and also signal of proportional to current in the circuit discharge, they are shown in Fig. 10 and Fig. 11.

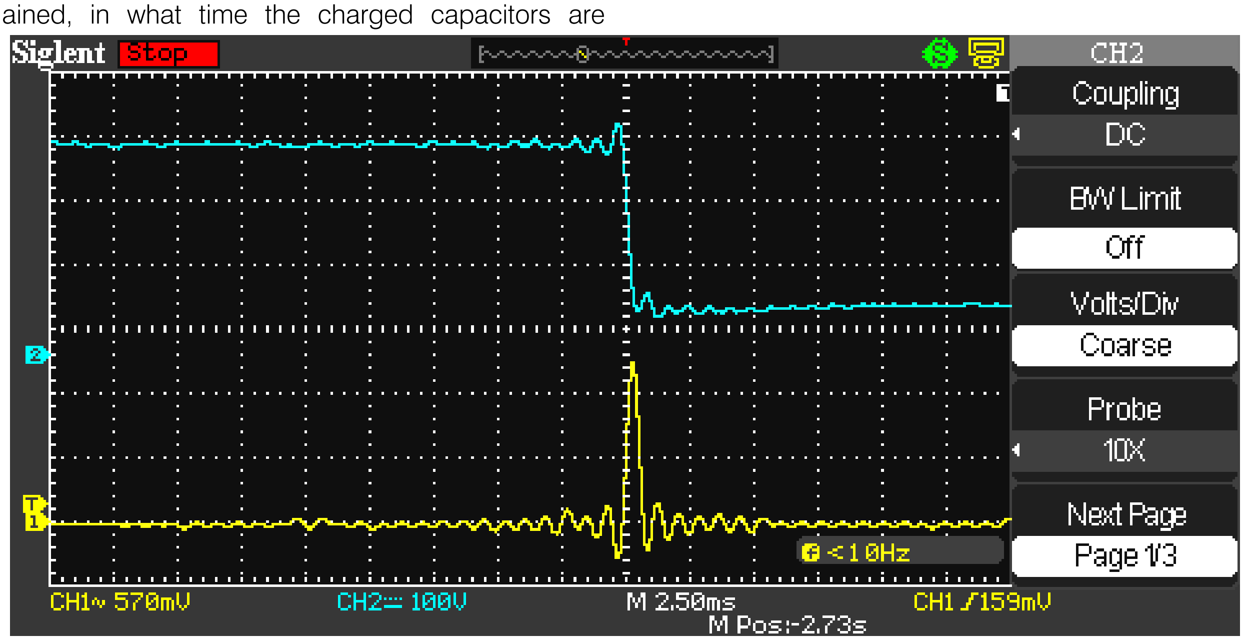

Fig. 10 : The oscillogram of transient process with the capacitor discharge through the discharger is represented. Scale value along the axis X is 2.5 ms

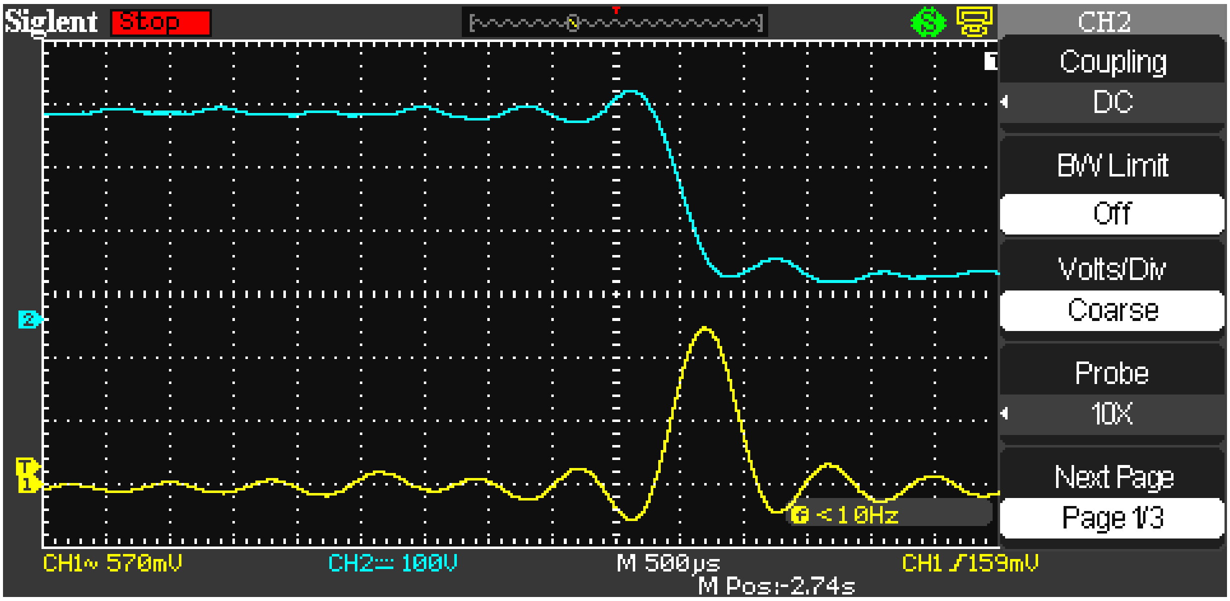

Fig. 11 : The oscillogram of transient process with the capacitor discharge through the discharger is represented. Scale value along the axis X is 2.5 ms

The measurement of a voltage drop across capacitors during their the discharge through the discharger, and also the signal, proportional to the current of discharge, was made according to the diagram of that represented in Fig. 12.

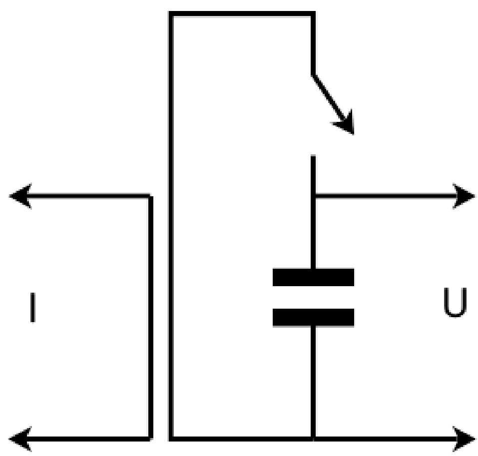

Fig. 12 : The measurement of a voltage drop across capacitors during their the discharge through the discharger, and also the signal, proportional to the current of discharge

The chain, with the aid of which was measured the signal, proportional to the current of discharge, was inductively connected with the conductors of outline. The conductor, fixed in parallel to one of the conductors of outline, was used for this.

