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Now

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No success but from Him .

Consultation and Editaril


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Moon and Sun Perturbations Effects on The Orbital Elements of Earth Satellites Orbits

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الخلاصة

تم دراسة تأثير الجسم الثالث على الاقمار الصناعية وذلك باستخدام برنامج الميكانيك السماوي والتي تعتمد على حساب تأثير اضطراب القمر والشمس عن طريق حل المعادلات بالتكاملات العددية.

تأثير الجسم الثالث (الشمس والقمر) يكون بشكل اساسي على الاقمار الصناعية ذات المدارات المتوسطة والعالية حيث تكون تأثيرها جذبيه لذلك تظهر تأثيرها على شكل تأثيرات دورية وغير دورية حالها حال تأثير الجسم المركزي.

تناول البحث دراسة تحليلية للتغيرات الناتجة في العناصر المدارية للقمر الصناعي بتأثير الشمس والقمر وتبين ان تأثيرها على عنصري المحور الكبير والشذوذية تكون دورية في حين تكون غير دورية على عنصر العقدة والحضيض وان تأثير القمر يكون أكبر على الاقمار الصناعية لكونها أقرب الى مدار الارض

الكلمات المفتاحية

اضطراب الجسم الثالث، العناصر المدارية، اضطراب الشمس والقمر، اضطراب الاقمار الصناعية.

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Abstract

The effect of the third object on satellites was studied using the program of celestial mechanics which depends on the calculation of the effect of the moon and sun disturbance by solving the equations by numerical integrations.

The influence of the third body (sun and moon) is mainly on satellites with medium and high orbits where their effect is attractive, so their effect appears in the form of periodic and secular effects, as is the case with the central body.

The study analysis the resulting changes in the orbital elements of the satellite by the influence of the sun and the moon and found that their effect on the elements of the semi major axis and eccentricity are periodic while secular perturbation dominated on the node and the argument of perigee, the effect of the moon is greater than that produced by sun on the satellites due to the closer distance of the moon.

Keyword

Three body perturbation, orbital elements, lunisolar perturbation, satellite perturbation.

1. Introduction

Studying and modeling perturbations are very important to celestial mechanics; many inter planetary missions would miss their target if the perturbing effect weren't taken into account, the perturbations always small if comparable to the primary attracting force but case the motion well vary from the theoretical two body path, the perturbation divides in to three groups, corresponding on their periods, these are secular (linear), long period and short period perturbations shown in Fig.(1)[1].

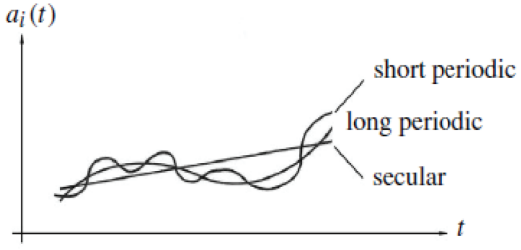

Fig.(1): Perturbations of the elements[1]

There are two types of satellite perturbations that affect satellite location and velocity, then satellite period, gravitational, and non-gravitational.

Gravitational perturbations include the spherical harmonics, Earth tide, ocean tide effect and Sun and Moon attraction effect; second the non-gravitational perturbations include atmospheric drag force, solar radiation pressure, and magnetic forces etc.[2].

The Low Orbit Sun Synchronous Satellite (LEO) travels in an east direction with an angular motion velocity reaching the Sun motion velocity relative to the stars (about 1 per day), that provides a fixed angle between the plane in orbit and the Sun's position. Going along this orbit, at the same moment of the true solar time, the satellite travels over the same point of the Earth's surface, offering in near dates approximately the same observational conditions, Geostationary communication satellites typically use high altitude orbits, the movement of satellites in these orbits is greatly disrupted by the sun and moon's third-body gravity disturbances[3].

Global positioning system (GPS), nominally the GPS space segment, consists of 24 satellites (21 working satellites plus 3 active spares). The satellites are located in nearly circular orbits in six planes, about 20000 km above the surface of the Earth. Both planes are divided on the equator by (60) Degree and inclined by (55) Degree relative to the equator. The constellation is illustrated in Figure 2.5 as it would be seen from outside the system from the poles (left) and from a latitude of (35) Degree[4].

Many others view the effects of lunisolar perturbations on orbital elements, Upton, E.et al. have measured the solar and lunar effects on highly eccentric satellite orbits and have resulted in large changes in perigee height from the sun and the moon over long periods of time [5].

Delhaise, F. & Morbidelli, A., compare the effects of Sun and Moon attractions in view of the fact that the terrestrial attraction alone represents a strong increase in the amplitude of releases in inclination and a decrease in the corresponding release period (from 200 years to 20 years)[6].

Bourassa M. et al. Studying the Lunar and Solar perturbations, combined with the Earth's oblateness effects, causes large predictable oscillations in the eccentricity and perigee arguments of critically inclined highly eccentric orbits such as Molniya and Tundra orbits. [7]. The gravitational attraction of the sun and moon on the synchronous satellite results in minor oscillatory in-plane deviations from the synchronous position with a potential displacement of (45) mi, maxi- mum, the main effect of the sun and moon is to shift the orbital plane from the equatorial plane at a rate of (0.8525 °) per year. [8]. Jiang M. et al. Based on the orbital perturbation, GEO SAR imagery is influenced by no marginal phase errors and the necessary orbital precision should be in the radial direction at a centimeter stage. [9]. Youssef, M. founded the solar radiation pressure and gravitational wave perturbations caused second order effects on all elliptic orbit elements [10]. Izzet, A. K studied the effect of the solar radiation on orbital element of artificial earth satellite and founded the effect on high orbit satellite is much more than that on low orbit [11]. Kuzetsov E. D and Jasim A.T. they studied of sun synchronous orbit with a height of 751and 1191km and founded, the variations of semi major axis and inclination are depending on the initial value of ascending node longitude [12]. Hough, M. E., Sun-synchronous orbits were commonly used in meteorological and remote sensing satellite missions, gravitational effects from the spherical Earth, the Moon and the Sun caused long-term variations in the mean argument of perigee, eccentricity, inclination and ascending node [13]. Rodriguez-Solano. C. J. Earth's radiation pressure has a non-negligible effect on GPS orbits, and the earth's radiation level results in a shift in GPS ground station estimates [14]. Eshagh, M. and A.M. NAJAFI, They reached Among other perturbing forces, air drag is the most prevalent: rotational deformation, solar radiation, third body effect, solid Earth tide, ocean tide, and general relativity according to their magnitude[15].

In this paper we shall be analyzing the luni-solar perturbation on three different satellites orbits and to determine the change in the orbital elements, the first is the sun synchronous satellite with a low altitude and the scanned Global positioning system (GPS) which have medium high altitude, and the third is the Geostationary (we use celestial mechanics program which solve perturbation equations by numerical integration.

