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Iron Traction Transformer

Digital Pulsed Power System

Highlights

Adaptive Temporal Averaging

Independent Component Analysis

Discovering Thoughts, Inventing Future

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Fault Diagnosis of High Speed Iron Traction Transformer for V/V Type Wiring based on Fast Independent Component Analysis

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Abstract- For rail traction transformer operation may have a failure, using the V/V wired traction transformer model, this paper presents a method based on Fast independent component analysis (ICA) algorithm to monitor the traction transformer of this model. And the traction transformer input and output voltage signal data collected, to get I2 and SPE statistics, to achieve high-speed traction transformer operation in real-time monitoring.

Keywords: traction transformer; V/V wired independent component analysis (ICA); fault diagnosis.

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Wan Yi α, Tu Ming σ, YAN Wei ρ, Zhao Yang Ѡ & Wang Enrong ¥

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I. Introduction

The railway is the great artery of the national economy. It's safe and reliable rapid development is of great significance to speed up the process of national modernization and promote economy and society. In recent years, with the gradual improvement of high-speed rail traction system, there has been wide usage of high-speed rail traction transformer [1]. Therefore, it not only makes the high-speed rail traction transformer failure is coming out one after other, but also poses a hazard to the system. Therefore, how to monitor the traction transformer operation and how to diagnose its fault in time, these problems have become important in research of traction transformer fault diagnosis. Accurate and real-time detection of the fault state of traction transformer, high-speed rail traction system for the efficient and safe operation is of great significance.

In recent years, with the development of data-driven [2] fault diagnosis technology, fault diagnosis of high-speed rail traction system has provided a lot of valuable reference ideas. Based on the expert experience and the model-based fault diagnosis method, the fault diagnosis method based on data can avoid the uncertainties of system modeling, the shortcomings of unknown interference and the difficulty of obtaining expert experience. It can improve the fault diagnosis method the ability to detect faults, and is convenient in practical application. Based on Fast ICA [3] algorithm, the fault diagnosis of high-speed traction transformer derives from the data-driven fault diagnosis method. This paper presents a method of fault diagnosis using the V/V wiring [4] model of the high-speed traction transformer and the Fast ICA algorithm [5]. The simulation results show that the algorithm has high resolution and precision, It is of practical value for fault detection of high-speed traction transformer.

II. High-Speed Iron Traction Transformer & Fault Diagnosis

V/V type wiring is the two single-phase transformer to V-shaped connection, two transformers secondary winding, each with one end connected to the traction substation two-phase bus. The other end connects to the rail back to the return line. By connecting two single-phase transformers to the three-phase power system in a V-way, each traction substation can be powered by a two-phase voltage of a three-phase system. Turn three-phase voltage of the power system into traction power supply of two-phase voltage power supply.

The so-called fault diagnosis is the operation of the equipment and abnormal circumstances to make judgments, which consists of fault detection, fault separation and fault identification. Specifically, it refers to fault separation and fault identification. With the success of China's high-speed railway has been completed, traction transformer fault diagnosis made a higher demand, that is quick detection of transformer latent fault, and identification of the type of failure. Therefore, it is of great practical significance to study a complete fault diagnosis system of traction transformer, which can deal with the latent fault and reduce the economic loss. Fault diagnosis of traction transformer is a nonlinear mapping process from fault information to fault type, which cannot be described by the precise mathematical model, and it is difficult to obtain a large number of fault samples when the transformer fails. Therefore, the traditional fault diagnosis method has limitations in application.

III. Fault Diagnosis of Traction Transformer based on Fast ICA Algorithm

V/V type wiring is the two single-phase transformer to V-shaped connection, two transformer-secondary-windings, each with one end connected to the traction substation two-phase bus. The other end connects to the rail back to the return line. By connecting two single-phase transformers to the three-phase power

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system in a V-way, each traction substation can be powered by a two-phase voltage of a three-phase system. Turn three-phase voltage of the power system into traction power supply of two-phase voltage power supply.

ICA algorithm has been a new statistical signal processing method developed in recent years. Compared with the traditional methods, ICA algorithm has the following advantages: it is not necessary to assume that the measured data satisfy the Gaussian distribution when modeling. The independent composition of the ICA algorithm can not only remove the relevance of the variables, but also describe the process characteristics with high-level statistical information. The number of independent components to be processed by ICA algorithm is less than that of principal component analysis. It chooses the Newton iteration method as the optimization algorithm for fast speed, no need of selecting the step parameters, easy to use and so on. Given this, this paper mainly uses Fast ICA algorithm to capture and process the voltage signal of the traction transformer and establish the monitoring statistic to diagnose the failure of the traction transformer.

Fast ICA algorithm[6], also known as fixed-point (Fixed-Point) algorithm. Fast ICA is an efficient algorithm for independent component analysis, invented by Aapo Hyvärinen at Helsinki University of Technology, which is a fast optimization iterative algorithm. Despite ordinary neural network algorithm, it uses a batch approach, which means a large number of sample data is involved in each step of operation. Fast ICA algorithm includes several forms such as kurtosis, the maximum likelihood, the largest negentropy, and etc. This paper is based on the largest negentropy, which uses the largest negentropy as a search direction to extract the independent source, fully embodies the projection tracking (Projection Pursuit) this traditional linear transformation of the idea. Also, the algorithm uses a fixed-point iteration scheme maximizing non-Gaussianity as a measure of statistical independence, which is faster than conventional gradient descent methods for ICA.

The matrix model of ICA algorithm is,

$$X = AS + E \tag{1}$$

There are d components in the input signal source,

$$S = [s(1), s(2), \ldots s(d)]^T \tag{2}$$

Which are independent of each other, the observed signal is mixed signal matrix

$$X = [x(1), x(2), \ldots x(m)]^T \tag{3}$$

There are m of mixed signals, this mixed signal is the actual observation signal. A is the mixed coefficient matrix with m rows and d columns, E is the error matrix with m rows and n columns, where n is the number of sampling points. The estimation of the active signal is,

$$\hat{S} = WX = WAS \approx S \tag{4}$$

We can see that W and A are the mutually inverse matrix. The objective of the ICA is to obtain the separation matrix W and the independent component matrix S from the observed signal X in the case where the quantities of the source signals are independent of each other.

Because the Fast ICA algorithm takes the largest negentropy as a search direction, we first discuss the negentropy criterion. From the theory of information theory, we can see that the entropy of Gaussian variables is the largest in all random variables of equal variance, so we can use entropy to measure non-Gaussian, common entropy correction forms, that is negentropy. According to the central limit theorem, if a random variable X is composed of many independent random variables Si(i=1,2,3,...N), as long as Si has a finite mean and variance, the random variable X is closer to the Gaussian distribution, regardless of its distribution. In other words, Si is more non-Gaussian than X. Thus, in the separation process, the independence of the separation results can be expressed by the non-Gaussian measure of the separation result, and when the non-Gaussian measurement reaches the maximum, it indicates that the separation of the individual components is completed.

Negentropy Ng(Y) is defined by

$$N_g(Y) = H(Y_{Gauss}) - H(Y) \tag{5}$$

Where Y Gauss is a Gaussian random variable with the same variance as Y, H() is the differential entropy of the random variable.

$$H(Y) = -\int p_Y(\xi) \lg p_Y(\xi) d\xi \tag{6}$$

In the above equation, $p_Y(\xi)$ is the probability density function. According to the information theory, the random variable of Gaussian distribution has the differential entropy in the random variable with the same variance. When Y has a Gaussian distribution, $N_g(Y)$. The higher the non-Gaussian property of Y, the smaller the differential entropy, the value of $N_g(Y)$, so $N_g(Y)$ can be used as a measure of the non-Gaussian property of the random variable Y. Since the probability density distribution function that needs to be known for calculating the differential entropy according to equation (6) is obviously impractical, so the following approximate formula

$$N_g(Y) = \{E[g(Y)] - E[g(Y_{Guass})]\} \tag{7}$$

Where E[·] is the mean operation, g(·) is a nonlinear function, take it as $g_1(y) = \tanh(y)$

$$g_2(y) = y\exp(-y^2/2) \quad g_3(y) = y^3 \tag{8}$$

ICA optimization algorithm consists of two parts

Step 1: Preprocessing of Observed Data

At first, the signal is de-centered. Removal of the center is to make the mean of each vector zero. The variable itself is subtracted from the mean. After normalization, the center of the data is divided by its own standard deviation to make each variable equal weight for preventing a variable in the process of accounting for a dominant position. In practical applications, according to the actual situation of operation, each variable is given a different weight to get more targeted results.

Step 2: Whitening

The first step is to whiten the data, which can remove the correlation between the observed signals and reduce the computational complexity, thereby makes the convergence of the algorithm better.

Let the random variable x the k^{th} sample value be x(k), the covariance matrix is:

$$R_x = E(x(k)x^T(k)) \tag{9}$$

The characteristic value of Rx is decomposed into

$$R_x = U\Lambda U^T \tag{10}$$

The whitening transformation matrix is:

$$z(k) = Qx(k) \tag{11}$$

$$Q = \Lambda^{-\frac{1}{2}}U^T \tag{12}$$

From the whitening transformation matrix can be obtained:

$$z(k) = Qx(k) = QAs(k) = Bs(k) \tag{13}$$

Where B is an orthogonal matrix and has a relation:

$$E(z(k)z^T(k)) = BE(s(k)s^T(k))B^T \tag{14}$$
$$= BB^T = I$$

It appears that the operation of ICA becomes simplified by whitening transformation. The problem of solving ICA is simplified from matrix A to solving quadrature matrix B, and the estimation of source signal is:

$$\hat{s}(k) = B^T z(k) = B^T Qx(k) \tag{15}$$

Combining formula (4), which can be obtain,

$$B = (WQ^{-1})^T \tag{16}$$

The Fast ICA Algorithm is:

Step 1: The observation data X is centered so that its mean is zero.

Step 2: And whiten the data $X \rightarrow Z$.

Step 3: Select the number of m components to be estimated, set the number of iteration $p \leftarrow 1$.

Step 4: Choose an initial (e.g., random) vector b_p possessing a unit norm.

Step 5: Set

$$b_p = E\{Zg(b_p{}^T Z)\} - E\{g'(b_p{}^T Z)\}b_p \tag{17}$$

Step 6: Do the following orthogonalization

$$b_p = b_p - \sum_{j=1}^{p-1}(b_p^T b_j)b_j \tag{18}$$

Step 7: Normalize

$$b_p = b_p / \|b_p\| \tag{19}$$

Step 8: If it is not converged, go back to Step5.

Step 9: Let $p = p+1$. If p is not greater than the desired number of m, go back to Step4.

IV. Theoretical Analysis & Simulation

First of all, to create the simulation model with MATLAB / SIMULINK (Fig.1):

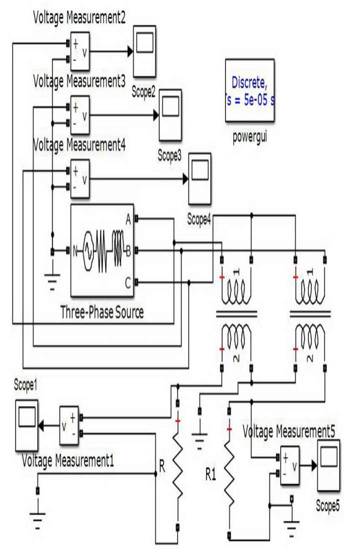

Fig. 1: Correct Simulation Model

Secondly, offline modeling. The mixed signal matrix X = [x (1), x (2), ... x (m)] T is taken as the signal observation point in the Fast ICA algorithm. The matrix is m rows and n columns, Where m is the number of observed signals. In this model, m is the number of observation vectors m = 5, and n is the number of sampling points, and X is the actually observed signal.

Thirdly, establish historical statistics. Here in the Fast ICA fault diagnosis method, the two most widely used statistics, I^2 statistics and Squared Prediction Error (SPE) statistics, are used to monitor whether the process is normal or not. The I^2 statistic is used to measure the system change of the process, whereas The SPE is used to measure the random variation, and the I^2 and SPE statistic with reasonable control limits can detect different types of faults. Therefore, this method combines the two statistics for better monitoring effect. Combine the formula (16), The estimation of the mixed signal by independent component analysis is:

$$\hat{x}(k) = Q^{-1}BWx(k) \tag{20}$$

The error of the estimated and actual value of the mixed signal is:

$$e(k) = x(k) - \hat{x}(k) \tag{21}$$

You can get the SPE statistic expression as:

$$SPE(k) = e(k)^T e(k) \tag{22}$$

The I^2 statistic expression is:

$$I^2(k) = \hat{s}(k)^T \hat{s}(k) \tag{23}$$

By substituting the collected historical data into the above formula, there can get the historical statistics during operation.