The dependence on the time of voltage across capacitors during the discharge is represented in the upper oscillogram. It is evident that in the time ~ 500 μs the stress falls in 300 V to 50 V. Lower oscillogram presents the current pulse, registered by the method examined. 150

It is evident that in discharge time voltage across capacitors falls in 300 V to 50 V. In this case the discharge time is approximately one 600 μs. The difference between the energy of the capacitors, charged to 300 V in those charged to 50 V composes 162 J therefore the average power of micro-burst is 270 kW. If one considers that for the heating, the melting and evaporating the wire of discharger it is necessary to spend energy ~ 10 J, then the remained energy ~ 150 J to the warming-up of the formed plasma.

It is evident from the given oscillograms that the current, which flows through the plasma reaches its maximum value toward the end of capacitor discharge.

The form of the voltage pulse between the external screen and the screen of Faraday cage, obtained with the discharge through the discharger of the capacitors with a capacity 6000 μF, charged to the voltage 300 V, it is shown in Fig. 14.

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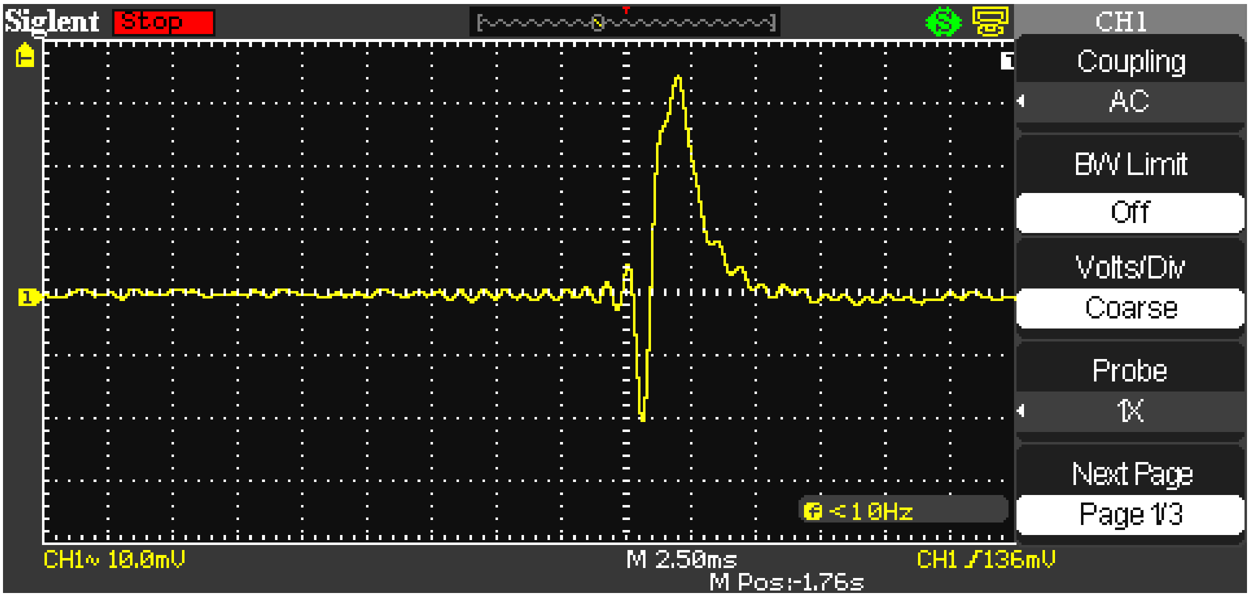

Fig. 14 : Form of the voltage pulse between the external screen and the screen of Faraday cage, obtained with capacitor discharge with a capacity 6000 μF , charged to the voltage 300 V. Scale along the X-axis is 5 ms to one large cell

The same pulse with the scale value the axis X 500 μs is shown in Fig. 15.

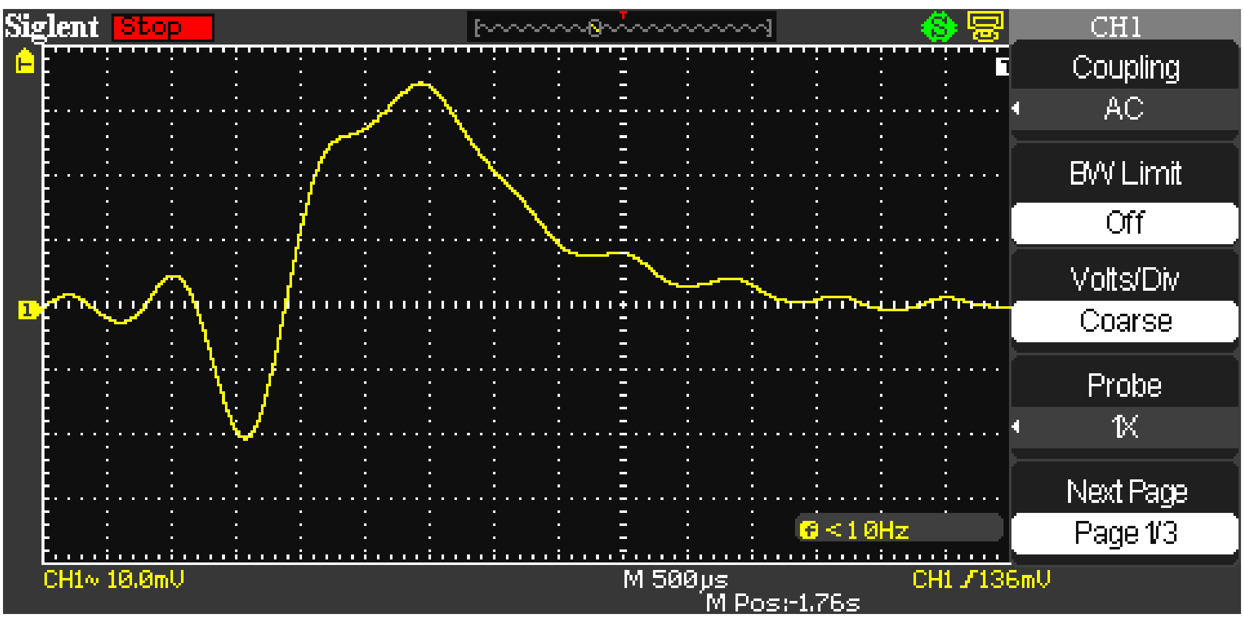

Fig. 15 : Form of the voltage pulse between the external screen and the screen of Faraday cage, obtained with capacitor discharge with a capacity 6000 μF , charged to the stress 300 V. Scale along the X-axis is 5 ms to one large cell

Should be focused attention on the fact that the formation of the negative part of the pulse (Fig. 14) practically it coincides with the capacitor discharge time (Fig. 11), when through the plasma maximum current flows precisely in this time and the maximum warming-up of plasma occurs, since with the flow through it of high currents the warming-up is connected not only with its effective resistance, but also with the pinch effect.