1.2. Three body problem:

The masses of the Sun and the Moon can be called a victor that causes the orbits of the satellite to be perturbed, we can use the basic equation of motion ($\ddot{r} = \frac{GM}{r^3} r$) .

Using the Figure (2) We consider the perturbing satellite acceleration induced by the Moon's mass (mM) and the Earth's mass (m_M) [1].

$$\ddot{r}o = G\left(-\frac{m_E}{|r|^3}r + \frac{m_M}{|p_M|}P_M\right) \quad (1)$$

And the perturbing acceleration induced by the satellite's Moon's gravitational attraction (cause of the moon's mass) is

$$\ddot{r}_M = Gm_M\left(-\frac{r_M - 1}{|r_M - r|^3} - \frac{r_M}{r^3{}_M}\right) \quad (2)$$

And the perturbing acceleration $\ddot{r}_S$ that cause by the mass of the sun on satellite is

$$\ddot{r}_S = Gm_S\left(-\frac{r_S - 1}{|r_S - r|^3} - \frac{r_S}{r^3{}_S}\right) \quad (3)$$

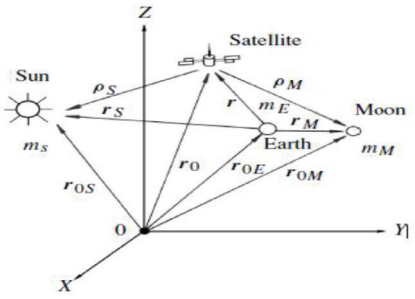

Fig. (2): Gravitational attraction of the Sun and the Moon on a satellite[1]

In the Fig. (2), Numerical computations must be known for the masses of the alarming bodies and their locations within the geocentric reference frame. Useful constants are for the Sun mass: ($GmS \approx 1325 \cdot 10^8$) $km^3\ s^{-2}$, and for the mass of the Moon: ($GmM \approx 49 \cdot 10^2$) $km^3\ s^{-2}$.

Where r_M – geocentric moon vector in equatorial position,

r_S – geocentric sun vector in equatorial position[1]

For accelerations in x, y and z-direction due to a third body, Moon or Sun's gravitational attraction, we have the following expressions [16]

$$f_x = \mu_d\left(\frac{x_d - x_s}{r^3{}_{sd}} - \frac{x_d}{r_d{}^3}\right) \quad (4)$$

$$f_y = \mu_d\left(\frac{y_d - y_s}{r^3{}_{sd}} - \frac{y_d}{r_d{}^3}\right) \quad (5)$$

$$f_z = \mu_d\left(\frac{z_d - z_s}{r^3{}_{sd}} - \frac{z_d}{r_d{}^3}\right) \quad (6)$$

Where we used very different notation: μ_d Is the perturbing body gravitational parameter (d), r_s is the position vector of the satellite (s) relative to the non-rotating geocentric frame of reference, r_d is the perturbing body location vector relative to the non-rotating geocentric frame of reference and r_{sd} Is the satellite vector to the perturbing body. Working out the above equations results in:

$$f_x = \mu_d\left(\frac{x_d - x_s}{\left\{(x_d - x_s)^2 + (y_d - y_s)^2 + (z_d - z_s)^2\right\}^{\frac{3}{2}}} - \frac{x_d}{r_d{}^3}\right) \quad (7)$$

And in the same way we can find f_y, f_z when the Sun perturbs the body, then $\frac{r_S}{r_d} \ll 1$ for all satellite orbital altitudes; When the moon perturbs the body, then $(\frac{r_S}{r_d} \ll 1 \text{ if } r_S < 45{,}000)$ km [16].

Where f_x,f_y,f_z, are accelerations components.

According to Fig. (2) the satellite's perturbing forces are divided into three mutually perpendicular components as shown in Fig. (3).

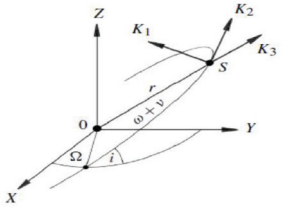

Fig. (3): Gaussian form of perturbing forces [1]

$$grad\ \ R = \nabla R\begin{pmatrix} k_1 \\ k_2 \\ k_3 \end{pmatrix}, \quad (8)$$

Where

K_1–Positive towards the North Pole perpendicular to the orbital plane;

K_2 – perpendicular to the radius vector in the orbital plane, positive in the direction of increasing longitude;

K_3 – In the direction of the vector radius, positive in the direction of radial distance increase [1]

The corresponding perturbation equations are the Newton-Euler equations (these equations are called the Gaussian equations) for the semi- major axis a, eccentricity e, the moment of passage of the pericentre T_0, the inclination i, the longitude of the ascending node Ω, the pericentre argument ω, have the form: [4]

$$\frac{da}{dt} = \frac{2}{n\sqrt{1-e^2}}\left\{e\sin v\, k_3 + \frac{p}{r}k_2\right\}$$
$$\frac{de}{dt} = \sqrt{\frac{1-e^2}{na}}\{\sin v\, k_3 + (\cos e + \cos v)\, k_2\}$$
$$\frac{dT_0}{dt} = n - \frac{1}{na}\left(\frac{2r}{a} - \frac{1-e^2}{e}\cos v\right)k_3 - \frac{1-e^2}{nae}\left(1+\frac{r}{b}\right)\sin v k_2$$
$$\frac{di}{dt} = \frac{1}{na\sqrt{1-e^2}}\frac{r}{a}\cos(w+v)k_1 \qquad (9)$$
$$\frac{d\Omega}{dt} = \frac{r\sin u}{na\sqrt{1-e^2}}\frac{r}{a}\frac{\sin(w+v)}{\sin i}k_1$$
$$\frac{dw}{dt} = \sqrt{\frac{1-e^2}{nae}}\left\{-\cos v\, k_3 + \left(1+\frac{r}{p}\right)\sin v\, k_2\right\} - \cos i\,\frac{\Omega}{dt}$$

The above equations are convenient in that they make the component influences.

K_1, K_2, K_3. We immediately see that only K_1 is capable of changing the orbital plane's orientation (elements Ω and *i*). K_2 will achieve a shift in the semi-major axis for e << 1, i.e.

Where μ=GM – gravitational parameter, $м^3/с^2$;
G – Gravitational constant, $м^3\ кg^{-1}\ с^{-2}$;
M – Mass of disturbing body, кg;
ν – True anomaly, rad;
r– The real perturbed orbit position vector;
p–The osculating location vector (reference) orbit;
t–physical time, s;
u- gravitational potential of the Earth.

2. Result and Discussion:

To evaluate the result of lunisolar attraction perturbation on the orbital elements of the satellite, a computer program (Celestial Mechanics) used to simulate the variation in orbital elements. The results we get are drawn using Matlab.