And then the traction transformer system for real-time data acquisition is to monitor the data, the monitoring data for pretreatment. The standardized data is decomposed by ICA to compute the corresponding I^2 and SPE statistics, and is compared with the control limits obtained in the historical statistical data. If the statistics are not exceeded, the system is running normally. If the statistics are overrun, the system is faulty.

In MATLAB, the model of the high-speed traction transformer, which simulates the V/V wiring, is used to monitor the voltage signal of the input and output. The monitoring signal is a mixed signal and the observation signal. And then after collecting 500 sampling points, as shown in Fig.3 below, which input and output signals have five sampling points. Add a short circuit fault to Fig.1 above, As shown in Figure Fig.2 below. In the Fig.2, the phase A and phase B of the V/V traction transformer input phase are interrupted. And then continue to sample this simulation, the same collection of 500 sampling points, sampling diagram shown in Fig.4, then use the 1000 sampling points as Fast ICA algorithm in the signal observation points.

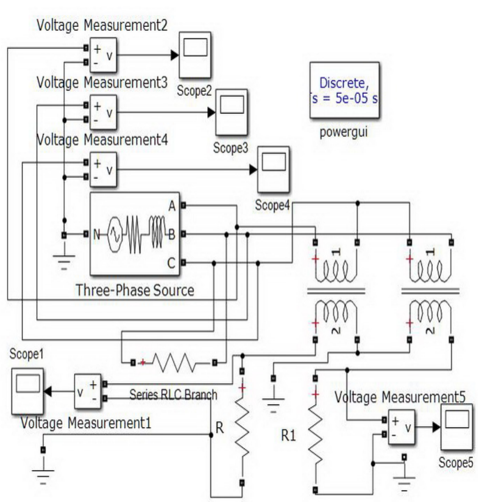

Fig. 2: Fault Simulation Model

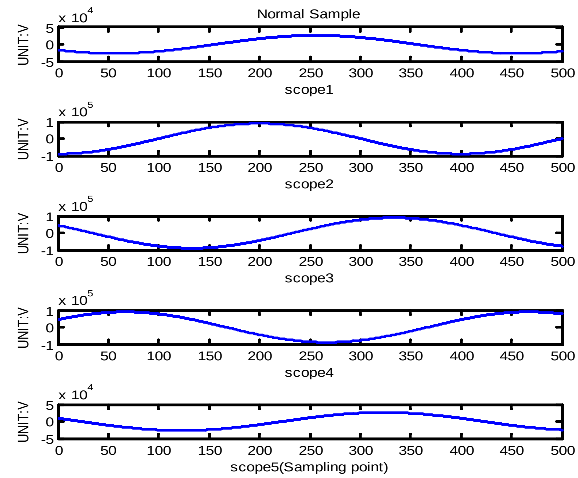

Fig. 3: Normal Operation Sampling Signal

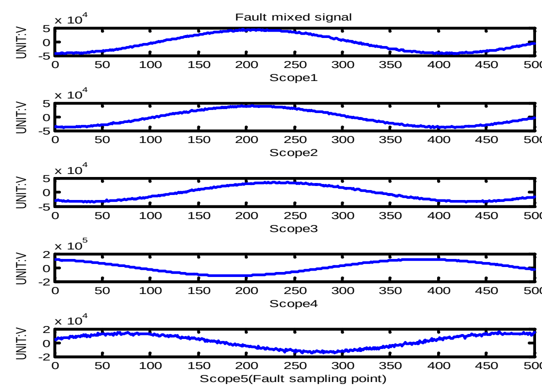

Fig. 4: Fault Sampling Signal

The monitoring data were pretreated, the standardized data were ICA decomposition, Calculate the corresponding I2 and SPE statistics to compare it with the control limits obtained from historical statistics. It reveals that a failure has occurred after the 500th sampling point, as shown in Fig.5 below.

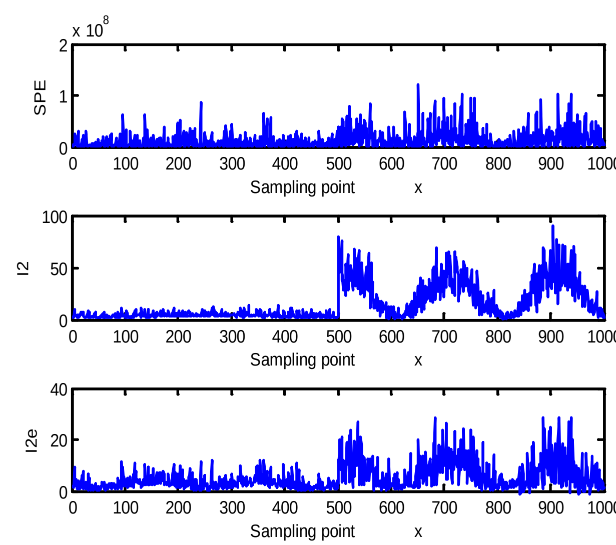

Fig. 5: Fault Simulation Model

V. Conclusion

The Fast ICA algorithm based on the maximum negative entropy criterion is used to analyze the data in the precision range, and the I and SPE monitoring statistics are calculated by Fast ICA algorithm. In the data simulation experiment, the waveform was also successfully monitored for failure.

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Influence of the Permittivity on Carbon Fiber Particulates Applied in Radiation Absorbing Materials

By Miguel Angelo do Amaral Junior, Newton Adriano do Santos Gomes, Simone de Souza Pinto, Mirabel Cerqueira Rezende, Jossano Saldanha Marcuzzo, Sandro Fonseca Quirino & Maurício Ribeiro Baldan

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Strictly as per the compliance and regulations of:

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I. Introduction

The measure which electronic technology information by means unguided and use of electronic devices develop also growing problems with electromagnetic interference, making it a serious problem for communication between devices that communicate at the same frequency. The occurrences of interference leads to a malfunction of electronic devices [1,2,3]. In order to resolve these interference problems, many materials have been developed, so that a coating on the equipment to be used. These materials are known as radiation absorbed materials (RAM) which have ability to convert electromagnetic energy into heat. Basically RAMs are made of dielectric and or magnetic materials, that when processed conveniently promote high power loss in certain frequency bands. These materials have been used to solution the interference problem in most varied materials, such as covered, copper covered, polymer composites, carbon fiber, activated carbon fiber and deposit thin films [4,5,6].

Other areas which received great attention from the industries and academic research centers, due to their RAM applications in the most diverse areas are military, aeronautics, aerospace and telecommunications [7,8,9]. In the aeronautical and military areas the RAMs have been extensively studied in the frequency bands of 8 - 12 GHz, known as X-Band [10,11]. Materials such as carbon, ceramic oxides, ferromagnetic and conductive polymers are traditionally applied to RAM and are thus used as centers for the absorption of unwanted radiation [12]. In particular, carbon is traditionally applied as RAM in the frequency range in GHz because it is an excellent reflector of electromagnetic radiation [13]. Therefore, many researches on this frequency were conducted with carbon in its different allotropic forms for the production of RAMs, whether in the form of activated carbon fibers [14], felt fabrics of carbon fiber in rectangular shape [15], particles dispersed in a matrix [16], cobalt oxide deposited [17], composite of activated carbon fiber with polymer [18], nickel particulates covered by carbon layer [19] and carbonaceous material in pyramidal form [20]. However, the use of these absorbers centers present as major disadvantages the weight and the volume occupied by the absorber final material. Hence, RAMs based carbon fibers, have been explored to improve these characteristics, as is known by its low density which facilitates applications in aerospace industry.

The RAMs are characterized by their ability to convert electromagnetic waves into thermal energy, so that the permittivity (ε) and the magnetic permeability (μ) are parameters related to the electrical and magnetic properties of the material, which in turn are directly associated with the interaction of the wave with matter. When an electromagnetic wave propagates in a medium, the electric field of this wave polarizes the material. However, when a material is lossy, there is a delay between the electric field and the polarization of the medium, causing losses. The level of the losses depends on the difference between the phase electric field and polarization. These materials are classified into two types depending on the interaction with the wave.

The first type, materials with dielectric losses which have interaction with the electric field of the wave. Second, materials with magnetic losses, have interaction with the magnetic field of the wave. However,

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these characteristics are presented intrinsic properties of the materials, there are still features about the material geometry that also influence the attenuation of the wave such as: irregular features on the sample surface (example: pores), distribution of particulates and size of these particulates [21]. The way in which the matrix material is distributed in the samples improves the effect of wave absorption [22. In the CF particles embedded in a matrix and CFF in case have different materials distributions which is directly related with geometrical characteristics of the material, producing a material that allows or not allows the wave penetration, causing different in side interaction with radiation incident. Others authors have been study the role of the carbon fiber concentration by a matrix of high and low concentrations, but not with reference made studies of the particulate size [23,24]. Thus, this study aims to understand the behavior of the electromagnetic wave in frequency range of 8.2-12.4GHz (x-band) for carbon fibers (CF) in different distributions in epoxy resin (ER). For this is first produced a carbon fibers felts (CFF) so that impede the wave of entry into the test body, and then the CFF will be pulverized and molded in epoxy resin with different concentrations of CFF and particulate size to modify the way in which the wave interacts with the particles.

II. Materials and Methods

a) *Production of Samples*

In order to produce CF it was used textile PAN, due to its low cost compared with other raw materials for the production of CFs. The commercial 200 ktex tow of 5.0 dtex textile PAN fibers, was thermal oxidized in a laboratory scale oven set by, aiming the production of flame resistant fibers. The oxidation process was performed in two steps, the first at 200°C and the second at 300°C. The total time process were 50 minutes for each step. After that, the oxidized PAN produced used as a raw material to produce a CFF having 200 g/m^2. During the carbonization process, the oxidized PAN loses about 50% in mass and shrinks linearly about 10%. The shrinkage is an important parameter and must be controlled because an inadequate shrinkage result in poor mechanical characteristics and the fiber can't be handled. For this purpose, the CFF sample was cut into pieces of about 0.7 x 0.25m and placed in a special sample holder that can control the sample shrinkage in two dimensions.

The set was introduced in an electrical furnace. Both ends of the furnace tube were closed by flanges, which allow the insertion and the purge of processing gas to provide an atmosphere condition necessary for the carbonization and activation. The carbonization was performed in argon atmosphere at a final temperature of 1000°C by using a heating rate of 30°C/min. The process time at maximum temperature was set in 20 min to complete the carbonization process. After finishing the carbonization process, the furnace was turned off and maintained in Ar atmosphere. This condition of inert atmosphere was maintained until the room temperature inside the furnace reactor was reached.

b) *Experimental Procedure*

Different from granular or powdered carbon, CFs are composed of carbon filaments that may have different properties from other types of carbon materials due to the possibility of being transformed to fabric, felt or textile medium. The second stage is to powdering the CF before becoming felt, powdering it, and separates it into different particles sizes and embed them in epoxy resin (ER). The samples were separated in two particulates dimensions < 25um and in the range of 25-53um. Besides, two different mass fraction was studied, 25 and 50% of CF. The samples were produced with thickness of 1.5mm and dimensions of 10.22 x 22.70mm. The experiments were summarized in Table 1.

Table 1: Production of Composites based in CF

Samples	CF Concentration	Particulate Size
1	25%	<25um
2	25%	25-53um
3	50%	<25um
4	50%	25-53um

c) *Electromagnetic Properties*

The electromagnetic properties of the samples were studied through a waveguide technique in the frequency range 8.2-12.4 GHz. A rectangular waveguide (calibration kit WR-90 X11644A - Agilent) with a flexible cable 50Ω (85132F - Agilent) coupled to an analyzer Microwave PNA-G networks, model N5232A 20GHz was used to perform the reflection measurements and the scattering parameter (S parameter). The measured reflection gave information about the attenuation of the wave in the samples. The S parameter gives information about the material properties such as permittivity ε and permeability μ through the reflection coefficient (S_{11}) and transmission (S_{21}). The ε and μ we obtained from a specific software (85071E - Agilent), based on Nicolson Ross Weir (NWR) algorithms [25]. These values are essential to learn how the material reacts to electric and magnetic fields of the electromagnetic wave [26].

Also was possible to compare the experimental results of the reflection with transmission line model. Through of transmission line model the normalized input impedance Z_{in} of a metal-backed microwave-absorbing layer is given by[27]:

$$Z_{in} = \sqrt{\frac{\mu_r}{\varepsilon_r}}\, j \tanh\left[2\pi\sqrt{\mu_r \varepsilon_r} f d\right] \qquad (1)$$

Where μ_r and ε_r are the relative permeability and permittivity, respectively, of the composite medium, f is the frequency of microwaves, and d is the thickness of the absorber. The reflection is related to Z_{in} as [27].

$$Reflection\ loss\ (dB) = 20\ log \frac{|Z_{in} - 1|}{|Z_{in} + 1|} \qquad (2)$$

III. Results and Discussions

In Figure 1 (a) it shows the SEM image of the CF in the felt form with magnification of 1000x. CF filaments are distributed randomly throughout felt, thus not presenting a distribution in one direction. It is also worth noting that the textile PAN does not show cross section in cylindrical shape which can be seen in Figure 2 (b).