If we compare Fig. 9, where is shown the shape of pulse with introduction into Faraday cageof the charged amber and Fig. 14, that it is possible to see that the shapes of pulses it is very similar. The difference only in the fact that with the mechanical introduction and the withdrawal of amber from the cell it is not possible to ensure this pulse time and the steepness of its fronts as with the electrical discharge. in Fig. 14 and Fig. 15 the stages of warming-up and cooling of plasma are well visible, evident also that its heating occurs much faster than cooling.

The results of the conducted investigations attest to the fact that in the process of formation and warming-up of plasma in it the unitary negative charge is formed. In the formed plasma the number of electrons and positive ions is equal, but electrons have high speed, than ions; therefore naturally to assume that the formation of unitary charge is connected with the fact that the speed of electron motion more than in ions.

The total capacitance of the input circuit of oscillograph and capacity between the screen of the Faraday cage and the external screen is 204 pF, and the resistance of the input circuit of oscillograph equally by 1Mom, therefore, the input circuit of oscillograph is differentiating. Consequently, the input circuit of oscillograph together with the capacity between the screen of the Faraday cage and the external screen, between which appears the voltage pulse, is differentiating. Therefore the oscillograms, represented in Fig. 14 and Fig. 15 they present the derivative of the voltage pulse, which appears between the screen of the Faraday cage and the external screen.

With the explosion in space of H-bomb was discovered the pulse, shown in Fig. 1. Analog oscillograph was used during its record; however, it is not said, what in this case was used antenna. Input capacitance 50 pF and input resistance 1 Mom is the standard parameters of the input circuits of such oscillographs. Dipole antenna if one assumes that was used, then together with the capacity of feeder its capacity composes several hundred picofarads, and this means that the input circuits of oscillograph presented the differentiating circuit. Therefore with the registration of the electric pulse of space explosion, as in our case, was recorded the derivative of the pulse, accepted by antenna. Comparison of the shape of pulse, obtained with the space explosion of the H-bomb and shape of the pulse, depicted in Fig. 13 it shows that in Fig. 1 the very short negative part of the pulse is absent. The subsequent positive parts of the pulse are very similar. This can be connected with the fact that with the explosion of H-bomb the short part of the pulse was so short, that the utilized oscillograph had insufficient passband for the reproduction of so short a pulse.

Tests, carried out according to the diagram, depicted in Fig. 2 they showed that the shape of pulse with the identical values of the capacity of the discharged capacitor and stress on it, remains the same, as in the case of the connection of oscillograph to the screen of Faraday cage. If we above the enamel as the second screen stick the copper foil, which repeats the outlines of the screen of Faraday cage, and to connect to the oscilloscope face, then the pulse amplitude and the shape of pulse does not change. But if we inside the external screen put the same metal intermediate scrin of smaller sizes, which coincides in the form with the external screen, but with the ample clearance between it and screen of Faraday cage, then the shape of pulse remains, but its amplitude decreases. This fact means that in the process of the warming-up of plasma in it is formed the unitary electric charge, whose electric fields freely penetrate both through the screen of the Faraday cage and through the intermediate scrin, reaching external screen. These fields penetrate also through the external screen and it is possible to reveal them out of this screen with the aid of the dipole antenna, whose axis is directed to the side of external screen, but this is very difficult to make, since there are large external focusings. This experiment can be carried out only in the screened room, i.e., the large Faraday cage is necessary.

Given experimental data are the proof of the fact that in the process of the warming-up of plasma with an equal quantity in it of electrons and positive ions in it is formed the unitary negative charge, not compensated by positive ions the experiment examined it directly confirms that the fact that the invariant of speed is only the polarity of the moving electric charge, but its absolute value depends on speed.

III. Concepts of Scalar- Vector Potential and its use for Explaining the Obtained Results

The Maxwell equations do not give the possibility to write down fields in the moving coordinate systems, if fields in the fixed system are known. This problem is solved with the aid of the conversions of Lorenz, however, these conversions from the classical electrodynamics they do not follow.

In the work [9] it is shown that during writing of the equations of induction with the use by the substantional derivative these of uravneiya acquire the symmetrical form:

$$\oint \mathbf{E}' d\,\mathbf{l}' = -\int \frac{\partial \mathbf{B}}{\partial t} d\,S - \oint [\mathbf{B}\times\mathbf{V}] d\,\mathbf{l}' \ ,$$
$$\oint \mathbf{H}' d\,\mathbf{l}' = \int \frac{\partial \mathbf{D}}{\partial t} d\,S + \oint [\mathbf{D}\times\mathbf{V}] d\,\mathbf{l}' \ . \qquad (3.1)$$

$$\mathbf{E}' = \mathbf{E} + [\mathbf{V}\times\mathbf{B}] \ ,$$
$$\mathbf{H}' = \mathbf{H} - [\mathbf{V}\times\mathbf{D}] \ . \qquad (3.2)$$

Let us note that previously relationships (3.2) could be obtained only from the covariant conversions Of lorentsa, i.e., within the framework the special theory of relativity (SR). Thus, with an accuracy down to the terms $\sim \frac{V}{c}$ results SR follow from the laws of the induction within the framework of the Galileo conversions. Further we will show that they follow from conversions (3.1) and results SR with an accuracy to

$$\frac{V^2}{c^2}.$$

The relationship (3.2) attest to the fact that in the case of relative motion of frame of references, between the fields $\mathbf{E}$ and $\mathbf{H}$ there is a cross coupling, i.e., motion in the fields of $\mathbf{H}$ leads to the appearance pour on $\mathbf{E}$ and vice versa. From these relationships escape the additional consequences, which were for the first time examined in the work [9].