The data given in table1 were used to analyze the effect of perturbation on the orbital elements for three satellites, and Figs. (4-5) shows periodic perturbation in semi major axis (a), the eccentricity (e) and the inclination (i) in orbital elements of Sun synchronous satellites due to moon and sun attraction within a day.

The amplitude in semi major axis equal to (17) m while the amplitude is about (17×10^{-4}) and (7.5×10^{-4}) in eccentricity.

The Figs also show the effect of third body attraction on the inclination consist high frequency oscillation with an amplitude oscillates at long periodic frequency with amplitude (0.0145^0), also we get that secular perturbations decimate in the right ascension of the ascending node and the argument of perigee for sun synchronous satellite under the attraction of the third body.

Table (1): osculating orbital elements

Orbital element	sun synchronous	GPS	geostationary
A (km)	7129	28560.135	42112
e (deg)	0	0.02	0.1
I (deg)	98.61	56	5.7
Ω (deg)	50	0	0
Ω	0	270	0
initial epoch	01/01/2018	01/01/2018	01/01/2018

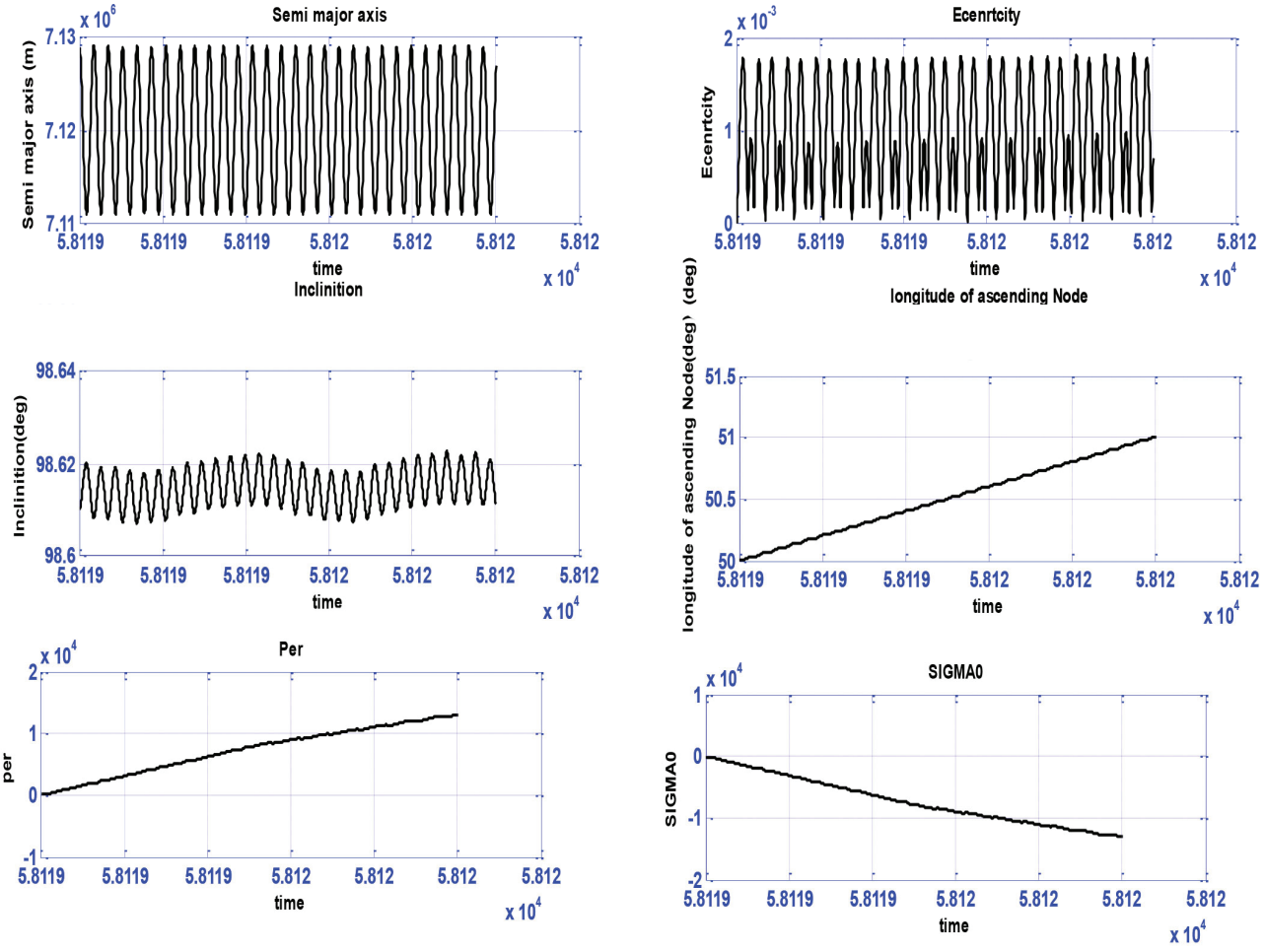

Fig. (4): the perturbation of sun synchronous orbit due to moon attraction over one day.