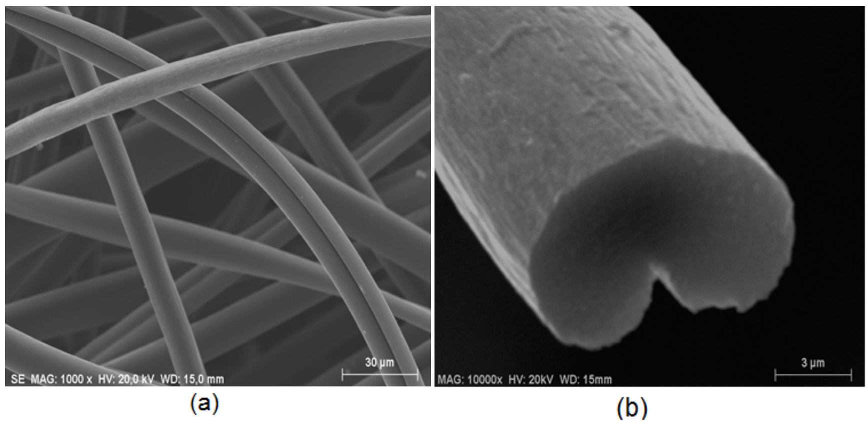

Fig. 1: SEM image (a) 1000x and (b) 10000x CFF.

It is well known that electrical permittivity and magnetic permeability are parameters related to reflection and attenuation characteristics of electromagnetic wave absorbers. The real part ε' and μ' represents the energy storage capacity and the imaginary part of the complex ε" and μ" account for the energy loss dissipative mechanisms in the materials. In other word, the ε' is related with the material capacitance which is proportional to charge stored into the system under an applied electric field. The measurement of the ε and loss tangent dielectric$\left(\frac{\varepsilon''}{\varepsilon'}\right)$ for a pure ER in frequency range of 8.2-12.4GHz is around 3.5 and 0.020. These results are in very good agreement with the results reported in the literature [28]. The low value of loss tangent dielectric indicates that the ER does not present a good dissipative property, therefore isa material that has not electromagnetic property enable to attenuate the electromagnetic wave at X-band. It is important to emphasize that the carbon fiber and epoxy resin are materials with exclusively electrical properties and then the real and imaginary permeability were not shown in this work.

The studies of the electromagnetic character-rization begin with the intrinsic properties and reflectivity of CFF impregnate in ER. According to Figure 2 the CFF present different results of particulate CF, because despite the material are the same, the form which the material are introduced in ER influence in the measurements. The CFF present ε' relative in range of 90-100, while the imaginary part have been a crescent behavior in frequency function of 50-90. It was also observed that through that the carbon in felt form are a good reflector, resulting in a reflectivity range of 85-90%. The fact that this sample exhibits a plate behavior is due to the carbon being known as a reflective material, and because it is in the form of felt it was also observed that corroborates with the reflection of the electromagnetic radiation [24]. The measures of the ε' and ε'' of the composite based in ER and CF with different particles sizes and concentrations are shown in Figure 3.

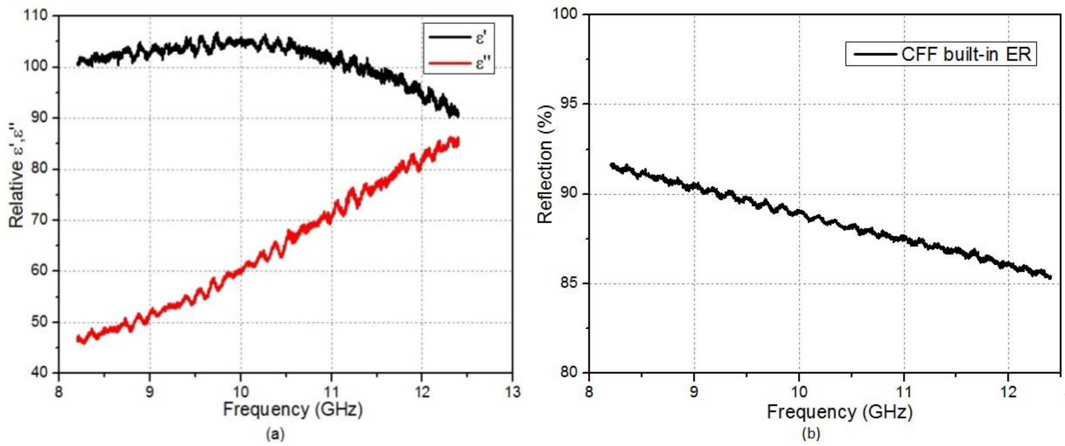

Fig. 2: Measured (a) real and imaginary permittivity and the (b) reflectivity of the CFF samples embedded in ER.

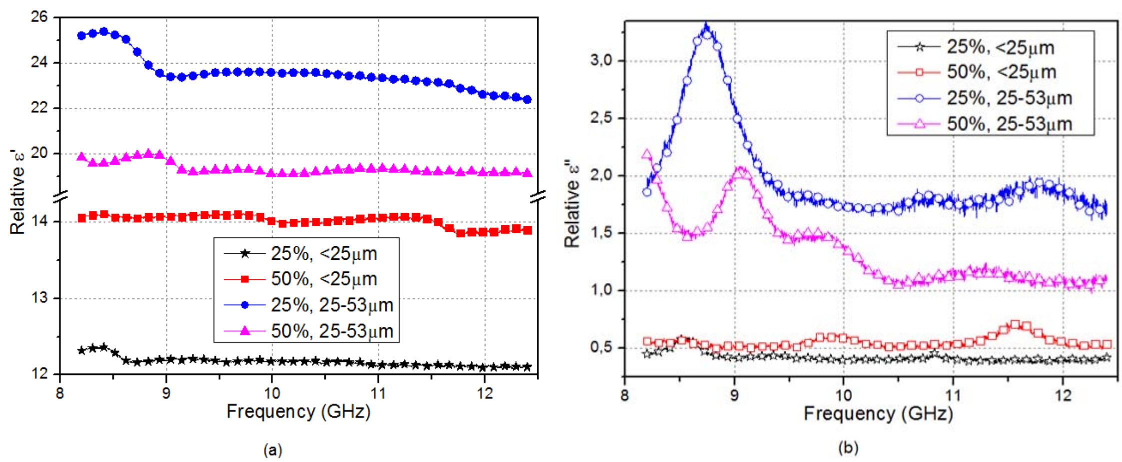

Fig. 3: Measurement of (a) ε' and (b)ε'' for the samples.

According to the Figure 3, keeping the concentration of CF in 25% and varying only the size of the particles we can observe some situations: (I) an increase in ε 'from about 12 (<25um) to 23 (25-53um) and from 0.5 (<25um) to 1.8 (25-53um) in ε ''. This increase is observed as a function of the increase of the particulate size from <25um to 25-53um. (II) For the 50% concentration was observed that the variation in ε 'was from 14 (<25um) to approximately 23 (25-53um). For ε ''this variation from 0.5 (<25um) to on average 1.5 (25-53um).In summary, we can conclude that for both concentration of 25% and of 50% there was a significant increase in ε' due to the increase in the size of the particles. However, another way of analyzing these results is to fix the particle size at <25 um and observe the variation in ε '. In this way it is found that increasing the concentration from 25% to 50% favors an increase from about 12 (25%) to 14 (50%) in the ε ', but this linear increase in relation with concentration is not observed for particles size between 25-53um. The ε ' decrease from 23 (particulate size 25-53um) to 18 (particulate size <25um), and the same decreasing behavior is observed for ε". Same observations can be performed in relation this results. Firstly, the diminution the particulate size in both concentrations increase the transversal area of the CF with resin epoxy. Other observation is that the particulate dispersion in composite, because for low concentrations like that 25% and particulate size <25um the dispersion cannot produce a connections between the particulate CF. Then, the concentration of 50% have more probability to interact resulting in a particulate network. Figure 4 shows the schematic representation of the samples with different particulate concentrations and in the felt form.

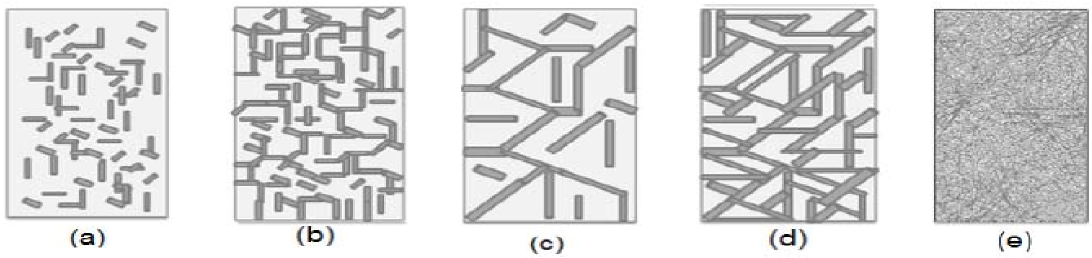

Fig. 4: Schematic representation of the samples with (a) 25% of CF with particle size <25um, (b) 50% of CF with particle size <25um, (c) 25% of CF with particle size 25-53um, (d) 50% of CF with particle size 25-53um and (e) CFF.

Is important highlight that in the Figure 3 (a) and (b) were observed some peaks in certain frequencies. Perhaps this peaks are associated with some process of absorbance by resonance due to the particulates presence. Besides, it was notice that the peak intensity and position are related with the concentration and particulates size. In order to investigate theses results was realized an fitting in the ε' and ε'' through the classic Lorentz model. The real and imaginary permittivity in frequency function is showed in the equations below.

$$\varepsilon^{'}(\omega) = \varepsilon_o + \sum_n \frac{\varepsilon_o \omega^2{}_p (\omega^2{}_{on} - \omega^2)}{(\omega^2 - \omega^2{}_{on})^2 + \Gamma^2{}_n \omega^2} \quad (4)$$

$$\varepsilon^{''}(\omega) = \sum_n \frac{\varepsilon_o \omega^2{}_p \Gamma_n \omega}{(\omega^2 - \omega^2{}_{on})^2 + \Gamma^2{}_n \omega^2} \quad (5)$$

Where ω_p is denominated plasma frequency which is associate with the charge q, ω_o is called resonance frequency, n is the number of difference resonance frequency contribute due to the different charges q in the system and Γis the damping constant [29]. Through these equations it was possible to perform the adjustment with the experimental data. Figure 5 shows an adjustment made for the 50% with particle size <25um sample using the sum of three equations.

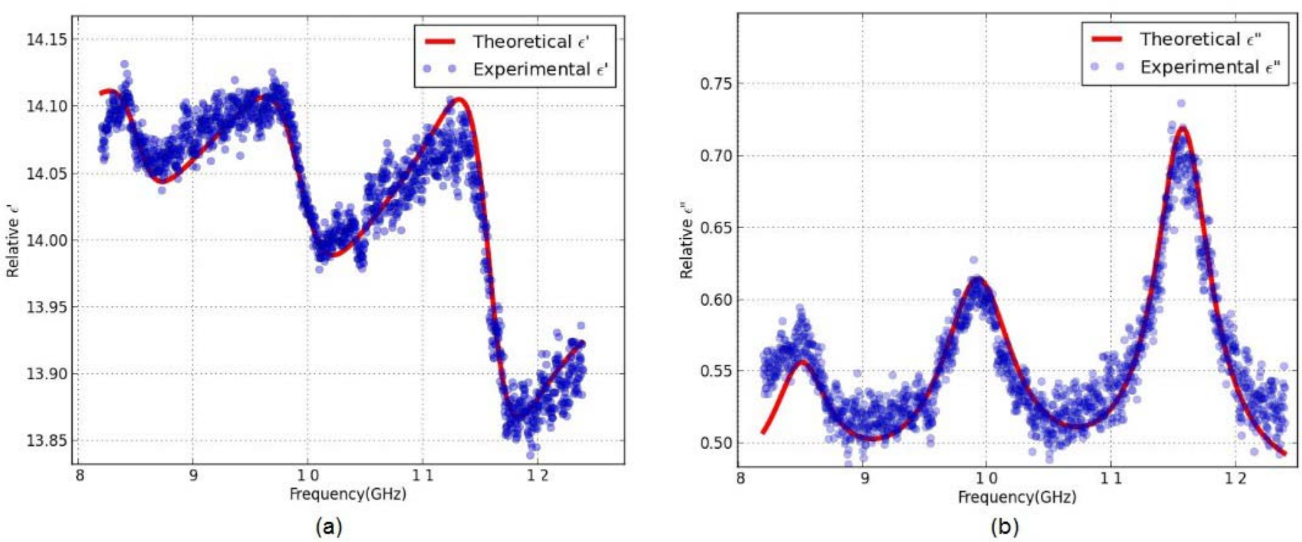

Fig. 5: Example of the experimental and calculated (a) e' and (b) e'' for the sample with particle size < 25um and mass fraction 50% of CF.