The electric field $E=\frac{g}{2\pi\varepsilon r}$ outside the chargedlong roddecreasesaccording to the law $\frac{1}{r}$, where r - distance from the centralaxis of the rodto the observation point.

If we in parallel to the axis of rod in the field E begin to move with the speed Δv another IRS, then in it will appear the additional magnetic field $\Delta H=\varepsilon E\Delta v$. If we now with respect to already moving IRS begin to move third frame of reference with the speed Δv, then already due to the motion in the field ΔH will appear additive to the electric field $\Delta E=\mu\varepsilon E\left(\Delta v\right)^2$. This process can be continued and further, as a result of which can be obtained the number, which gives the value of the electric field $E_v'\left(r\right)$ in moving IRS with reaching of the speed $v=n\Delta v$, when $\Delta v\to 0$, and $n\to\infty$. In the final analysis in moving IRS the value of dynamic electric field will prove to be more than in the initial and to be determined by the relationship:

$$E'\left(r,v_\perp\right)=\frac{gch\frac{v_\perp}{c}}{2\pi\varepsilon r}=Ech\frac{v_\perp}{c}.$$

if speech goes about the electric field of the single charge e, then its electric field will be determined by the relationship:

$$E'\left(r,v_\perp\right)=\frac{ech\frac{v_\perp}{c}}{4\pi\varepsilon r^2}, \tag{3.3}$$

where $v_\perp$ - normal component of charge rate to the vector, which connects the moving charge and observation point.

Expression for the scalar potential, created by the moving charge, for this case will be written down as follows [by 10,11,18]:

$$\varphi'(r,v_\perp)=\frac{ech\frac{v_\perp}{c}}{4\pi\varepsilon r}=\varphi(r)ch\frac{v_\perp}{c} \tag{3.4}$$

where $\varphi(r)$ - scalar potential of fixed charge. The potential $\varphi'(r,v_\perp)$ can be named scalar- vector, since it depends not only on the absolute value of charge, but also on speed and direction of its motion with respect to the observation point. It is not difficult to see that the obtained relationship with an accuracy to of the quadratic members of the expansion of the corresponding functions in series coincides with results SR, in which scalar potential is determined by the relationship.

$$\varphi'(r,v)=\frac{\varphi(r)}{\sqrt{1-\frac{v^2}{c^2}}}.$$

Using for enumerating the conversion of magnetic pour on the same method, we obtain:

$$H'(v_\perp)=Hch\frac{v_\perp}{c}.$$

where $v_\perp$ - speed normal to the direction of the magnetic field.

If we apply the obtained results to the electromagnetic wave and to designate components fields on parallel speeds IRS as $E_\uparrow$, $H_\uparrow$, , and $E_\perp$, $H_\perp$, as components normal to it, then with the conversion fields on components, parallel to speed will not change, but components, normal to the direction of speed are converted according to the rule

$$\begin{aligned}\mathbf{E}_\perp' &= \mathbf{E}_\perp ch\,\frac{v}{c}+\frac{v}{c}\mathbf{v}\times\mathbf{B}_\perp sh\frac{v}{c},\\ \mathbf{B}_\perp' &= \mathbf{B}_\perp ch\,\frac{v}{c}-\frac{1}{vc}\mathbf{v}\times\mathbf{E}_\perp sh\frac{v}{c},\end{aligned} \tag{3.5}$$

where $c=\sqrt{\frac{1}{\mu_0\varepsilon_0}}$ - speed of light.

Conversions pour on (3.5) they were for the first time obtained in their [9]work, let us name the Mende conversions.

IV. Trans-Coordinate Formulation of Maxwell Equations and its use for Explaining the Obtained Results

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 prime) 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 (prime) 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 consider that the physical equivalence of events $\mathbf{x}$ $\mathbf{x}'$ indicates the validity of the Galileo conversion

$$\mathbf{r} = \mathbf{r}' + t\mathbf{v} \tag{4.1}$$

or, otherwise, substituting vector idea by the component,

$$x^\alpha = x'^\alpha + tv\delta_{\alpha 1}. \tag{4.2}$$

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

$$\Phi(\mathbf{r}' + t\mathbf{v}, t) = \Phi'(\mathbf{v}, \mathbf{r}', t) \tag{4.3}$$

mathematically expressing the physical concept of the invariance of field relative to the speed of the motion of observer. In the theory of relativity (4.3) no longer it is carried out, but the Lorentz conversions are used instead of the conversions of Galileo. 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 giperkontinual ideas about the space and the time [24] 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 giperkontinuum play the Galileo conversions (4.1), (4.2), since they in this case they treat as the level conversions of Lorenz 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 giperkontinuum. Natural to consider that in giperkontinuum 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.

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:

$$\frac{d\,\Phi(\mathbf{r}, t)}{dt} = \frac{d\,\Phi(\mathbf{r}' + t\mathbf{v}, t)}{dt} = \lim_{\Delta t \to 0} \frac{\Phi(\mathbf{r}' + (t + \Delta t)\mathbf{v}, t + \Delta t) - \Phi(\mathbf{r}' + t\mathbf{v}, t)}{\Delta t}. \tag{4.4}$$

In the trans-coordinate electrodynamics is introduced new derivative (Galileo derivative) [23], arguments of which will coincide with the arguments of field function no longer in the laboratory, while in the substantive frame of reference:

$$\frac{\partial' \Phi}{\partial t}(\mathbf{v},\mathbf{r}',t)=\frac{d\,\Phi(\mathbf{r}'+t\mathbf{v},t)}{dt}=\lim_{\Delta t\to 0}\frac{\Phi(\mathbf{r}'+(t+\Delta t)\mathbf{v},t+\Delta t)-\Phi(\mathbf{r}'+t\mathbf{v},t)}{\Delta t}. \quad (4.5)$$

If the arguments of the Lagrange and Galileo derivativesare connected with equality (4.1), 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:

$$\frac{\partial' \Phi}{\partial t}(\mathbf{v},\mathbf{r}',t)=\frac{d\,\Phi(\mathbf{r},t)}{dt}=\frac{\partial\,\Phi(\mathbf{r}'+t\mathbf{v},t)}{\partial t}+(\mathbf{v}\cdot\nabla)\Phi(\mathbf{r}'+t\mathbf{v},t). \quad (4.6)$$

The Galileo derivative (4.5) 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 (4.4)-(4.6) naturally are generalized to the case derivative of higher order [23].