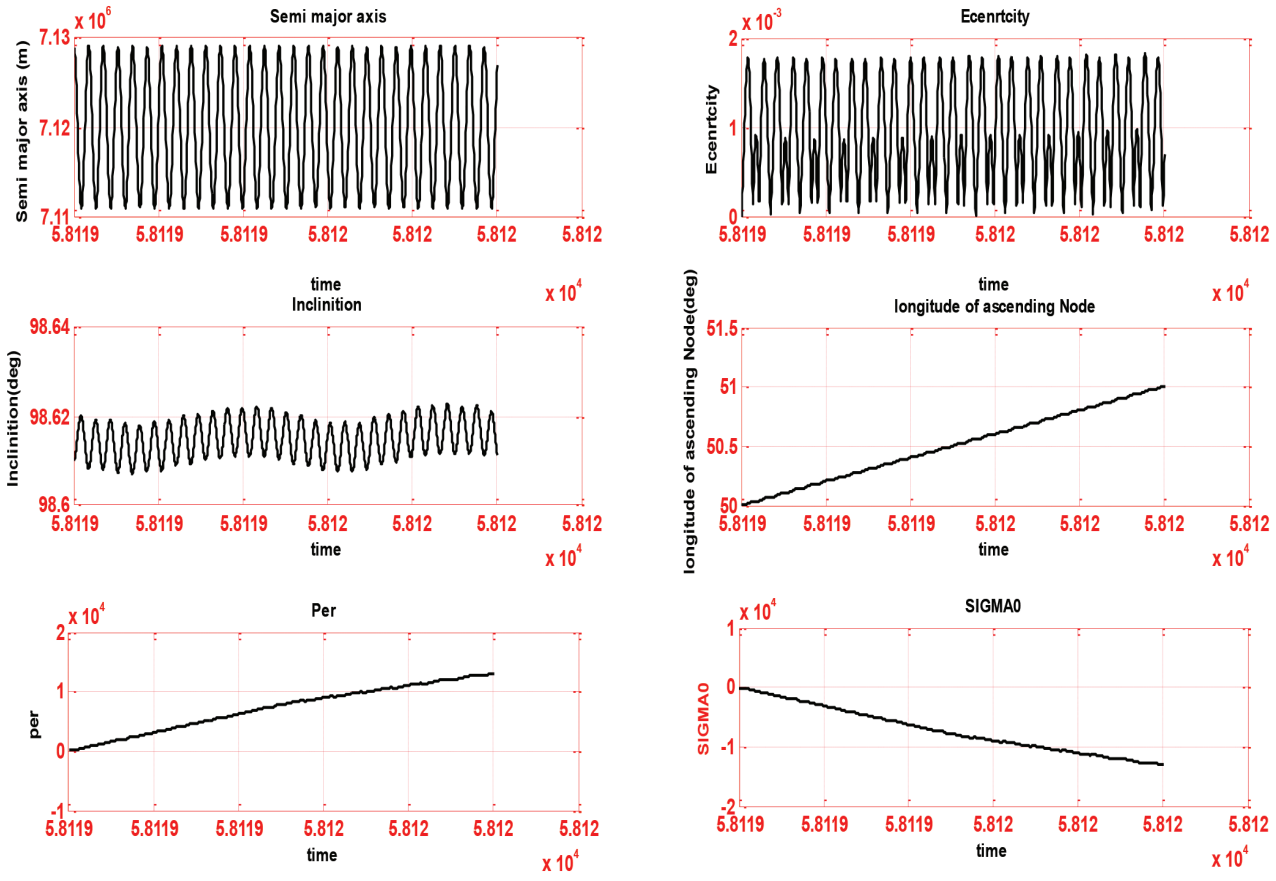

Fig. (5): the perturbation of sun synchronous orbit due to sun attraction over one day.

Figs. (6-7) show the development of these orbital elements (given in table 1) for GPS satellite over (5) day corresponding on about (10) revaluation around the earth.

Fig. (6) show the periodic perturbation exist in the semi major axis and eccentricity due to the sun attraction with amplitude (2.5) km, in semi major (a).

The inclination (i) and argument of perigee shows aperiodic and secular perturbations. In whole only secular perturbation in the ascending node due to sun attraction.

The perturbation of moon on the GPS satellite gives interesting characteristic as shown in Fig. (7), we observe a periodic perturbation with growing amplitude in semi major axis (a), eccentricity (e), and argument of perigee with a secular perturbation in ascending node.

The most interesting difference in the perturbation of the third body. Get when comparing the in variation in the inclination, the osculating inclination grows linearly with time and rate of change in the inclination of the satellite due to moon attraction is more than that due to sun attraction as shown in Figs. (6-7).

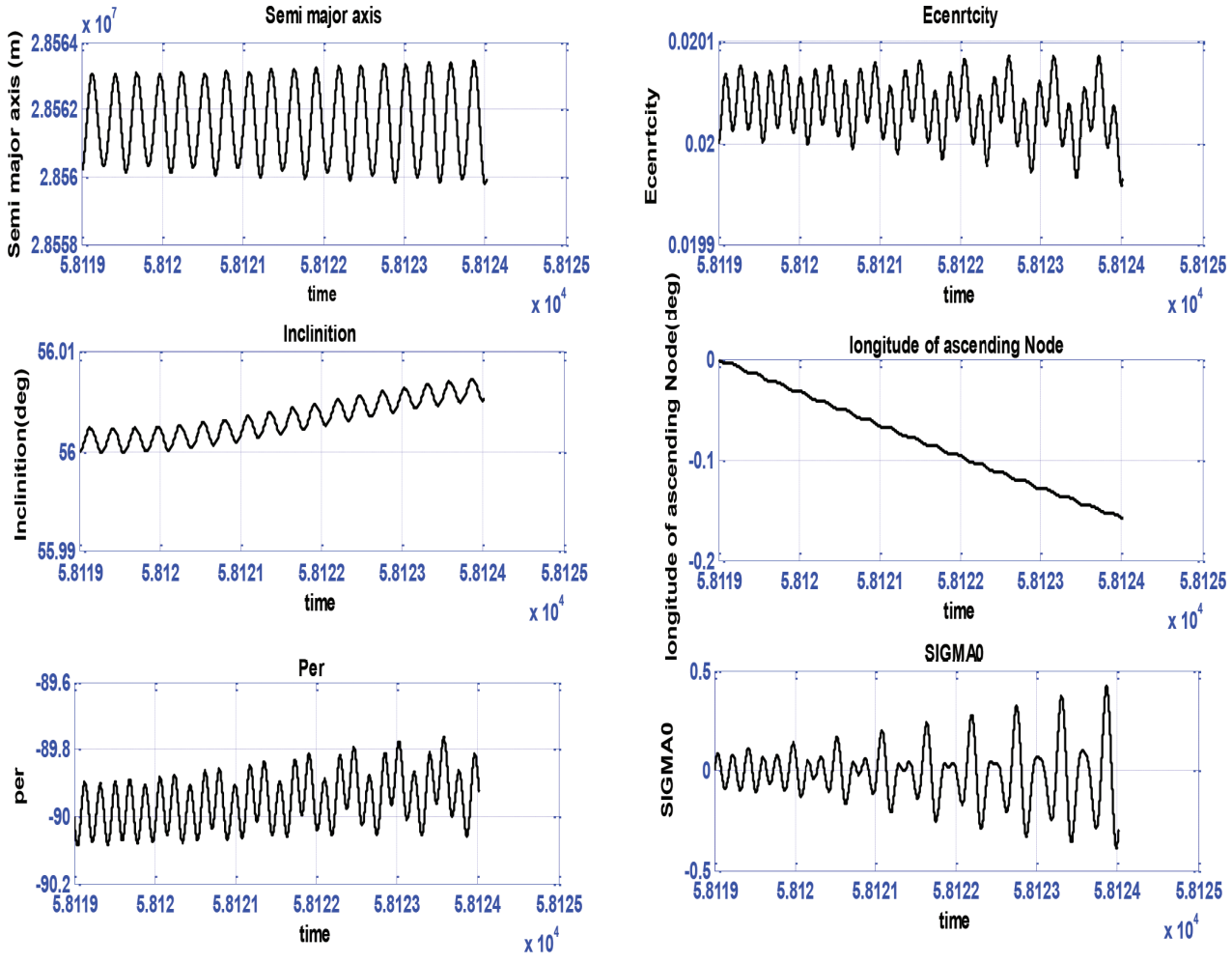

Fig.(6): the perturbation of GPS orbit due to moon attraction over five days.