According to ours first conclusions, ours results are in good correspondence with the results obtained Dang at al [30]. The authors investigated the dielectric properties of CF/polyethylene matrix composite. According to the authors there is a direct relationship between the dielectric constant with the increase of volume fraction of the CF for particle size distribution of approximately 100um. In order to explain the quantity of charge stored to justify the increase in the dielectric constant the authors concluded that the charge accumulated was related with the increase of CF/ER interfaces. In other words, by increasing the CF volume fraction the amount of interfaces increases causing an increase in the dielectric constant. According to our results there is an increase in the real part of permittivity when the CF volume fraction increases from composite with CF concentration of 25% and 50% for particle size (<25um). However, fixing the particle sizes in the range of (25-53um) the permittivity decreases with the increase of CF volume fraction, which is not in agreement with the results proposed Dang at all. More recently, Hong et all investigated the dielectric properties the carbon fiber randomly distributed [31]. The authors reported that the higher the volume fraction of carbon fiber the higher is the permittivity. Besides, by increasing the fiber length the real and imaginary part of dielectric constant increases. By increasing the particles size the polarization effect is enhanced and smaller is the depolarization effect. The decrease in the ε' as reported in our work may be related with a limit for CF/ER concentration. This limit also may be associated with the lack of space to allow multi-reflection between the fibers to enhance the polarization. The results were summarized in the Table 2.

Table 2: Measurement of real & imaginary permittivity for varied concentrations and particulates.

CF Concentration	Particulate Size	ε'	ε''
25%	<25um	12.50	0.47
50%	<25um	14.00	0.50
25%	25-53um	24.00	2.00
50%	25-53um	20.00	1.50

In Figure 6 are showed the results of reflectivity measurement of the samples with metal-backed. According to Figure 6 for concentration from 25% to 50% CF for particulates size <25um not have significant changes in the reflectivity, both exhibited a decreasing behavior as a function of frequency resulting in a minimum reflection of 60% in approximately12.4GHz. However, for particulates size between 25-53um the concentration increase reveal significant change. For theses particulates size, the results showed that for larger particulate sizes with 25% CF concentration the attenuation was higher in the frequency of 10.18 and 10.88GHz than for 50% CF concentration. In frequency of 10.18GHz the reflectivity was approximately 10% and in 10.88GHz was 6.4%. For 50% CF concentration were observed three peaks; 8.83, 10.18 and 11.65GHz with their respective reflectivity32.5, 25 and 35.6%. Despite there are more peaks of attenuation in 50% CF concentration than 25%, there is a greater attenuation for samples with 25% CF concentration than 50%.According to the results it was possible to observer that the material is more sensitive to the variation of granulometry than concentration of CF, this for high CF concentrations.

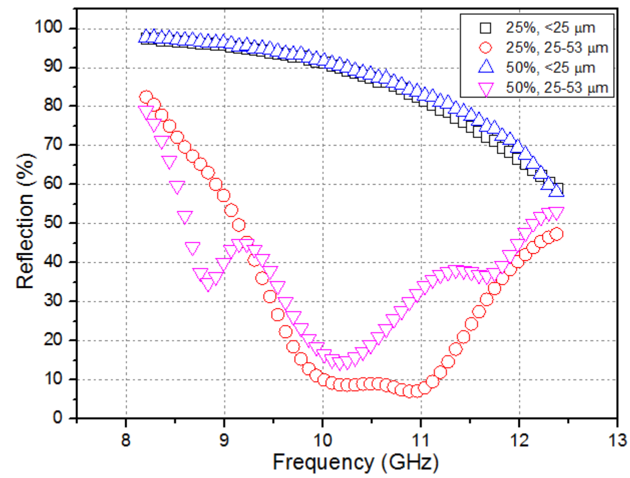

Fig. 6: Reflection measured for four different conditions.

Using the permittivity and permeability of the samples in transmission line model for short load it was possible to estimate the reflectivity by the Equation (1) and (2). The results are showed in Figure 7 and they are good concordances with the measured results (Figure 6). However, it was observed a peak shift in the relation of the measured results. Huang et al [32 also use the model described in Equation (1) to compare the calculated and the measured reflectivity for nickel encapsulated carbon particles for frequency range of 2-18GHz. Huang highlighted some reasons that can be influenced in this discrepancy, as different characteristics of the elements used in the manufacture of the composite and even device instrumental limitation. In contrast, the model showed really effective when the experimental conditions are accurate, for example the uniformity and thickness of the samples.

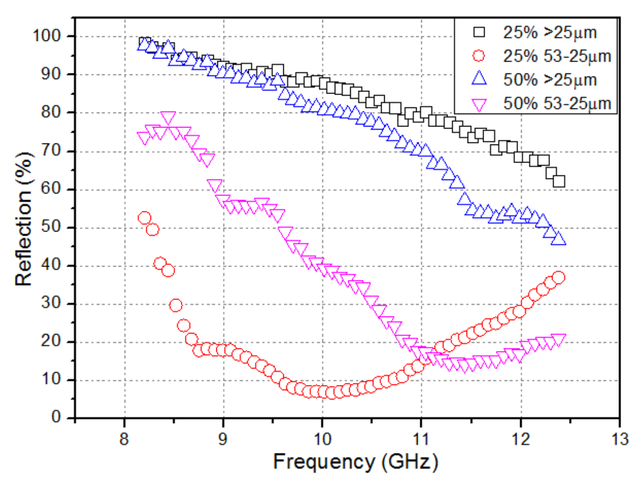

Fig. 7: Reflection calculated for the samples trough the transmit line model.

Thus, the electromagnetic wave in the frequency range of 8 - 12.4GHz cannot fully penetrate the CFF. This is due to the large number of intertwined fibers in random directions, then occurring reflection to the source. However, minority, some of the signal can still penetrate the fiber occurring multiple reflections inside, these multiple reflections are gradually attenuating the signal by dielectric loss of CFF. Therefore, with the samples in particulate fixed by epoxy resin electromagnetic wave can penetrate the material and suffer attenuation by multiple reflections and other process like resonance.

IV. Conclusion

The study of how the carbon fiber is disposed in the resin, whether in permittivity the form of felted or particulate, showed a strong influence in the behavior of the permittivity and consequently in the attenuation of the electromagnetic wave. The carbon fiber in felt form presents properties of reflector material and it was not observe the attenuation peaks in the frequency range of 8.2-12.4GHz. According to the results it is possible to observe that the variation of particle size has different contributions in behavior of the permittivity and reflectivity. Too was observed in imaginary permittivity peaks give rise of some absorbance process. This peaks are more salient for samples with particulate 25-53um than <25um. The particulates size 25-53um and 25% carbon fiber concentration present peaks position approximately in 8.75, 10.85 and 11.65GHz and the samples with 25-53um with 50% present peaks in 9, 10.10 and 11.25GHz. Theses resonates peaks are contribute the reflective results. The best attenuation occurred for samples with particulate size 25-53um, where the concentration of 50% attenuated until 75% and the samples with 25% carbon fiber concentration until 93.6%. The transmission line model showed to be a good method to estimate the reflectivity since it has accuracy in the measurement of the thickness. Therefore, is a good technique to estimate thickness of the sample before of the production.

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Removal of Noise from Video Signals using Adaptive Temporal Averaging

By Himanshu Makkar & Onkar Singh Lamba

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Abstract- This abstract proposed an algorithm for video denoising base on adaptive, pixel-wise, temporal averaging. This algorithm decomposes video signals into the set of 1-D time dependent signals and then removes the noise via establish the temporal averaging intervals during each signal from the set. Temporal averaging intervals established by simple, effective evaluation process which contain two-way thresholding. The proposed algorithm is experienced on quite a few types of 1-D signals and benchmark videos. Experiments advise that the proposed algorithm, regardless of its ease, produces high-quality denoising results.

Keywords: signal processing, video denoising, temporal averaging, averaging interval, pixel-domain method.

GJRE-F Classification: *FOR Code: 090609*

REMOVALOFNOISEFROMVIDEOSIGNALSUSINGADAPTIVETEMPORALAVERAGING

Strictly as per the compliance and regulations of:

Removal of Noise from Video Signals using Adaptive Temporal Averaging

Himanshu Makkar [α] & Onkar Singh Lamba [σ]

Abstract- This abstract proposed an algorithm for video denoising base on adaptive, pixel-wise, temporal averaging. This algorithm decomposes video signals into the set of 1-D time dependent signals and then removes the noise via establish the temporal averaging intervals during each signal from the set. Temporal averaging intervals established by simple, effective evaluation process which contain two-way thresholding. The proposed algorithm is experienced on quite a few types of 1-D signals and benchmark videos. Experiments advise that the proposed algorithm, regardless of its ease, produces high-quality denoising results.

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I. Introduction

Video superiority enrichment is the long-standing and broad region of the research. Video signals are frequently impure by the noise all through attainment and transmission and noise is a governing factor that degrades the quality of the video signalsy. Low-end camera market is increasing fast (digital cameras, web-cams, cell phones etc.) and there is a necessity now more than ever for fast and effective and reliable video signal upgrading technologies to get better their output results. Even high-end and the proficient apparatus (surveillance cameras, medical devices etc.) contain to manage with video squalor and noise corruption (especially in extreme conditions). Nowadays, practically every video-capturing devices incorporates some kind of noise removal techniques. Video denoising is highly advantageous, not only for improving the perceptual quality, as well for the increasing compression speed and the efficacy and facilitating transmission bandwidth diminution. Most of the video denoising algorithms proposed in the literature consider an additive white Gaussian noise (AWGN) and that can be further divided into the pixel domain and transform domain methods. The Pixel domain methods can be subcategorized into spatial, temporal and the spatiotemporal domain methods and generally decrease noise by the weighted averaging. Majority of the recently proposed pixel domain algorithms is going to argue that spatiotemporal filtering method performs wellr than the temporal filtering, e.g. ST-GSM algorithm [1]. Nevertheless , spatiotemporal filtering, as well as the spatial filtering method, may significantly trim down theefficient resolution of the video signal due to spatial blurring [2]. Most video signals are temporally consistent and each new frame can be predicted from prior frames. If the two video signals are known with similar *PSNR* values, then one filtered with spatial method and the other with the temporal algorithm, the latter may be chosen just because of the temporal coherence. Motion information and the temporal coherence information can be included in the denoising algorithms of video signals throughout applying the advanced transforms [3, 4]. However, most of the transform domain methods for video denoising be likely to be complex, sluggish, and not appropriate on end user electronics. Now the pixel domain temporal method of denoising algorithms also offers the ability of motion detection with the intention of conserve full resolution of the input image sequence signals and temporal coherence. But, even the pixel domain methods, which is used block-matching or similar methods, Frequently have need of lots of computer resources for the efficient noise removal. This paper proposes the pixel-wise temporal method for removing noise from video signals which is straightforward, spontaneous, yet effectual and competitive. This method observes video signals as group of 1-D signals – each video signal is decaying in *m*-by-*n* one-dimensional signals (*m* represents to width, and *n* height of image frame in numerous pixels) and then processed. This approach allows the algorithm to stay straightforward, quick and extremely adaptable. Removal of noise is achieved by an adaptive temporal averaging method applied on averaging intervals. This piece of writing intends to show that the high-quality of video denoising does not need the use of wavelet transforms, NLM technique of searching of related patches and other techniques (which are inescapably and inherently difficult). This paper shows a simple, easy and "lightweight" pixel-wise method for denoising video signals that can be produces high-quality noise removal results and even the out-perform of some of its more complicated competitors.

Experiments be conducted for testing the developed algorithms. The proposed algorithm is the first tested algorithm on a set of test 1-D signals that is degraded by additive white Gaussian noise and its results are used for the alteration of the algorithm. This algorithm is next evaluated with gray-scale benchmark video signals. The proposed method is offered in Section 2. Section 3 that contains experimental results and the conclusion element is existing in Section 4.

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II. Algorithm Proposed

a) Model of Observation

Prior to examining the algorithm, the observation model and information used right through the paper have to be introduced. A noisy signal is measured:

$$f[k] = s[k] + n[k] \qquad (1)$$

where $s[k]$ is a noise-free signal and $n[k]$ is the additive white Gaussian noise among zero mean and variance σ^2 (standard deviation σ). If the signal $f[k]$ is a demonstration of time-dependent pixel concentration taken as of a monochromatic video signal then $f[k]$ takes values between 0 and 255 and it has a limited number of the samples.

b) ATA Method

The projected method in this paper is the ATA (Adaptive Temporal Averaging) method. This method is based on a straightforward idea. A noisy input signal $f[k]$ is considered, where the value of $k = 1, 2, 3, \ldots, m$. Noise is detached by establishing assessment intervals and applying averaging. Estimation intervals are recognized for each sample of the noisy input and each section of the resulting (noise-free) signal is obtained by means of the corresponding estimation/averaging interval of the noisy input.