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:

$$\frac{\partial' \Phi}{\partial t}(\mathbf{v},\mathbf{r}',t)=\frac{d\,\Phi(\mathbf{r}'+t\mathbf{v},t)}{dt}=\frac{d\,\Phi'(\mathbf{v},\mathbf{r}',t)}{dt}=\frac{\partial\,\Phi'(\mathbf{v},\mathbf{r}',t)}{\partial t}, \quad (4.7)$$

i.e., Galilean the 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 derivative is empty because of the emptiness of very conversions of Galileo (in contrast to the Lorenz conversions). But giperkontinualnye ideas about the space and the time make Galilean derived completely by that claimed, and equality (4.7) – to false.

This view on the space, the period and the electromagnetic field in conjunction with the application of Galileo derivative leads to the new, trans-coordinate formulation of the electrodynamics [25], of that generalizing the conventional formulation of Hertz-Heaviside.

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 $\mathbf{E}=(E^{\alpha})$, $\mathbf{E}'=(E'^{\alpha})$ and magnetic induction $\mathbf{B}=(B^{\alpha})$, $\mathbf{B}'=(B'^{\alpha})$), by constants (electrical ε_0 and magnetic μ_0 , and also expressed as them speed of light in the vacuum $c=1/\sqrt{\varepsilon_0\mu_0}$), 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 $\mathbf{j}=(j^{\alpha})$, $\mathbf{j}'=(j'^{\alpha})$, electric charge Q , Q' , electric current I , I'), by field functions $\mathbf{E}=\mathbf{E}(\mathbf{r},t)=(E^{\alpha}(\mathbf{r},t))$,

$$\mathbf{B}=\mathbf{B}(\mathbf{r},t)=(B^{\alpha}(\mathbf{r},t)),$$

$$\mathbf{E}'=\mathbf{E}'(v,\mathbf{r}',t)=(E'^{\alpha}(v,\mathbf{r}',t)),$$

$$\mathbf{B}'=\mathbf{B}'(v,\mathbf{r}',t)=(B'^{\alpha}(v,\mathbf{r}',t)),$$

moreover

$$\mathbf{E}'(0,\mathbf{r}',t)=\mathbf{E}(\mathbf{r}',t);\ \mathbf{B}'(0,\mathbf{r}',t)=\mathbf{B}(v,\mathbf{r}',t). \quad (4.8)$$

In the classical nonrelativistic electrodynamics it is relied:

$$\mathbf{E}(\mathbf{r}'+tv\mathbf{e}_1,t)=\mathbf{E}'(v,\mathbf{r}',t),\quad \mathbf{B}(\mathbf{r}'+tv\mathbf{e}_1,t)=\mathbf{B}'(v,\mathbf{r}',t) \quad (4.9)$$

what is the application of a general formula (4.3) of the invariance of field relative to the speed of the motion of observer for the case of electromagnetic field. The proposed by us giperkontinual ideas about the space and the time [24] assume no longer the invariance of field, but is explained its nature 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:

$$\oint_s \mathbf{E}\cdot ds = \mathrm{Q}/(\varepsilon\varepsilon_0)\;;\; \oint_s \mathbf{B}\cdot ds = 0\;;\; \oint_l \mathbf{E}\cdot dl = -\frac{d}{dt}\int_s \mathbf{B}\cdot ds\;;\; \frac{c^2}{\varepsilon\mu}\oint_l \mathbf{B}\cdot dl = \frac{\mathrm{I}}{\varepsilon\varepsilon_0} + \frac{d}{dt}\int_s \mathbf{E}\cdot ds \tag{4.10}$$

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.

The region of the applicability of system of equations (4.10) 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's equations (we we call his trans-coordinate [25]), integral form of which will be in it the system of the generalizing (4.10) four integral equations of the electrodynamics of the moving media:

$$\oint_s \mathbf{E}\cdot ds = \mathrm{Q}/(\varepsilon\varepsilon_0);\; \oint_s \mathbf{B}\cdot ds = 0;\; \oint_l \mathbf{E}'\cdot dl = -\frac{d}{dt}\int_s \mathbf{B}\cdot ds;\; \frac{c^2}{\varepsilon\mu}\oint_l \mathbf{B}'\cdot dl = \frac{\mathrm{I}'}{\varepsilon\varepsilon_0} + \frac{d}{dt}\int_s \mathbf{E}\cdot ds \tag{4.11}$$

If the trans-coordinate idea of the Maxwell equations (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 giperkontinuum, then it is necessary to consider that the equalities (4.8) are always carried out, but (4.9) – in the general case no.

The differential form of Maxwell equations in the idea of Hertz-Heaviside is a system of those corresponding to the integral equations (4.11) of the differential equations of electrodynamics, which relate to the laboratory frame of reference:

$$\nabla\cdot\mathbf{E} = \rho/(\varepsilon\varepsilon_0)\;;\; \nabla\cdot\mathbf{B} = 0\;;\; \nabla\times\mathbf{E} = -\partial\mathbf{B}/\partial t\;;\; \nabla\times\mathbf{B} = \mu\mu_0\mathbf{j} + \left(\varepsilon\mu/c^2\right)(\partial\mathbf{E}/\partial t) \tag{4.12}$$

Equations (4.12) traditionally successfully are used in the electrodynamics, but 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.

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

$$\nabla\cdot\mathbf{E}(\mathbf{r},t) = \frac{\rho(\mathbf{r},t)}{\varepsilon\varepsilon_0}\;;\; \nabla\cdot\mathbf{B}(\mathbf{r},t) = 0\;; \tag{4.13}$$

$$\nabla\times\mathbf{E}'(v,\mathbf{r}',t) = -\frac{\partial'\mathbf{B}}{\partial t}(v,\mathbf{r}',t);\; \nabla\times\mathbf{B}'(v,\mathbf{r}',t) = \mu\mu_0\mathbf{j}'(v,\mathbf{r}',t) + \frac{\varepsilon\mu}{c^2}\frac{\partial'\mathbf{E}}{\partial t}(v,\mathbf{r}',t) \tag{4.14}$$

where $\partial'\mathbf{E}/\partial t$, $\partial'\mathbf{B}/\partial t$ – the derivatives of Galileo 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:

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

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

With $v = 0$ (4.13)-(4.14) it passes in (4.12).