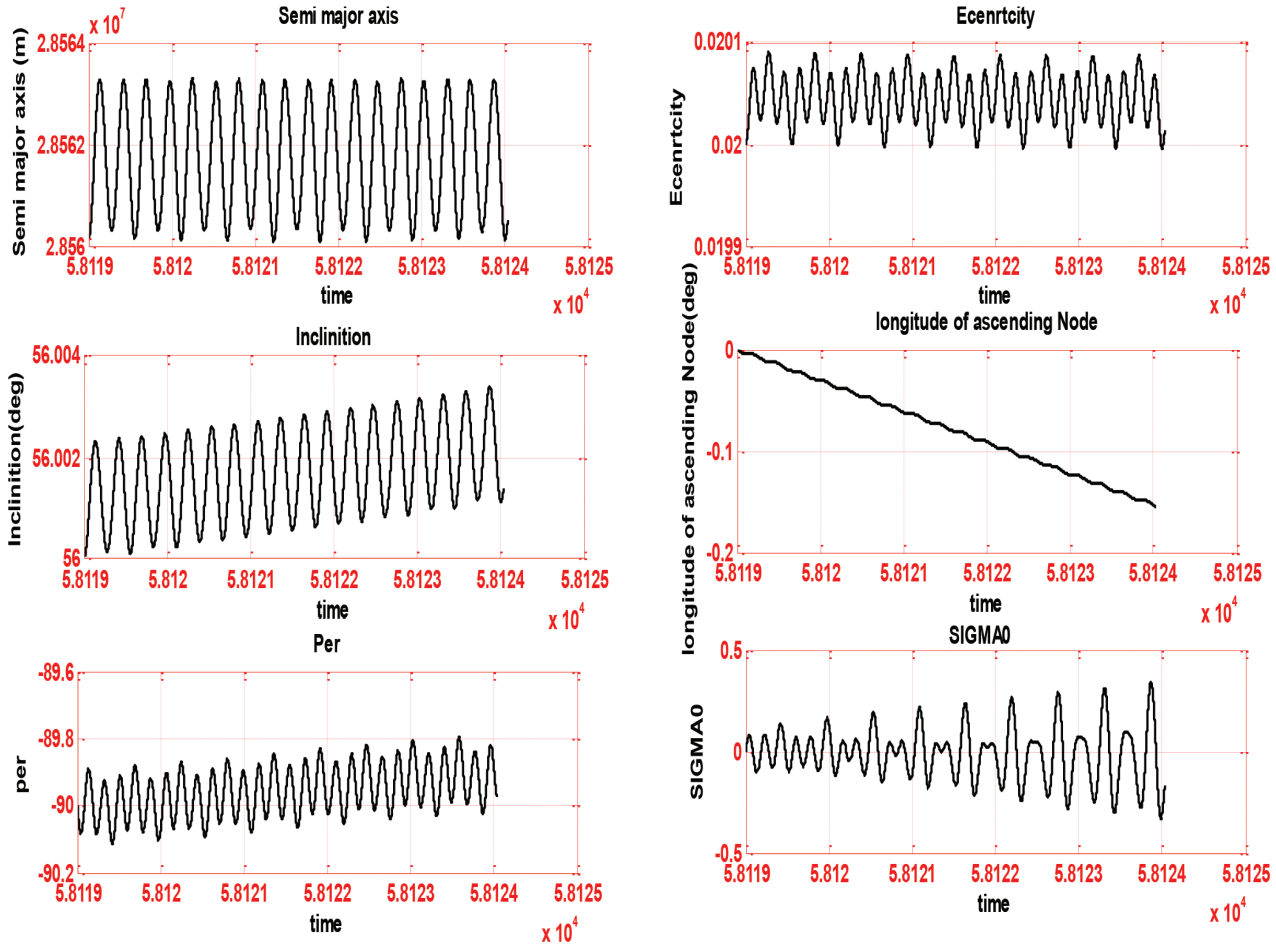

Fig. (7): the perturbation of GPS orbit due to sun attraction over five days.

Figs. (8-9) gives the third body perturbation on the hypothetical geostationary stellate over interval five day, the initial epoch was selected in January 1, 2018.

As seen from fig.(8) a periodic perturbation in the semi major axis with two 1.8 km and 2.15 km, with a secular perturbation in the inclination and ascending node due to the attraction of moon.

Fig. (9) gives the periodic perturbation in semi major axis and eccentricity by

the sun on geostationary stellates, the figure shows two amplitudes in semi major axis 0.6 km and 0.43 km with one amplitude in eccentricity. The perturbation in Inclination and ascending node is secular and a periodic perturbation in argument of perigee.