The key to high-quality denoising is reliable estimation of the averaging intervals. This paper recommend the use of temporal coherence of the signals in order of the establish averaging intervals significance that each sample of a noisy input has a assured amount of related samples occurring instantly before and/or after it. If that is obtainable graphically (with time placed on the x-axis and the sample values placed on the y-axis), then each sample has a definite amount of alike samples residing instantly to the left and/or to the right. Groups of related samples are used for the forming the averaging intervals and an averaging interval is formed for every sample of the noisy input. Forming of averaging intervals is easy – ATA algorithm is comparing currently progression sample with successive samples to its left and the right side (comparison of the samples to the left and to the right are jointly self-governing). When the comparison procedure arrive at a sample to the left that is considerably different from the one at present processed, then that algorithm stops the left-hand side successive comparison. This is what how the left-hand part border of the averaging interval is obtains. The similar process is used for obtaining of the right-hand side border of the averaging interval. When its averaging interval is determined, then the estimation of the noise-free signals is obtained using by the mean value of the averaging intervals which as follows:

$$e[k] = \frac{f[l_k] + \ldots + f[k] + \ldots + f[r_k]}{r_k - l_k + 1}, \qquad (2)$$

$$r_k \geq k \geq l_k$$

where $e[k]$ is the estimated noise-free signal, l_k is the left-hand-side and the r_k is the right-hand side boundary of the averaging interval. A two-way threshold condition is used to establish boundaries of the averaging intervals. Even as determining boundaries of the averaging intervals, the algorithm examines complete differences between the sample that is being at present processed and samples residing to its left/right. When its examined, complete difference is greater than the pre-estimated value (which was named Threshold A), the boundary of the averaging interval is establish. Consecutively, the ATA method is cumulating the over mentioned differences. When that summation is larger than pre-estimated value (which was named Threshold B), the boundary of the averaging interval is found (refer to Figure 1, that shows the algorithm flowchart). thus, two threshold criterion are liable for determining the boundaries of the averaging intervals (bear in the mind that the left-hand side boundary is totally independent from the right-hand boundary). Both the criterion are using consecutively, significance that the averaging interval boundary is determined by the one criterion which provides the averaging interval boundary first. Then the Threshold A is considered to react to immediate changes in the input signals and Threshold B is designed to respond to continuous changes in the input signal. Iterative methods were used for determining optimal values of the Threshold A and B – a variety of signals and videos were processed iteratively in anticipation of the best values of *MSE*, *PSNR* and *SSIM* were attained. With this approach, experiential optimal values for the Threshold A and the Threshold B were determined and that used in the further experiments. Which are as follows: *Threshold A* $= 5\cdot\sigma$, *Threshold B* $= 10\cdot\sigma$.

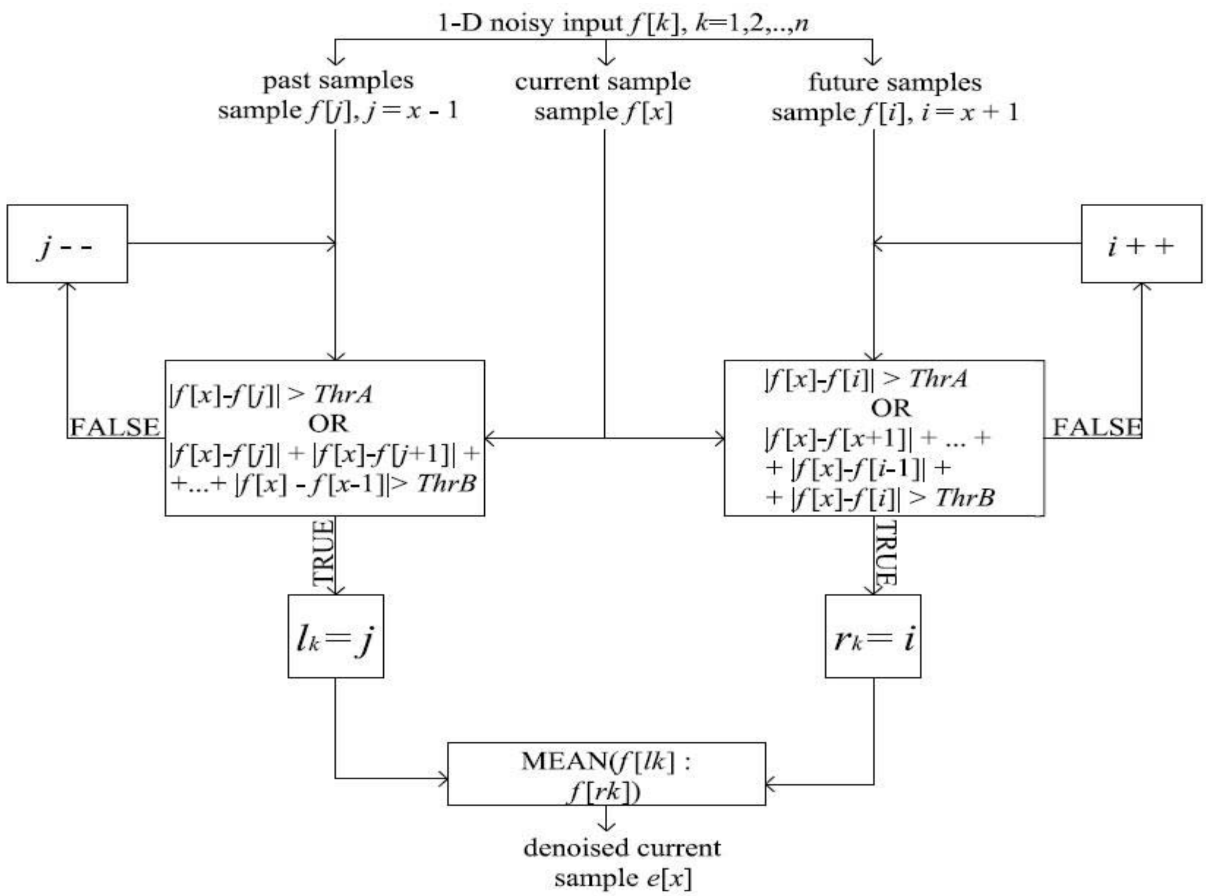

Fig. 1: Flowchart of the Proposed Algorithm

III. Experimental Results

In experiments there were two 1-D signals were used to determine the efficiency of the ATA method. Also, several dissimilar gray-scale sequences were introduced for testing the algorithm: “Salesman”, “Miss America”, and the “Tennis”. That were degraded with additive white Gaussian noise of a range of values of the standard deviation σ = 10, 15, 20 and processed with the projected filter.

a) *ATA Method Applied on 1-D signals*

Two dissimilar test signals were used:

- Signal A – quasi-rectangular signal; features areas of the stable values and the most important leaps in signal values.
- Signal B – quasi-sine wave; features continuous changes in the signal values.

Both of the signals were degraded by the Gaussian noise of standard deviation σ = 10, 15, 20. This ATA technique was used for noise removal and the output results are articulated by determining the *MSE* (Mean Squared Error) of the noise removed signals (Table 1). Figures 2 and 3 exemplify denoising of Signals A and B using by the ATA technique. Through examining the output results that shown in Table 1 (along with the Figures 2 and 3), the conclusion is reached that the considerable noise removal is accomplished.

Table 1: MSE values of 1-D signals denoised using ATA method

Noise σ	10	15	20
	MSE values		
Signal A	2.917	3.038	21.488
Signal B	9.150	10.361	13.180

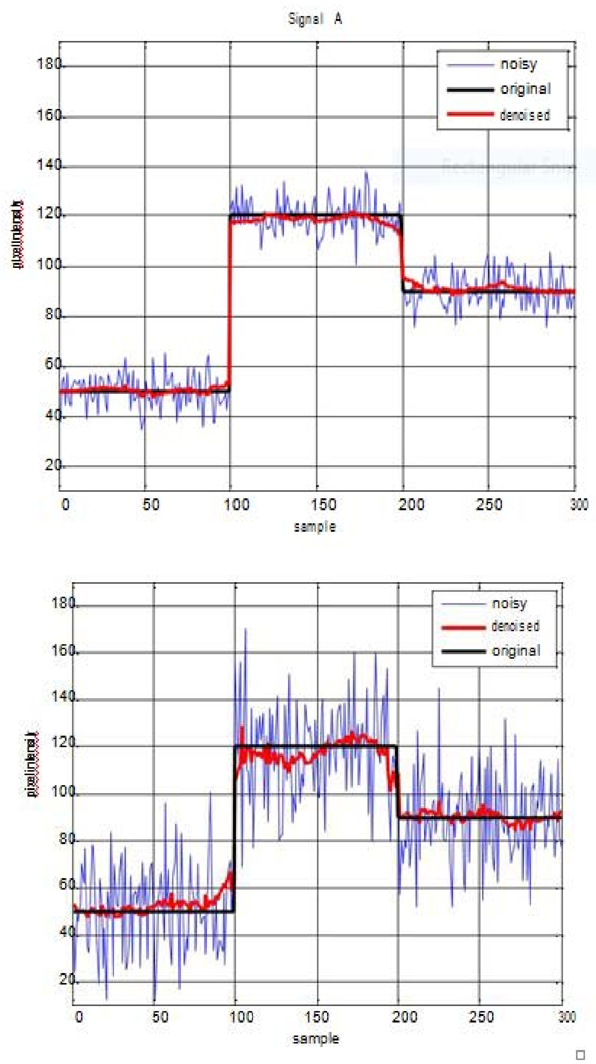

Fig. 2: Denoising of Signal A using ATA method; up: noise σ = 10, down: noise σ = 20

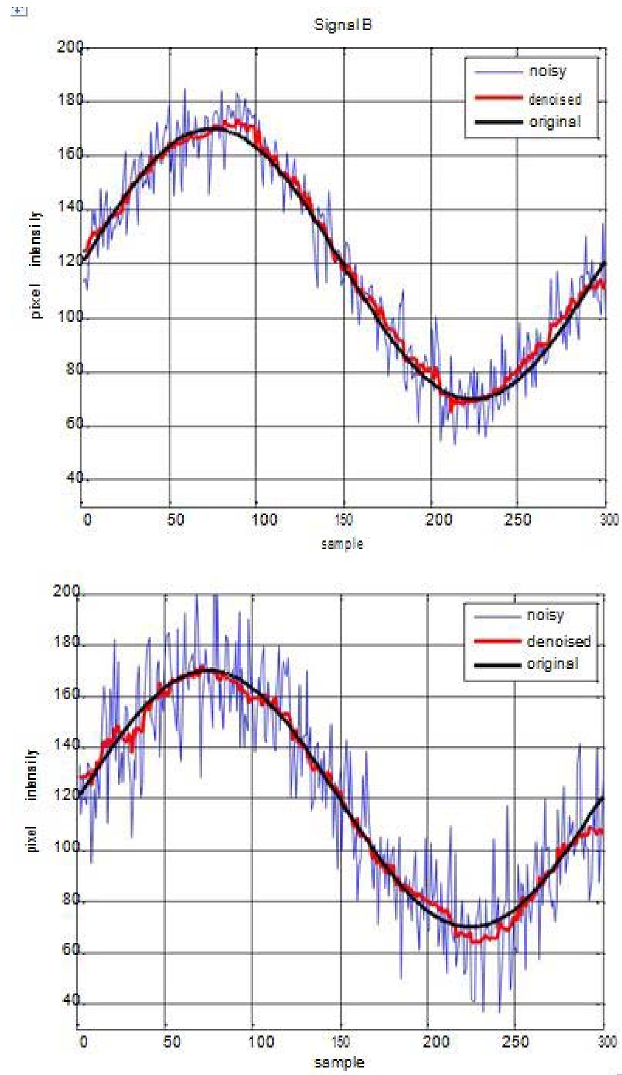

Fig. 3: Denoising of Signal B using ATA method; up: noise σ = 10, down: noise σ = 20

b) ATA Method Applied on Image Sequences

A number of dissimilar gray-scale sequences were used to determine the method performance. For the easy and simple comparison with the existing algorithms, and the noise standard deviations are selected to be 10, 15 and 20, correspondingly, and only the output results of the luminance (Y) channel are accounted. Thus the Peak signal-to-noise ratio (*PSNR*) and the structural similarity (*SSIM*) index [5] are to be used to provide the quantitative estimations of the algorithm. Then the latter has been shown to be the better indicator of the perceived image-sequence quality [5].