Equations (4.13)-(4.14) in the particular case of the absence of free charges and currents:

$$\nabla\cdot\mathbf{E}(\mathbf{r},t) = 0\;;\; \nabla\cdot\mathbf{B}(\mathbf{r},t) = 0\;; \tag{4.15}$$

$$\nabla\times\mathbf{E}'(v,\mathbf{r}',t) = -\frac{\partial'\mathbf{B}}{\partial t}(v,\mathbf{r}',t)\;;\; \nabla\times\mathbf{B}'(v,\mathbf{r}',t) = \frac{\varepsilon\mu}{c^2}\frac{\partial'\mathbf{E}}{\partial t}(v,\mathbf{r}',t) \tag{4.16}$$

With $v = 0$ (4.15)-(4.16) it passes into the well-known system of Maxwell equations:

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

The conversions of the electromagnetic field, described (4.15)-(4.16), upon transfer from one inertial reference system to another (Mende conversion) take the form [25]:

$$\mathbf{E}'(v,\mathbf{r}',t) = \mathbf{E}(\mathbf{r}',t)\cosh\frac{\sqrt{\varepsilon\mu}v}{c} + \frac{c}{\sqrt{\varepsilon\mu}}\mathbf{e}_1 \times \mathbf{B}(\mathbf{r}',t)\sinh\frac{\sqrt{\varepsilon\mu}v}{c}; \tag{4.17}$$

$$\mathbf{B}'(v,\mathbf{r}',t) = \mathbf{B}(\mathbf{r}',t)\cosh\frac{\sqrt{\varepsilon\mu}v}{c} - \frac{\sqrt{\varepsilon\mu}}{c}\mathbf{e}_1 \times \mathbf{E}(\mathbf{r}',t)\sinh\frac{\sqrt{\varepsilon\mu}v}{c} \tag{4.18}$$

In SR electric fields of charge they depend on speed, but component, its normal and parallel to direction motions change in such a way that the flow of the electric field through the surface, which surrounds charge, remains constant, i.e., charge is the invariant of speed. However, with the Mende conversions(4.17)-(4.18) situation entirely another – of the components, parallel to direction of motion, they do not depend on speed, but component, normal to direction of motion, they grow with an increase in the velocity. Thus, in the trans-coordinate electrodynamics the flow of the electric field through the surface, which surrounds charge, grows with an increase in the velocity, i.e., charge is not the invariant of speed. Specifically, this confirmed experiment.

V. Conclusion

Thus, the concept not of the invariance of electric charge (its dependence from the speed), proposed still in 1988 in the work [9], after almost 30 years obtains finally direct experimental confirmation. In this case the conversions of Mende prove to be more adequate of physical reality, than the classical and relativistic conversions of electromagnetic field. Thus, is obtained convincing evidence of the justification of the transfer of electrodynamics from the traditional formulation of Hertz- Heaviside to the trans-coordinate with the appropriate failure of the relativistic ideas about the space and the time and by the adoption of giperkontinual ideas. The sequential development of trans-coordinate 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. In particular, the obtained results open new technical capabilities for diagnostics of the kinetics of the warming-up of plasma, which is especially important for realizing of controlled thermonuclear fusion.

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Bite Controller for ESM Systems

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Abstract- Electronic Support measures (ESM) system is used to measure the parameters of radar emission in the operating frequency range along with pulse width, pulse repetition frequency, antenna scan period, signal strength, direction of arrival and more. These systems are installed in warships, aircrafts and submarines. The radar parameters along with their threat levels are to be made available to operator during the peace and wartime operations. In the modern ESM systems these parameters are to be measured instantaneously with great accuracies and instantaneously for tactical purposes. Different techniques are used for measuring different parameters of radar signals. Receiver measure these parameters in various parallel circuits and ensure the entire measured data is available less than 200ns for each pulse which is required for further processing. The BITE processor controls various operations of these parallel receivers. It controls the operation of system to ensure reliable performance. The BITE processor receives the signal from the ESM processor and generates it in the specified number of bits. It also interfaces ESM processors and antenna processors.

Keywords: electronic warfare (EW), electronic support measures (ESM), electronic intelligence (ENINT), antenna head unit (AHU).

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BITE CONTROLLERFORESMSYSTEMS

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I. Introduction

For the last few years one of the main things we have tried to emphasize are related to electronic warfare. The high effectiveness and widespread use of electronics, its associated equipment and weapon systems has led to the development of electronic warfare systems, to detect and counter these weapons. The stronger we are the safer and powerful we are. This is a why our country's EW capabilities have become the vital element which decides the outgrowth in the event of a campaign. The main enthusiasm behind this study is the need of high performance controller for the ESM systems.

Electronic warfare is to exploit the enemy's intention, plan and capabilities and to take a counter measure to deny the use of weapons systems and communication while safeguarding our own effective use of same spectrum. For this the EW uses ESM systems which measures the parameters from the radar emissions and detects the threats. The ESM system requires a high accurate, high speed and instantaneous controller to acquire updated information every moment. The BITE controller fulfils all the above mentioned abilities. Therefore, BITE controller is used all the ESM systems. Without such equipment the survivability of armed forces may be difficult.

II. Electronic Warfare (EW)

Electronic Warfare (EW) is a military action which involves the use of entire electromagnetic spectrum or directed energy to prevent, exploit, reduce or determine the use of the spectrum as well as action and friendly use if electromagnetic spectrum as it is not conducted by using electronics whereas it use electromagnetic spectrum to detect the attack some people also called it as electromagnetic warfare.

In this modern world the complexity, performance and specialization of the weapons is directly proportional to the electronic. It is believed that in particular EW and in general electronics will play the dominated role in the battlefield. EW is not a new technology it was practiced in one or another form earlier in most of the major conflicts. But it had gained its importance and maturity after world war –II. The main concept of EW to exploit the enemy's electromagnetic emission in all the parts of the spectrum to know the enemy's order of battle, capabilities and intention and to take the control measures to deny the use of communication and weapon systems. This spectrum is not limited to radar frequencies but includes ultraviolent, visible, IR and other less used portions of EW systems. This includes standoff, escort jamming, self-protection and anti-radiation attack. It is a specialized tool that enhances space functions and many air functions at multiple levels of conflicts. This is applied for air, land, space and sea by unmanned and manned systems.