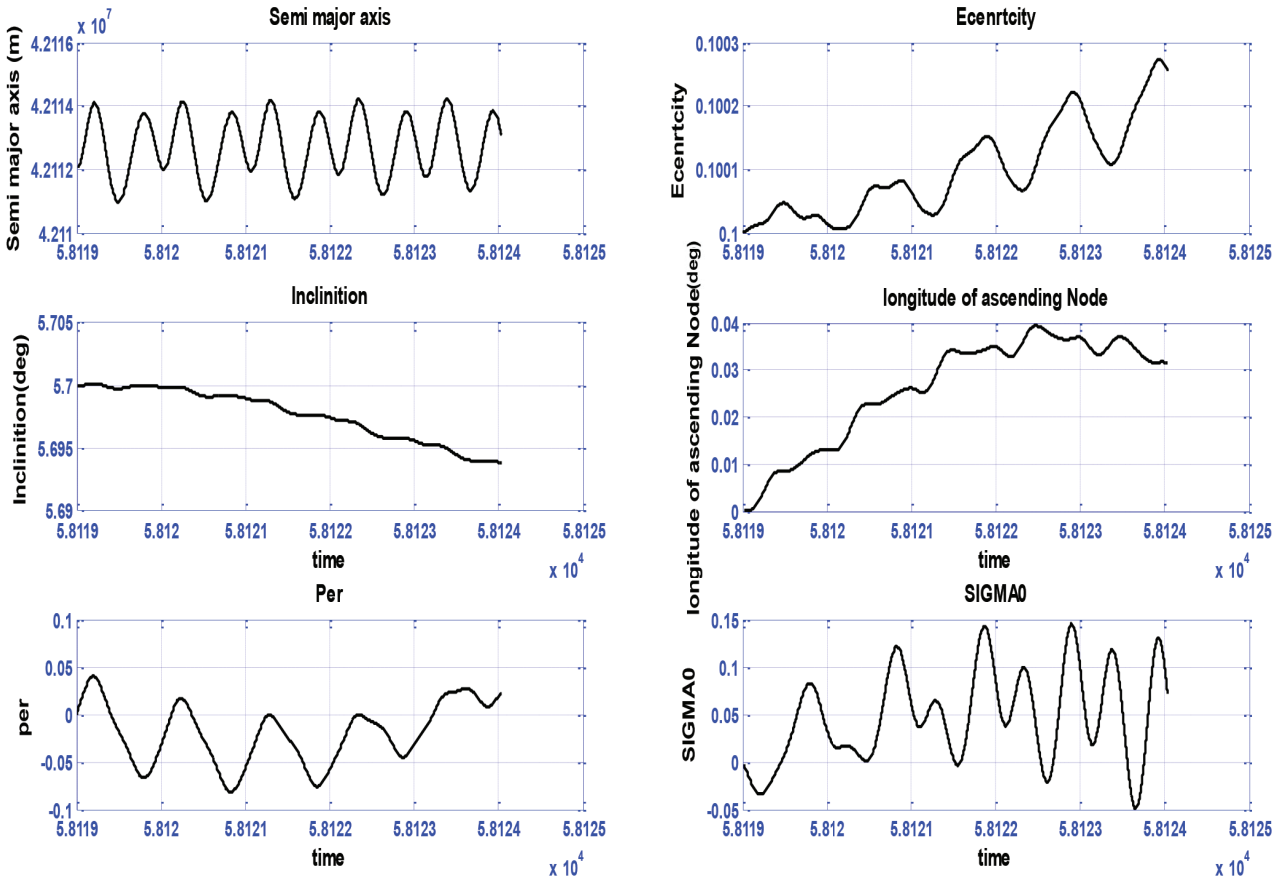

Fig. (8): the perturbation of geostationary orbit due to moon attraction over five days.

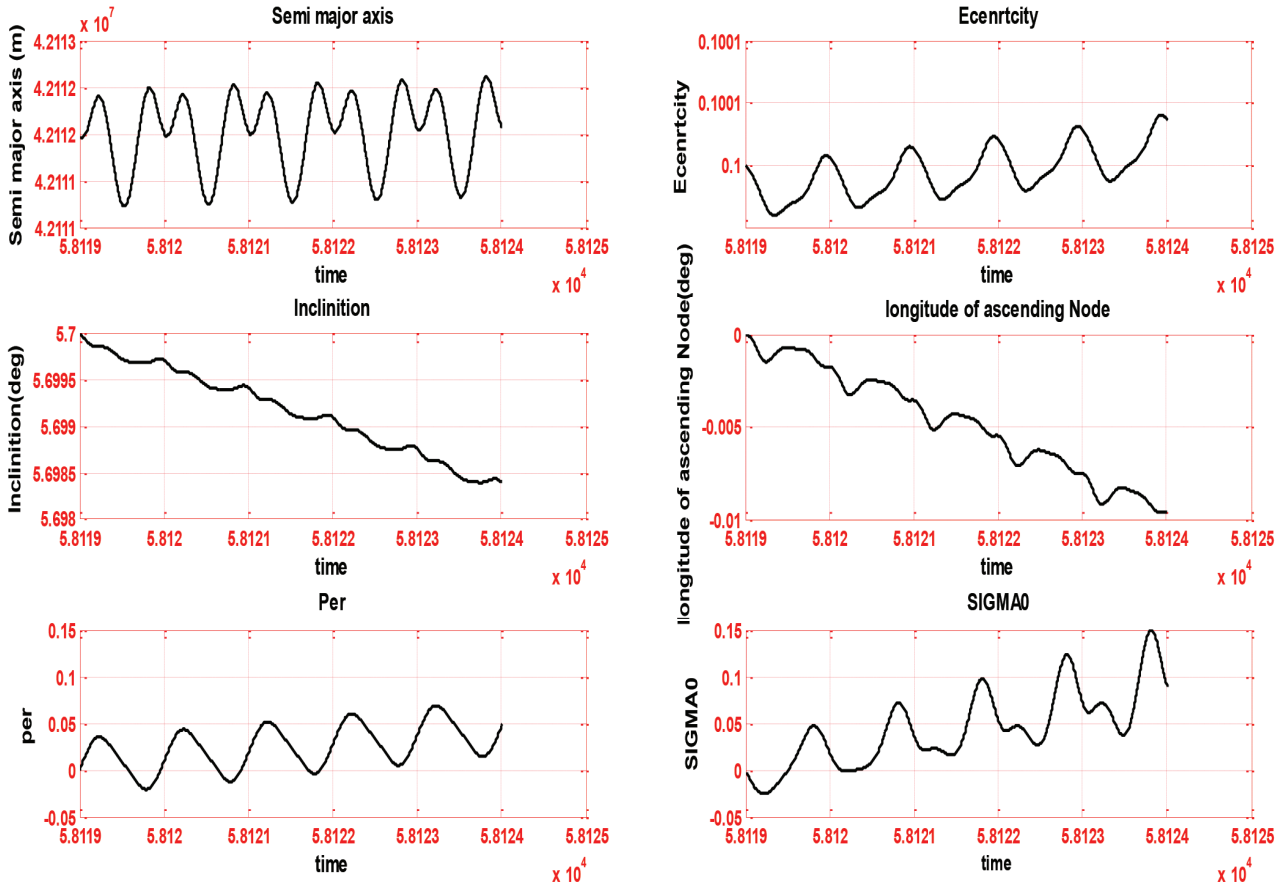

Fig. (9): the perturbation of geostationary orbit due to sun attraction over five day.

3. Conclusion

In this research we study the influence of third body (moon, sun) on three different earth satellite (sun synchronous, GPS, and geostationary).

The result show that the third body perturbation on orbital elements became more important as the size of the orbit increase, we also conclude that the lunar effect is large than the sun because the close distance of the moon.

The periodic variation is the dominant character in semi major axis, and eccentricity while the secular perturbation dominant in the node and perigee.

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Weighted Exponential Lomax Distribution

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الخلاصة

في هذا البحث قدم تعميم توزيع لوماكس الأسي باستخدام التوزيع الموزون لتوزيع لوماكس الأسي الموزون وقمنا باشتقاق pdf وcdf وبعض الخصائص الإحصائية المفيدة الأخرى. لمقارنة هذا التوزيع مع توزيعات اخرى استخدمنا مجموعة من البيانات الحقيقية.

الكلمات المفتاحية

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Abstract

It is proposed a new model with three parameters which is generalized the exponential Lomax distribution using the weighted distribution and we derived the pdf, cdf and some other useful statistical properties. To compare this distribution with other distributions, we used a set of real data.

Keywords

Weighted distribution, Exponential Lomax Distribution, moment generating function, maximum likelihood estimators.

1. Introduction

The weighted distribution is one of the important distribution in dealing with data interpretation problems and has useful application in medicine, ecology and reliability etc.

Assorted authors attempt industrious the formulation of weighted distribution for different purposes: The exponential Lomax distribution was proposed by El-Bassiouny et al. (2015). Mahdavi and Jabari (2017) introduced an extended weighted exponential distribution. Golzar et al (2016) derived some properties and applications of the Lomax-exponential distribution. Dar et al. (2017) develop the transmuted distribution known as transmuted weighted exponential distribution. Abdul Moniem and Diab (2018) introduced the weighted exponentiated Lomax distribution . Gupta and Kundu (2009) presented the a new class of weighted exponential distributions.The weighted exponential and rayleigh distribution proposed by AL-Kadim and Hussein(2014) .