This projected algorithm has been compared with the state-of-the-art noise removal algorithms for video signals, including the SEQWT [6], IFSM [7] and the ST-GSM [1]. To be the better place the performance estimation in the context, the one baseline algorithm has also been incorporated in comparison; still the GSM [8]: static image GSM denoising technique applied on a frame-by-frame basis. Then the values of *PSNR* and *SSIM* obtained by the ATA technique and comparison to the other state-of-the-art techniques are enclosed in Table 2. In the shown figures 4 and 5 denoised frames of the video signals "Salesman" and "Tennis" are shown along with the original and noisy frames also for comparison. Then the evaluation shows that the amount of the noise removed is significant and the ATA technique is the highly competitive than others when compared to state-of-the-art noise removal algorithms.

IV. Conclusion

A simple, easy and intuitive method is projected in this paper, yet highly competitive video denoising technique based on determining averaging intervals. This method exploits video's temporal coherence to attain the averaging intervals by effortless two-way thresholding designed for create the averaging interval's on left-hand side and also on the right-hand side boundaries. Removal of noise is done by applying

Fig. 4: Denoising of video "Salesman" corrupted with noise σ = 20 using ATA method, frame 100; from left to right: original, noisy, denoised.

Fig. 5: Denoising of video "Tennis" corrupted with noise σ = 20 using ATA method, frame 300; from left to right: original, noisy, denoised.

Table 2: PSNR and SSIM values of video sequences denoised using ATA method and comparison to other methods.

Video	"Salesman"			"Miss America"			"Tennis'		
Noise σ	10	15	20	10	15	20	10	15	20
PSNR [dB]									
Noisy	28.16	24.72	22.32	28.15	24.62	22.29	28.22	24.72	22.25
SEQWT [6]	32.86	30.59	29.09	NA	NA	NA	31.19	29.14	27.59
IFSM [7]	34.22	31.85	30.22	37.52	35.41	33.86	32.41	30.10	28.56
still GSM [8]	33.80	31.73	30.28	38.52	37.14	36.14	31.82	29.87	28.65
ST-GSM [1]	38.04	36.03	34.61	40.57	39.40	38.50	34.05	31.97	30.59
Proposed	35.64	33.78	32.51	37.16	35.77	34.30	32.95	30.55	28.72
SSIM									
Noisy	0.718	0.574	0.467	0.493	0.321	0.226	0.719	0.573	0.466
SEQWT [6]	0.900	0.846	0.796	NA	NA	NA	0.842	0.772	0.716
IFSM [7]	0.904	0.851	0.801	0.904	0.857	0.812	0.855	0.776	0.709
still GSM [8]	0.909	0.865	0.825	0.936	0.922	0.913	0.831	0.758	0.711
ST-GSM [1]	0.960	0.941	0.923	0.952	0.943	0.936	0.894	0.841	0.797
Proposed	0.941	0.920	0.899	0.910	0.884	0.861	0.870	0.813	0.756

averaging on sample-wise temporally adaptive intervals. A number of 1-D signals and benchmark video signals were used to examine the performance of the projected technique of denoising 1-D signals with the proposed technique has formed considerable enhancement in *MSE* values. Denoising the video signals with the proposed technique has also created significant enhancement in *PSNR* and *SSIM* values. Compared to the other state-of-the-art methods, and the proposed techniques outperforms the many of its competitors, e.g. SEQWT [6], IFSM [7] and still GSM [8]. This projected algorithm is simple and easy to use and doesn't involve more complex video denoising actions which are numerically more demanding. Further improvements of the proposed scheme are feasible and desirable, especially taken into accounts that ST-GSM [1] technique is still capable to generate somewhat improved denoising results. Improvements will be explored not only the considering efficacy of the projected technique but also of its speed. In the upcoming research will be focus on the enlargement of more complicated and more consistent threshold criterion for determining boundaries of the averaging intervals, which will facilitate enhanced and faster performance of the technique.

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Digital Pulsed Power System to Drive a 20J Repetitive Plasma Focus Device

By Esmaeli Abdolreza, Goudarzi Shervin, Babaee Hojat, Nasiri Ali & Mazandarani Abolfazl

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Abstract- In this paper the digital pulsed power system to supply a very small repetitive Mather-type Plasma Focus Device (20 J) is presented. The structure of this electrical system included a pulsed power supply and a Microcontroller based control system. In Plasma Focus Devices a dc power supply charges a high voltage capacitor and then this saved energy discharges between two coaxial electrodes using a controllable spark gap switch. The procedure of control the capacitor charging and discharging are explained in this paper. Finally, the experimental results of electrical discharge and pinch shaping in plasma focus in different working conditions are presented and a good repetitive performance in a wide domain of working conditions is seen.

Keywords: plasma focus, pulsed power system, microcontroller, SORENA-1.

GJRE-F Classification: FOR Code: 090699

DIGITALPULSEDPOWERSYSTEMTODRIVEA20JREPETITIVEPLASMAFOCUSDEVICE

Strictly as per the compliance and regulations of:

Digital Pulsed Power System to Drive a 20J Repetitive Plasma Focus Device

Esmaeli Abdolreza [α], Goudarzi Shervin [σ], Babaee Hojat [ρ], Nasiri Ali [Ѡ] & Mazandarani Abolfazl [¥]

Abstract- In this paper the digital pulsed power system to supply a very small repetitive Mather-type Plasma Focus Device (20 J) is presented. The structure of this electrical system included a pulsed power supply and a Microcontroller based control system. In Plasma Focus Devices a dc power supply charges a high voltage capacitor and then this saved energy discharges between two coaxial electrodes using a controllable spark gap switch. The procedure of control the capacitor charging and discharging are explained in this paper. Finally, the experimental results of electrical discharge and pinch shaping in plasma focus in different working conditions are presented and a good repetitive performance in a wide domain of working conditions is seen.

Keywords: plasma focus, pulsed power system, microcontroller, SORENA-1.

I. Introduction

Plasma Focus (PF) devices have been developed independently in 1960's in two different models by N. V. Filippov in the Soviet Union [1] and J.W. Mather in the United States [2]. These devices are good sources of high energy ion, electron beam, soft and hard X-ray and neutron (when Deuterium is used) pulses [3- 5]. They also can be used to study on dense and hot plasmas [4, 5]. Due to wide applications of PF and the simplicity of its structure and operation, in the last 5 decades, high research activities have been done in this field and several numbers of these devices with energies less than 1 J up to several Mega Joules have been constructed [6-11]. High energy PF devices can only work single shot, but small (Low energy) PF devices can operate repetitively and as a result, they can generate and emit neutron and X-ray pulses with high frequencies [8]. In recent years different laboratories have been worked on small PF devices [8, 9, 12, 13]. The smallest PF device in the world is Nano focus (0.1 J) in the CCHEN (Chile) [14].

In experiments with Plasma Focus Devices, the stored energy in a capacitor bank discharges in a low pressure gas between two coaxial electrodes to produce a dense and hot plasma column [13]. For repetitive performance, these devices need electrical systems that can act with controllable frequencies, so a digital control system must be designed & constructed which can control the working frequency, number of shots and also can control capacitor charging system.

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Partlo, William N., et al. [15] presented optimization of capacitance values, anode length and shape and preferred active gas delivery systems for plasma focus. They also include a pulse power system comprising a charging capacitor and spark gap switch, capacitor, a microcontroller as pulse controlling part. Due to importance of pulsed power system in repetitive plasma focus and other similar devices, many researchers are working on pulsed power system development [16-18]

In this article, we have explained the design and construction of the electrical system of a very small (20 J) Mather-type repetitive PF device named SORENA-1whichhas been designed and constructed in Plasma and Nuclear Fusion Research School of Nuclear Science and Technology Research Institute of Iran and finally explained the results of some experiments with it at different working conditions (different gases, initial pressures, discharge voltages, single shot and repetitive performance).Its characteristics have been completely explained elsewhere[19]. The aim of construction of this device is to extend the research activities of PF in Iran to make very small portable PF devices with repetitive performance which can be used for medical and industrial applications. The high voltage capacitor charging system of SORENA-1 is designed and constructed in Plasma and Nuclear Fusion Research School of Nuclear Science and Technology Research Institute of Iran. The pulsed power system used a spark gap as switch. The plasma focus device is modelled in electrical point of view and the proposed electrical model of device and spark gap are simulated by MATLAB/Simulink to evaluate the verification of our design, then the experimental data and simulation results of electrical system of SORENA-1 are compared and analyzed.

II. Design & Construction of the Electrical System

The electrical system of SORENA-1 consists of a 25 kV dc power supply for charging the capacitor, one adjustable Spark gap (5 - 20 kV) and its triggering system, a fast high voltage capacitor (200 nF, 5 nH, 25 kV) used as capacitor bank) (Figs. 1&2), and a digital control system (voltage control and monitoring system). The frequency of discharges is controlled by this control system. It is a simple circuit based on AVR microcontroller (Atmel Company);by using this system the frequency of charging and discharging & the charging voltage can be adjusted. The proposed microcontroller circuit diagram is shown in Fig. 3. The control system can be used either automatically or manually. The frequency of discharges can be adjusted from 0.1 to 10 Hz. Capacitor charging voltage is regulated at desired voltage (7-14 kV) and after that the dc power supply will stop to charging capacitor, then spark gap will be triggered when microcontroller program comment to triggering system.

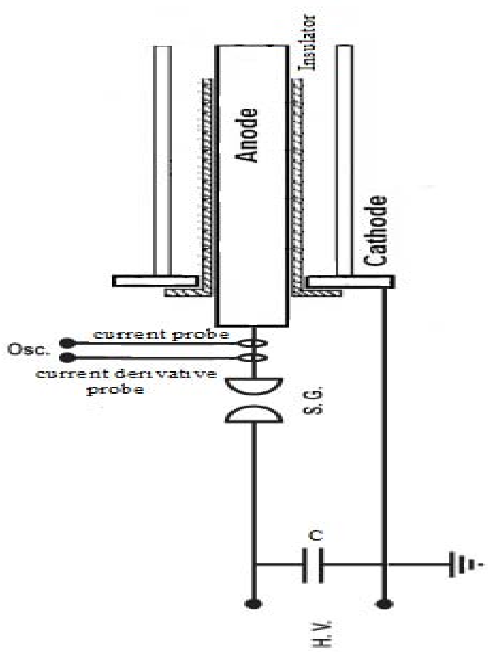


Fig. 1: General structure of electrical connections between capacitor bank and electrodes of. SORENA-1.

III. Experimental Set-Up

As shown in Fig.4a, the whole system of SORENA-1 included its electrical power supply, gas puffing and vacuum system, gas cylinder, vessel of PF, capacitor, sparkgap and other parts of system. DC power supply to charging capacitor included manual commander (Fig. 4b), digital control box (Fig. 7), high voltage transformer (Fig. 4c), charge and discharge system (Fig. 4d), and capacitor that is connected to sparkgap directly (anode of sparkgap connected to anode of capacitor), then the other side plate of sparkgap by 12 coaxial short cable are connected to anode of PF as shown in Fig. 4e, the negative point of capacitor and the cathode and body of steel working table, all are earthed.

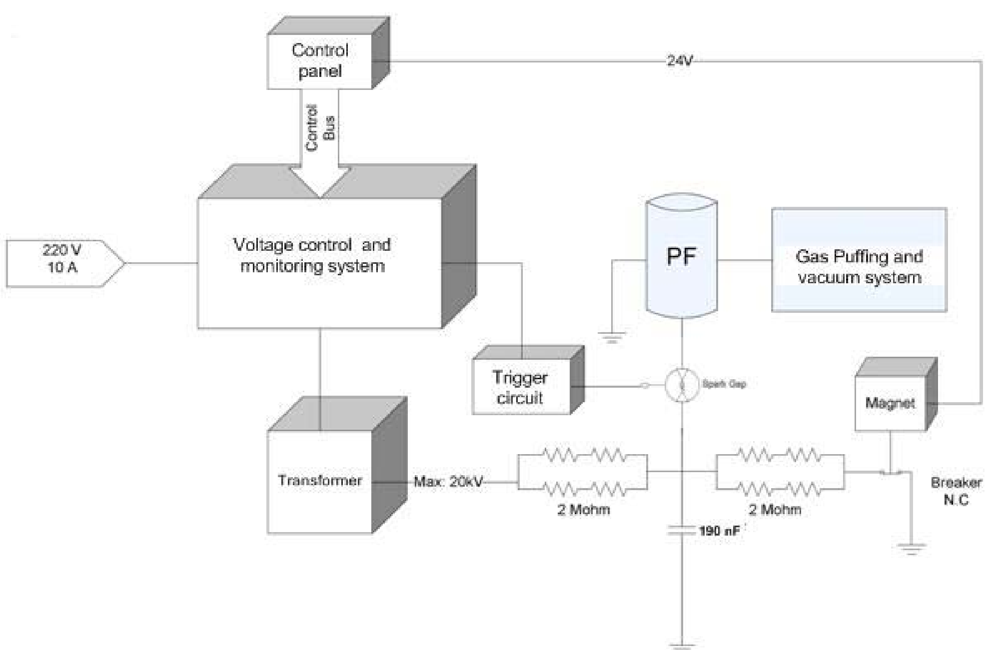


Fig. 2: Schematic of the electrical and mechanical systems of SORENA-1.