EW is mainly subdivided into three major categories. Electronic attack (EA),Electronic protection (EP)Electronic warfare support (ES).Electronic attack (EA) This involves the use of anti-radiation weapons, directed energy, EM energy to attack facilities, personnel or equipment with the intent of destroying enemy combat capabilities. Jamming can be performed on communication system. Electronic protection (EP) is nothing but taking protection measures in the war field by counter measures. EP is also known as electronic counter measures (ECCM).The defensive EA action and EP both protects the facilities, and equipment.ES This is a sub division of EW which involves the actions tasked by or under direct control of an operational commands to identify, locate and intercept sources of unintentional and intentional radiated electromagnetic energy for the

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purpose of targeting, planning, immediate threat recognition and conduct future operations.

III. Electronic Support Measures (ESM)

ESM is a division in EW which involves the action that are taken under the direct control of an operational commander which helps us to detect, record and analyse sources of electromagnetic energy which are been radiated. By recognizing this radiation the immediate threat can be avoided by taking the control measures. ESM will collect the intelligence through the passive listening to electromagnetic radiations of military interest. These systems will provide us very valuable information about the foreign system. It provides the operational data, tactical combat information about the foreign systems. ESM can be well described as a platform on electronically silent and analyses the radar transmission beyond the RADAR detection range as it has a greater power of electromagnetic pulse which is been transmitted with respect to a reflected echo of that pulse.

This has a desirable characters like wide dynamic range, narrow bandpass, good angle-of arrival measurements which will be used to locate the transmitter, and another main important character is it has a wide spectrum This ESM has two basic types they are Electronic intelligence (ELINT), Communication intelligence (COMINT).

The ELINT will analyse the radar emission, missile guidance radars in order to provide the protection COMINT-From the name communication we can define COMINT as an intelligence which is intended for the interception of communication .These both intelligence systems are highly dependent on digital computers to provide the analysis function. Before any operational mission this functions are carried out on a software program which will give the necessary analysis on multiple signals. The processor will contain parameter of 2,000 or more radar system. In many cases if the program is not available then it can be reprogrammed by the operator to store the unidentified signals for later processing and analysis.

The processing of the signal consists of three stages in sequence 1st stage sorting of the radar pulses as they come in.2nd stage segregation of the pulse trains.3rd stage identification of the emitter .ELINT and COMINT works together known as signal intelligence (SIGINT).

IV. Electronic Intelligence (ELINT)

Electronic intelligence it is essentially procured from the electronic signals which doesn't carry speech or text .It is sub divided into categories. Technical ELINT in this sector it traces about the Modes of the operation Emitter functions Weapons systems Emission characteristics Navigating signals .The chief motto of this sector is to secure signals specification and reports the task, potentials and functionality of the emitter which performs in the huge system. As of ground radar locating aircraft and thus become the prototype of radar recognition, counter weapons apparatus. The comprehension of this incorporate operation of counter measures which also a part of the electronic warfare.

Another major sector is operational ELINT another vital sector operational ELINT which focus on to detect precise ELINT goals and regulate the operational designs of the sector. These outcomes are frequently called Electronic order of battle. The ELINT also contribute caution evaluation, usually mentioned as skilful ELINT. The ELINT intelligence outcomes support military operational planners and tactical military commanders on the battle field.

A former third major branch of ELINT is the group, processing, and outline of foreign telemetry signals intelligence. TELINT is technical intelligence information obtained from the intercept and analysis of foreign telemetry. Once Telemetry Intelligence was accounted as a branch of ELINT since TELINT now to be called Foreign Instrumentation Signals Intelligence (FISINT) these are closely related to Tech ELINT procedures which were held by all of the Department of Defence military departments. TELINT is a critical source of performance information on foreign missiles and space vehicles while they are being developed and tested. TELINT can also provide much operational information on foreign satellites and space vehicles.

ELINT is not only used for direction finding but also for the report of the incoming signals for taking the actions immediately in the missile systems, fire controls and radars. After receiving the signal it gives the warning to the systems and the processors which are connected to it will respond immediately for proving the parameters such as frequency, direction and pulse. With these parameters it is easy enough to find out what type of emitter it is and rest of the completions with the parameters and the signal analysed for air crafts and ships warning systems are the most important because for the survival in the environment of the battle field .

V. Antenna Head Unit (AHU)

The antenna head unit is the main part of the ESM systems because the signals are transmitted through it. The AHU processor it receives various control signals from the receiver processor. These control signals are also called as control codes. These control codes are decoded and are sent to the next stage in the ESM system. The control codes are also given to the BITE (built –in-test-equipment) controller which will generate the frequency. Now auto calibration should be done so for the execution of the auto calibration by the AHU processor we require interface circuits. These

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interface circuits are, Front end processor Receiver processor ESM processor .

The AHU processor will supply all the control signals so as to provide an interface for the purpose of the auto calibration in the system. The AHU processor will send control signals to various parts. So, to send the signals to various parts it should be designed in such a way that it will send at a speed of 1.2micro seconds. It will acts as an interface between the RF signals processor and the ESM processor, in receiver processor RF signal is compared with many other signals and then after the comparison then a command code is entered in to the AHU processor. The AHU will decode the given command code and it provides us the frequency, attenuation and various other parameters.

The AHU has 2 modes of operation. They are, BITE mode & Normal mode. The signals will be changed by the AHU processor to have the system in the normal mode or the bite mode. AHU uses 5 BITS of amplitude which is given by the threshold level.AHU will be having two inputs Serial communication which is given by the receiver processor .Blanking signal from RADAR to keep the system in the BITE mode. In the bite mode signals are sent by the line driver for the purpose of elimination of the noise in the system.It does not detect its own signal in the BITE mode .AHU will convert the RF signal in to the video signal .which can also be used to measure the radar parameters Finally , if AHU fails the entire ESM system fails as it is the most important part .

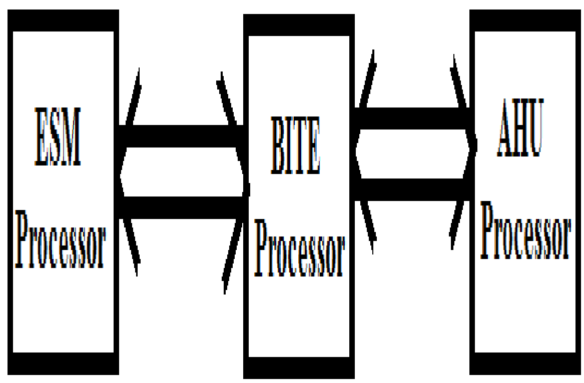

Fig 1: Basic block diagram of ESM system.