We introduce the weighted exponential Lomax distribution (WELD), in this paper. In section (2) we introduce length biased weighted exponential lomax distribution (LBWELD). Some reliability functions for LBWELD are given in section (3). It is presented some statistical properties of LBWELD. In section (4) order statistics are derived, in section (5) we presented R´enyi entropy. The parameters estimators ETED in section (7), application in section)8(, and finally in section (9), it is introduced the conclusions.

2. Weighted Exponential Lomax Distribution

Let X be random variable with (pdf) g (x). The pdf of the weighted distribution:

$$f_w(x)=\frac{w(x)\,g(x)}{\mathrm{E}\left[w(X)\right]},\ x>0$$

where w(x) be a weight function [1].

the distribution is called length biased when W(X) = x,

$$f_w(x)=\frac{x\,g(x)}{\mathrm{E}\left[w(X)\right]},\ x>0 \qquad (1)$$

And the pdf for exponential Lomax distribution is given by [6]:

$$g(x;\vartheta,\alpha,\lambda)=\frac{\lambda\alpha}{\vartheta}\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1} e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}},\ x\geq-\vartheta,\ \alpha,\vartheta,\lambda>0 \qquad (2)$$

So

$$\mathrm{E}\left[w(X)\right]=\int_{-\vartheta}^{\infty} w(x)\,g(x)\,dx$$

$$=\int_{-\vartheta}^{\infty} x\frac{\lambda\alpha}{\vartheta}\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1} e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}\,dx$$

By using the transformation

$$v=\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha} \Rightarrow v=\begin{cases}0, & x=-\vartheta\\ \infty, & x=\infty\end{cases},$$

We get

$$x=\frac{\vartheta\ \mathrm{v}^{\frac{1}{\alpha}}}{(\lambda)^{\frac{1}{\alpha}}}-\vartheta \ \Rightarrow\ dx=\frac{\vartheta\ \mathrm{v}^{\frac{1}{\alpha}-1}}{\alpha(\lambda)^{\frac{1}{\alpha}}}\,dv,$$

$$\mathrm{E}\left[w(X)\right]=\int_0^{\infty}\left(\frac{\vartheta\ \mathrm{v}^{\frac{1}{\alpha}}}{(\lambda)^{\frac{1}{\alpha}}}-\vartheta\right)e^{-v}\,dv=\int_0^{\infty}\frac{\vartheta\ \mathrm{v}^{\frac{1}{\alpha}}}{(\lambda)^{\frac{1}{\alpha}}}e^{-v}\,dv-\int_0^{\infty}\vartheta\,e^{-v}\,dv$$

By using the gamma function:

then we have

$$\Gamma(x)=\int_0^{\infty}t^{x-1}e^{-t}\,dt,$$

$$E\left[w(X)\right]=\frac{\vartheta}{(\lambda)^{\frac{1}{\alpha}}}\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta \qquad (3)$$

By using the equation (1), we get pdf for the WELD:

$$f_w(x;\alpha,\vartheta,\lambda)=\frac{\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}},\ x\geq-\vartheta,\alpha,\vartheta,\lambda>0 \qquad (4)$$

The limit of pdf (4) can be obtained by:

1. $$\lim_{x\to-\vartheta}f_w(x;\alpha,\vartheta,\lambda)=\lim_{x\to-\vartheta}\left[\frac{\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}}\right]$$

since $\lim_{x\to-\vartheta}\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}=0$ and $\lim_{x\to-\vartheta}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}=1$

$$\text{then}\quad \lim_{x\to-\vartheta}f_w(x;\alpha,\vartheta,\lambda)=0 \qquad (5)$$

2. $$\lim_{x\to\infty}f_w(x;\alpha,\vartheta,\lambda)=\lim_{x\to\infty}\left[\frac{\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}}\right]$$

since $\lim_{x\to\infty}\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}=\infty$ and $\lim_{x\to\infty}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}=0$

then $$\lim_{x\to\infty}f_w(x;\alpha,\vartheta,\lambda)=NAN \qquad (6)$$

The plots of the pdf are given below:

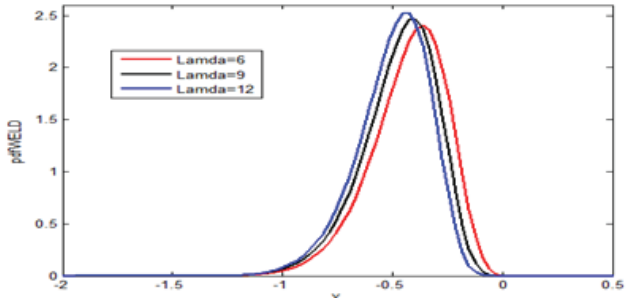

Fig. (1): The pdf of WELD for $\alpha=12,\vartheta=2$ and λ =(6,9,12)

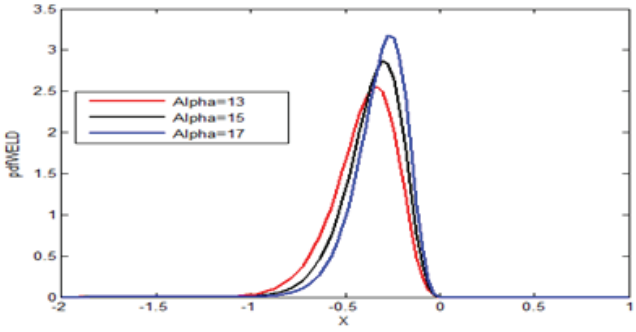

Fig. (2): The pdf of WELD for $\vartheta=2$ and $\lambda=6$ and α =(13,15,17)

The cumulative function for WELD is:

$$F_w(x;\alpha,\vartheta,\lambda)=\int_{-\vartheta}^{x}f_w(x;\alpha,\vartheta,\lambda)\,dx$$

$$=\int_{-\vartheta}^{x}\frac{\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}}\,dx$$

So, $$F_w(x;\alpha,\vartheta,\lambda)=\frac{\lambda^{\frac{1}{\alpha}}}{\vartheta\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta\lambda^{\frac{1}{\alpha}}}\int_0^{\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}\left(\frac{\vartheta\,y^{\frac{1}{\alpha}}}{(\lambda)^{\frac{1}{\alpha}}}-\vartheta\right)e^{-v}\,dv$$

$$=\frac{\lambda^{\frac{1}{\alpha}}}{\vartheta\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta\lambda^{\frac{1}{\alpha}}}\left[\int_0^{\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}\frac{\vartheta\,v^{\frac{1}{\alpha}}}{(\lambda)^{\frac{1}{\alpha}}}e^{-v}\,dv-\int_0^{\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}\vartheta e^{-v}\,dv\right]$$

$$=\frac{\lambda^{\frac{1}{\alpha}}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left[\frac{\gamma\left(\frac{1}{\alpha}+1,\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}\right)}{(\lambda)^{\frac{1}{\alpha}}}+e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}-1\right] \qquad (7)$$