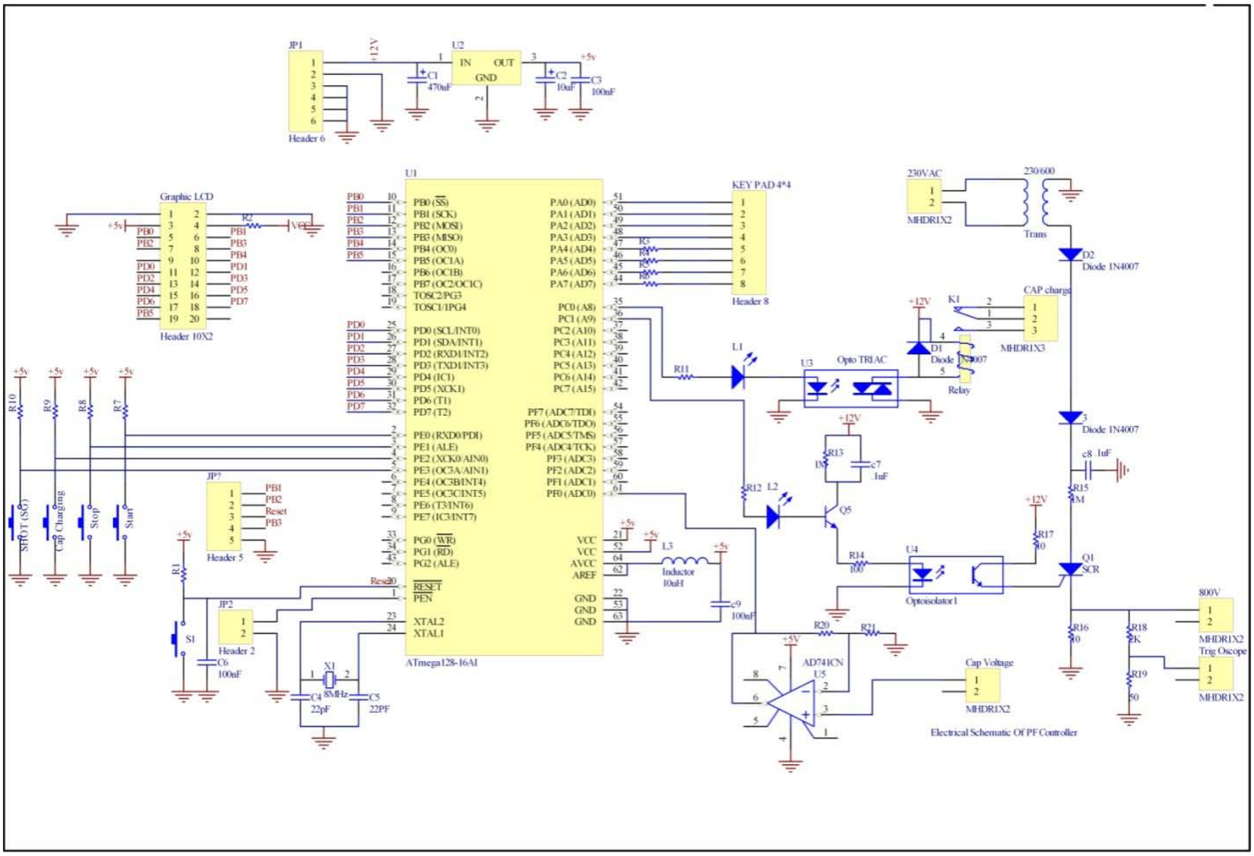


Fig. 3: AVR Microcontroller Circuitry.

(a)

(b)

(c)

(d)

(e)

Fig. 4: a) General view of SORENA-1 b) power supply box c) transformer d) charge and discharge resistances and damper e) capacitor and its connections to spark gap

Fig. 5 shows the equivalent circuit diagram of charging system in MATLAB/Simulink. Equivalent resistance of charging and discharging system is equal to 2 Mega Ohm that connected to charging capacitor. The AC voltage from mains is increased by transformer and then rectified by diode rectifier that shown in Fig. 5.

The energy that charged in capacitor can be discharged between anode and cathode of Plasma Focus by a sparkgap switch as shown in Fig. 6. In this simulation resistance and inductance of plasma during discharge time is represented as R_p and L_p.

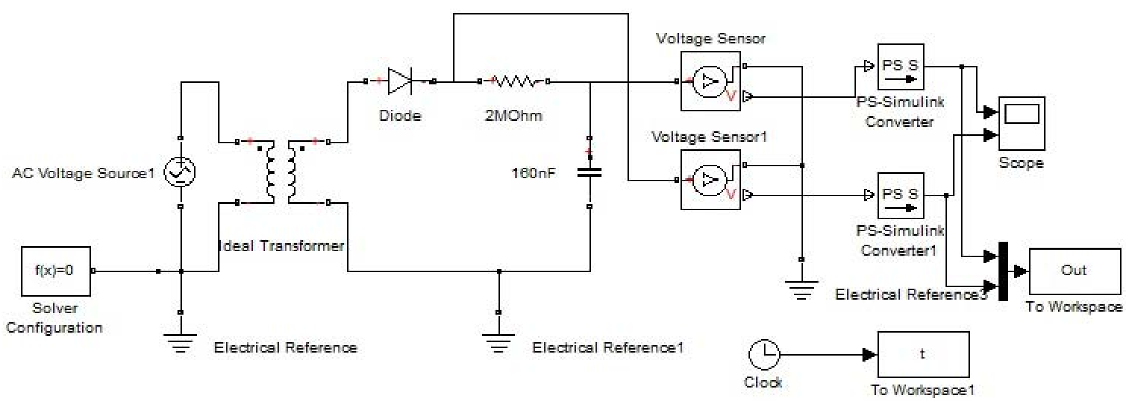


Fig. 5: Equivalent Circuit diagram of charging system in MATLAB/Simulink

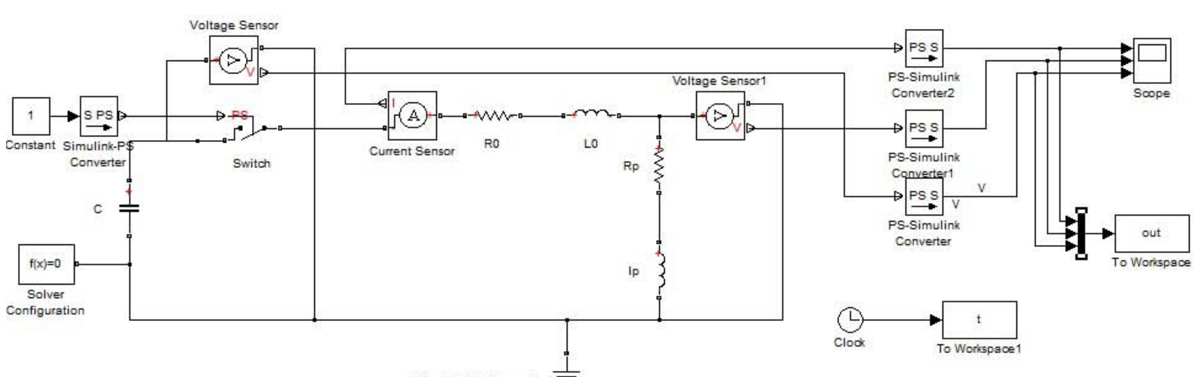


Fig. 6: Equivalent Circuit diagram of plasma and spark gap in MATLAB/Simulink

IV. Control System

The control system included microcontroller and the system monitoring part is installed in a special box (Fig. 7). In this box the input data to order the microcontroller are provided using simple keyboard that it determines the charging voltage, repetition rate of charging (time interval between discharges). This control system can work manually or automatically. In automatic mode, after every shot the number of shots compares with primary regulated shots and if these numbers are not equal, the system will continue to shot again.

Fig. 7: The box which includes the control system and the system monitoring part

The control algorithm contains 3 phases:
Phase 1 (Preparation of the System)
Phase 2 (Main Process)
Phase 3 (Data Logging)

Fig. 8 shows Executive flowchart of SORENA-1 control system. The control process of PF can be manual or automatic. After Start, we should choice or mode as described, then if it choices as manual we can start the charging of capacitor and then order to shot (discharge capacitor to PF), of x but if we choice automatic, the number of shots should be define as positive integer value of x, then define capacitor charging frequency (w) and the current shot frequency (y), if w>y then capacitor will charge to defined voltage, and then the capacitor will separate from charging power supply, so if we have enough delay from last shot, will shot again, then compare the number of shots to defined value, if the number of shots < x then capacitor will charge again but if number of shots = x, end of shot cycling and we can save data in data logger and see in LCD monitor.

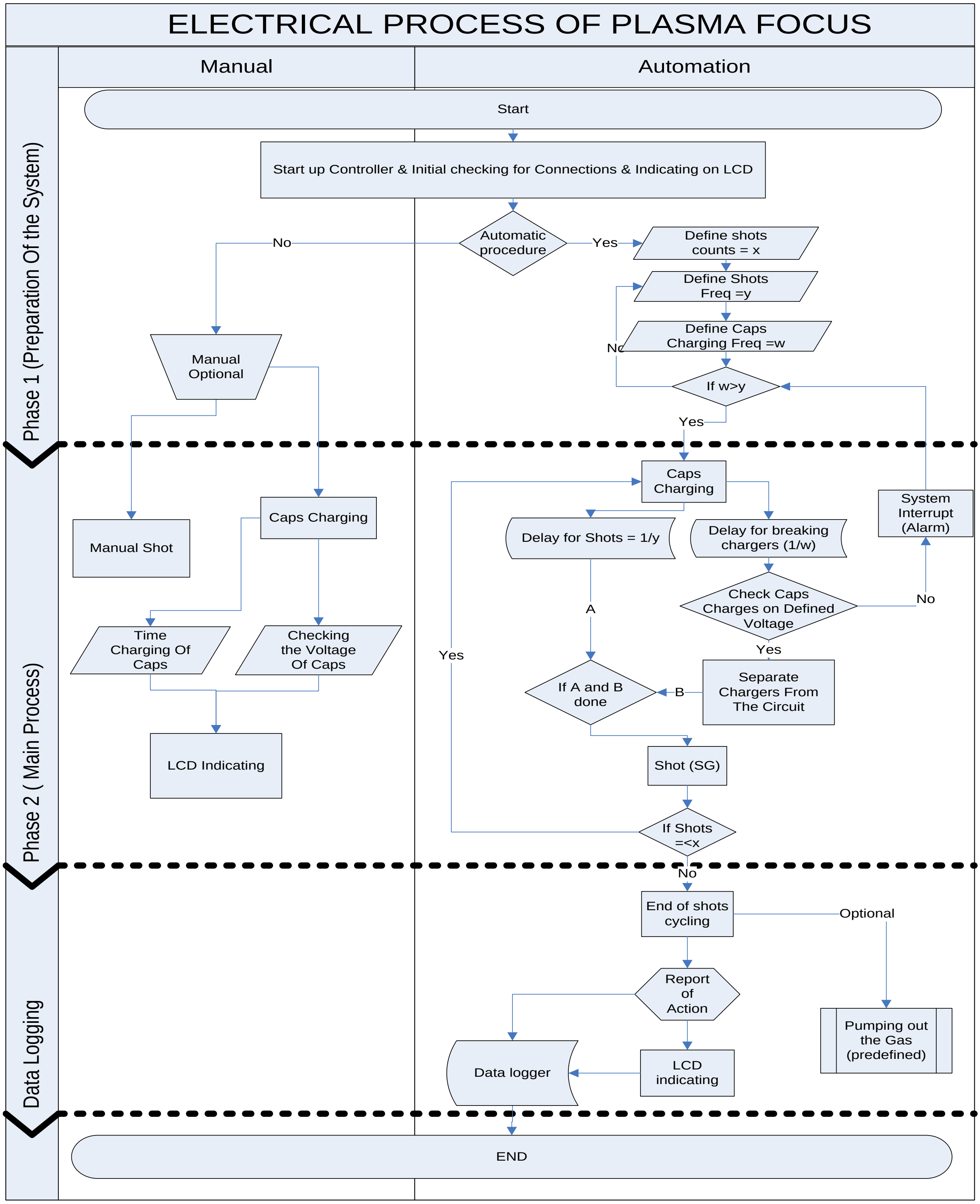


Fig. 8: Executive flowchart of SORENA-1 control system.