VI. BITE CONTROLLER

The functions of the BITE controller are

S1. it should receive signals from Internal signal source.

S2.it should generate BITE/Normal controls.

S3.It should send the serial link data to Antenna Head Unit.

S4.It should set the amplitude level.

S5.It should generate CW flag, if not CW, then it should generate a pulse wave.

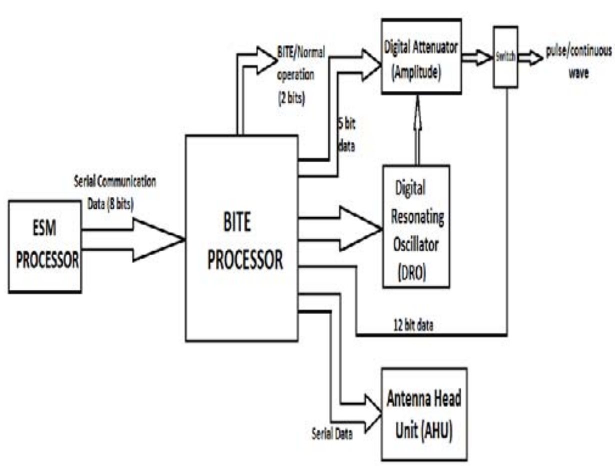

Fig 2 : Functional Block diagram of ESM system

Whenever the ESM system receives the RF signal, it first sends it to the front end receiver where the signal is amplified. This receiver also suppresses the noise in the received signal. The signal is then given to the ESM processor. The ESM processor sends an 8 bit serial communication data to the BITE processor using NMEA0184 or NMEA0185 protocol.

The BITE processor usually has a database. The received signal is compared with all its signal parameters in the database. When all the parameters are matched, the receiver gives the required outputs in a specified number of bits i.e., amplitude of 5 bits, frequency of 12 bits, type of the signal continuous wave (CW) or pulse of 1 bit, 3 serial link lines and the mode of the system. These outputs are given to the line drivers for the removal of noise before sending it to the interfaced circuits. The ESM system generally has 2 modes, Normal mode and BITE mode.

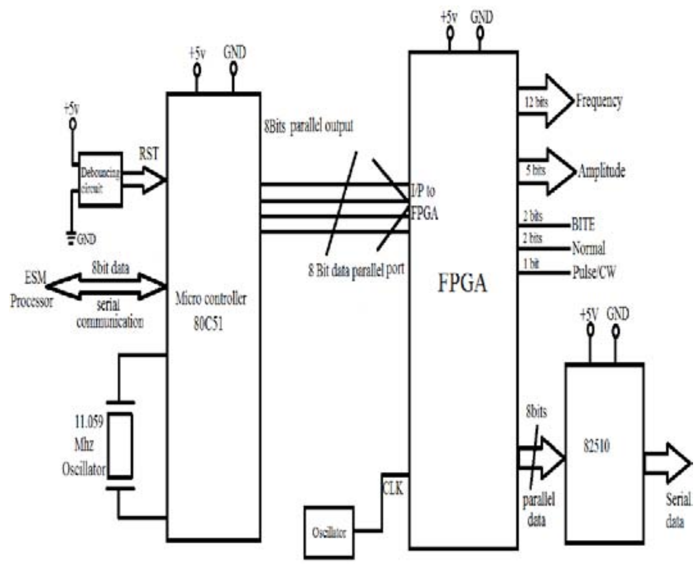

Fig 3 : Block diagram of BITE controller.

When the system receives signal from the external environment radar signals it operates in normal mode When the system takes the information from the internal sources . the BITE processor operates in BITE mode. The entire significance of ESM system lies in this mode of operation which is due to the signals given by the ESM processor. When the system is in BITE mode it enters into idle state and the entire data base of the BITE controller is thoroughly compared and the accurate output is given.

The BITE processor checks and indicates if the generated signal is in continuous wave or pulse mode. The BITE processor also sends a serial link data to the Antenna Head Unit (AHU). This data has 2 functions, to send the commands to the AHU to keep AHU hardware in BITE/Normal mode according to the mode of the BITE processor and to receive the response from the AHU processor. The entire operation described above will be performed in less than 200 nanoseconds. The output bits of BITE processor are sent to the next stages of the system for further operations.

Table1 : Truth Table for Receiver Processor

Serial Cmd	RST	Frequency f11.......f0	Power	BITE	NORMAL	PULSE	CW ON/OFF	AHU Serial Link
00H	1	000000000000	00000	0	0	0	0	00H
01H	0	000000000000	00000	1	0	WAVE	0	01H
02H	0	000000000001	11111	1	0	WAVE	0	02H
03H	0	000000000010	00000	1	0	WAVE	0	03H
04H	0	000000000100	11111	1	0	WAVE	0	04H
0CH	0	100000000000	11111	1	0	WAVE	0	0CH
0DH	0	111111111111	00000	1	0	0	1	0DH
0EH	0	000000000000	11111	0	1	0	0	0EH
0FH	0	000000000000	00000	0	1	0	1	0FH

VII. Conclusion and Future scope

In this paper the need of modern electronic warfare has been presented. The most usually used ESM system and its sub-parts have been discussed. The BITE processor and its working have also been presented. The major guidelines for further study and development lies in the advancement of the circuitry to endure extreme conditions and optimization of the circuit for the best use of the system for tactical purpose.

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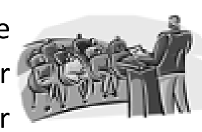

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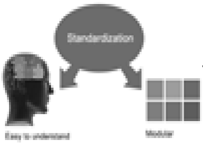

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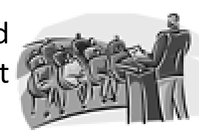

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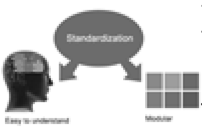

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27. Refresh your mind after intervals: Try to give rest to your mind by listening to soft music or by sleeping in intervals. This will also improve your memory.

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.

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Key points to remember:

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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.

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- Significant conclusions or questions that track from the research(es)

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- Present a justification. Status your particular theory (es) or aim(s), and describe the logic that led you to choose them.
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Approach:

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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.

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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
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