The second part of our control system is used for data acquisition from our diagnosis system like hard and soft x-ray and neutron detectors and plasma current measurement system.

V. Results and Discussions

The experiments with SORENA-1 started at December 2012. We have done a lot of experiments in pressure range 0.1 -10 mbar and discharge voltages 7-14 kV and using Ar, Ne & D2 as working gases. In these experiments, the current and current derivative signals have been measured by a Rogowski coil (shown in Fig. 4e) and a magnetic probe, respectively, and displayed on a 200 MHz digital oscilloscope TDS-2022C.

In the experiments with this device, the maximum value for current peak was about 14 kA.

In using of each gas, the pinch formation (a negative spike in current derivative signal) for discharge voltages more than 8 kV & an initial proper pressure domain was observed (Table 1). Three typical signals of derivatives and discharge currents obtained in different PF discharges of SORENA-1are shown in Fig. 9. It is seen that similar to other PF devices, pinch formation happens in wider domains for lighter gases.

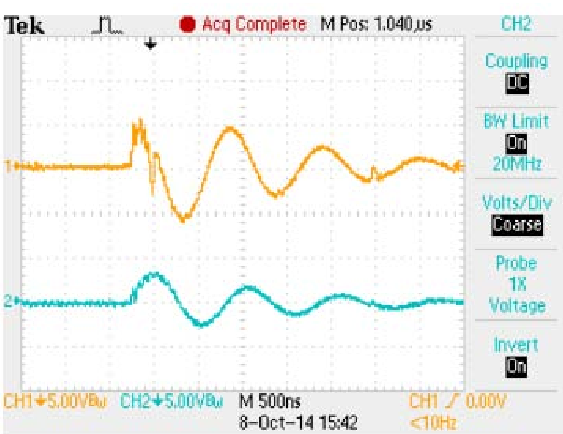
The repetitive performance (repetitive pinch formation) of SORENA-1 by using Ne & D2 as working gases is acceptable. When Ne is used, the device showed a repetitive performance in pressure range 0.1-0.6 mbar (Figs 10 and 11) and the maximum working frequency is about 0.7 Hz (discharge voltage: 12 kV, initial pressures: 0.1-0.4 mbar), using D2 as working gas, the pressure range for repetitive performance is 0.3-0.5 mbar and the maximum working frequency is 1 Hz (discharge voltage:13 kV, initial pressure: 0.3 mbar). It is seen that the frequency and its limits change with discharge voltage, initial pressure and working gas (Fig. 12).

Using the Ar as working gas, only in 11 kV discharge voltage and 0.1 mbar initial pressure, repetitive operation has been observed (f=0.2 Hz).

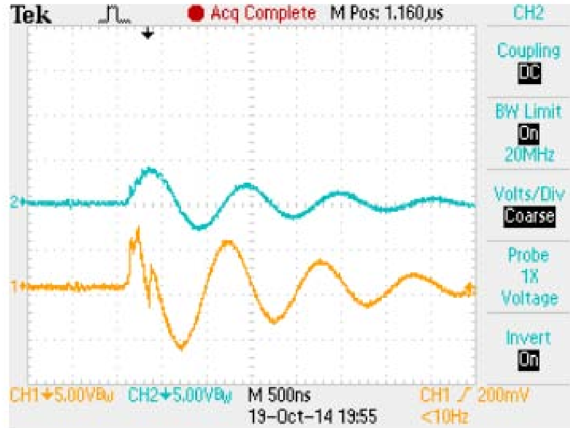
All experiments show fast response of electrical system as spark gap triggering system and charge and discharge process. Charging of capacitor is done in a seconds as is shown in Fig. 13 (experimental result) and Fig. 14 (Simulation by Multi Sim software).

Table 1: The pressure domains of Ar, Ne and D2 gases for pinch formation.

Gas	Pressure domain, mbar
Ar	0.1 – 0.2
Ne	0.1 – 0.8
D2	0.1 – 1.5



(a)



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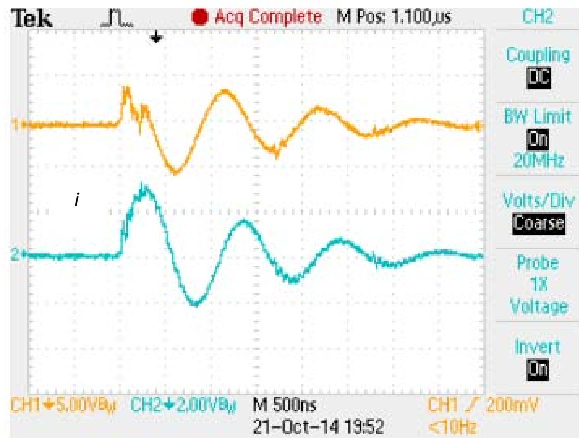

(c)

Fig. 9: Typical oscillograms of derivatives $\frac{di(t)}{dt}$ and discharge currents $i(t)$ obtained in different PF discharges of SORENA-1.a) Ar, 0.12 mbar, 9 kV; b) Ne, 0.38mbar, 10 kV; c) D2 , 0.44 mbar, 8 kV.

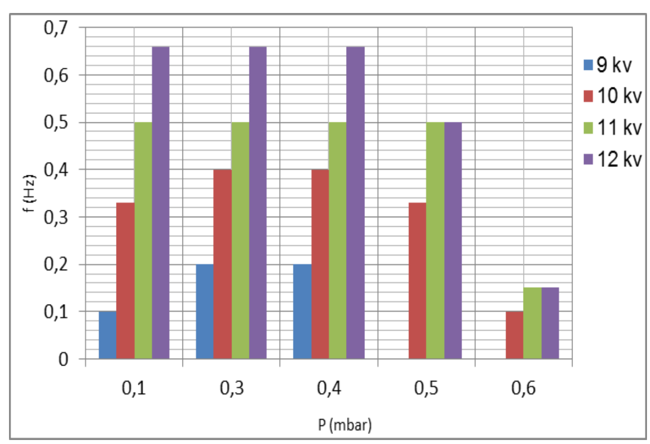

Fig. 10: Variation of repetition frequency for the SORENA-1 PF discharges with initial pressure of working gas. Working gas: Ne; discharge voltage: 9-12 kV.

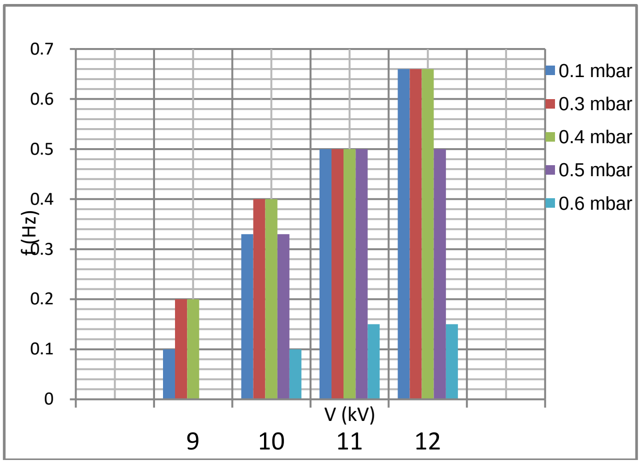

Fig. 11: Variation of repetition frequency for the SORENA-1 PF discharges with discharge voltage. Working gas: Ne; range of initial pressure: (0.1 - 0.6) mbar.

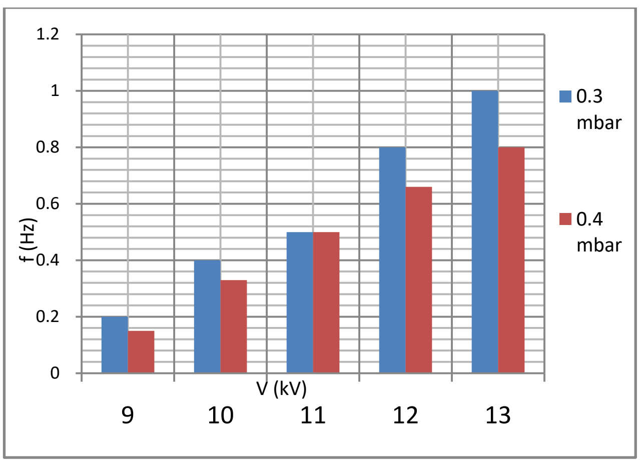

Fig. 12: Variation of repetition frequency for the SORENA-1 PF discharges with discharge voltage. Working gas: D_2; range of initial pressure: (0.3 - 0.4) mbar.

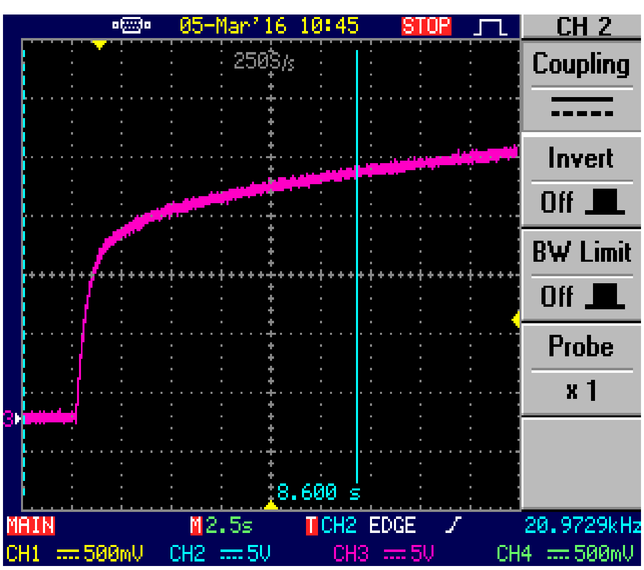

Fig. 13: Charging of capacitor by DC power supply

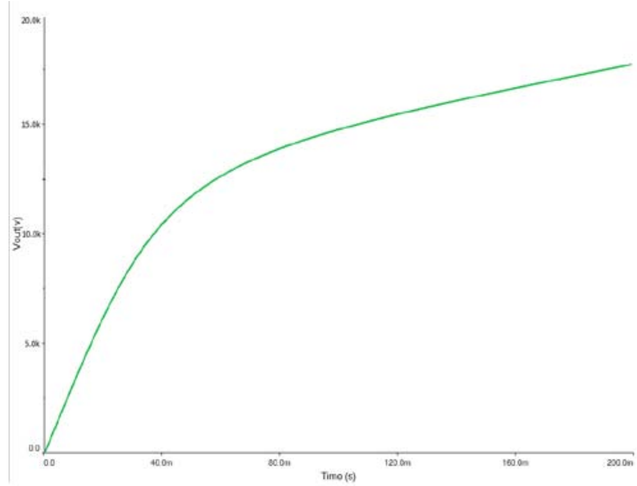

Fig. 14: Charging of capacitor by DC power supply simulated by MultiSim

VI. Conclusion

In this paper, the controllable pulsed power system of a very small (20 J) repetitive Plasma Focus device has been presented and the results of the experiments with it in different working conditions (different discharge voltages, initial pressures &using Ar, Ne & D2 as working gases) are analyzed. All experiments show fast response of electrical system as sparkgap triggering system and charge and discharge process.

From the experimental results, by using this controllable pulsed power system, the pinch formation has been observed for each working gas in different discharge voltages & initial pressures domains, but only in the experiments with Ne and D2 this device showed good repetitive performance in a notable pressure domain, and in the experiments with Ar it the repetitive performance only observed in one working condition.

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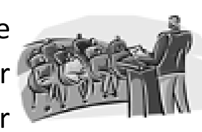

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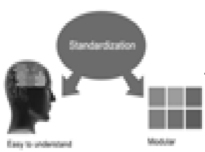

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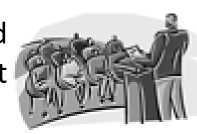

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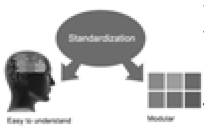

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Key Words

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

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

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

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

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

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

Acknowledgements: Please make these as concise as possible.

References

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

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

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

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

Tables, Figures and Figure Legends

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

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

Preparation of Electronic Figures for Publication

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

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

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

6. AFTER ACCEPTANCE

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

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Informal Guidelines of Research Paper Writing

Key points to remember:

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

Final Points:

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

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

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

General style:

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

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

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

In every sections of your document

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

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

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

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

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

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

Title Page:

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

Abstract:

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

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

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

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

Approach:

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

Introduction:

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

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

Approach:

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

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

Procedures (Methods and Materials):

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

Materials:

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

Methods:

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

Approach:

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

What to keep away from

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

Results:

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

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

Content

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

What to stay away from

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

Approach

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

Figures and tables

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

Discussion:

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

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

Approach:

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

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

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