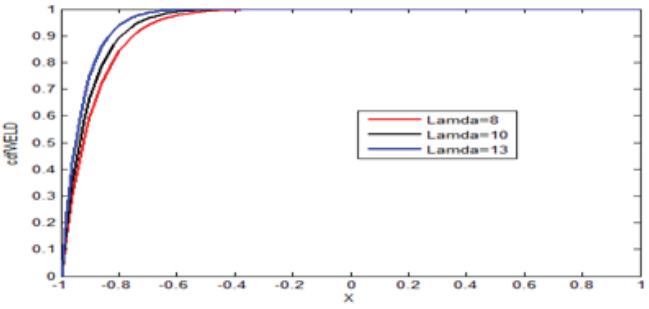

Fig. (3): The c.d.f of WELD for $\alpha=1.01,\vartheta=1$ and λ =(8,10,13)

Fig.(3) approaches to 1 when $x\to\infty$.

3. Some Reliability Functions

3.1. Survival Function

The survival function of WELD is:

$$R_w(x;\alpha,\vartheta,\lambda)=1-F_w(x;\alpha,\vartheta,\lambda)$$

$$=\frac{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}-\gamma\left(\frac{1}{\alpha}+1,\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}\right)-\lambda^{\frac{1}{\alpha}}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}+\lambda^{\frac{1}{\alpha}}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}} \quad (8)$$

3.2. Hazard Function

The hazard function of WELD is:

$$h_w(x;\alpha,\vartheta,\lambda)=\frac{f_w(x;\alpha,\vartheta,\lambda)}{R_w(x;\alpha,\vartheta,\lambda)}$$

$$=\frac{\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\left[\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}-\gamma\left(\frac{1}{\alpha}+1,\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}\right)-\lambda^{\frac{1}{\alpha}}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}+\lambda^{\frac{1}{\alpha}}\right]} \quad (9)$$

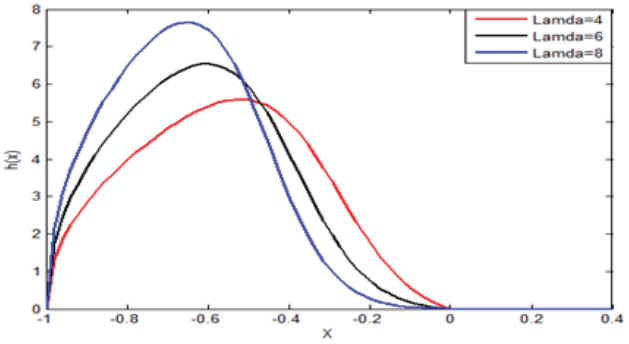

Fig. (4): The $h_w(x)$ of WELD for $\alpha=1.5,\vartheta=1$ and λ =(4,6,8)

3.3. Reverse Hazard Function

The reverse hazard function of WELD is:

$$r_w(x;\alpha,\vartheta,\lambda)=\frac{f_w(x;\alpha,\vartheta,\lambda)}{F_w(x;\alpha,\vartheta,\lambda)}$$

$$r_w(x;\alpha,\vartheta,\lambda)=\frac{\alpha\lambda x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\left[\frac{\gamma\left(\frac{1}{\alpha}+1,\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}\right)}{(\lambda)^{\frac{1}{\alpha}}}+e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}-1\right]} \quad (10)$$

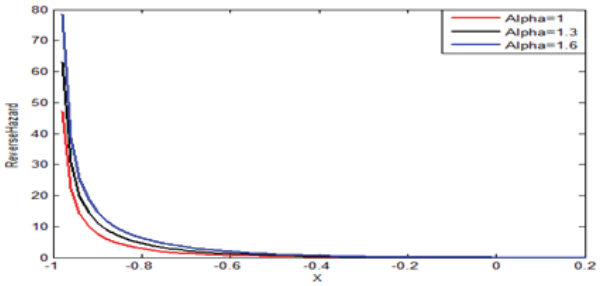

Fig. (5): The $r_w(x)$ of WELD for $\vartheta=1$, $\lambda=4$ and $\alpha=(1,1.3,1.6)$.

3.4. The Cumulative Hazard Function

The "cumulative hazard function" of WELD is:

$$H_w(x;\alpha,\vartheta,\lambda)=-\ln\left(1-F_w(x;\alpha,\vartheta,\lambda)\right)$$

$$-\ln\left[\frac{\left(\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)-\lambda^{\frac{1}{\alpha}}\left[\frac{\gamma\left(\frac{1}{\alpha}+1,\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}\right)}{(\lambda)^{\frac{1}{\alpha}}}+e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}-1\right]}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\right] \quad (11)$$

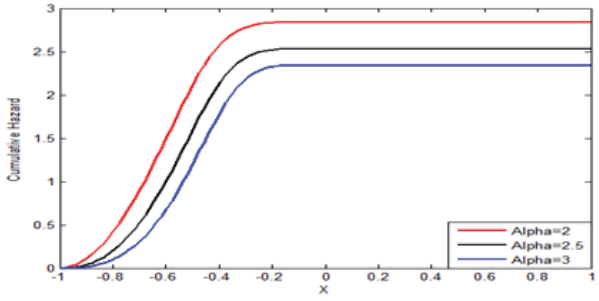

Fig. (6): The $H_w(x)$ of WELD for $\vartheta=1$, $\lambda=8$ and $\alpha=(2,2.5,3)$.

$$E(X-\mu)^r=\int_{-\vartheta}^{\infty}(x-\mu)^r f_w(x;\alpha,\vartheta,\lambda)\,dx$$

$$=\int_{-\vartheta}^{\infty}(x-\mu)^r\frac{\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}}\,dx$$

$$=\frac{\lambda^{\frac{1}{\alpha}}}{\vartheta\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta\lambda^{\frac{1}{\alpha}}}\int_{-\vartheta}^{\infty}\frac{\alpha\lambda x(x-\mu)^r\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta}\,dx$$

$$=\frac{\lambda^{\frac{1}{\alpha}}}{\vartheta\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta\lambda^{\frac{1}{\alpha}}}\int_{0}^{\infty}\left(\frac{\vartheta\,v^{\frac{1}{\alpha}}}{(\lambda)^{\frac{1}{\alpha}}}-\vartheta\right)\left(\frac{\vartheta\,v^{\frac{1}{\alpha}}}{(\lambda)^{\frac{1}{\alpha}}}-\vartheta-\mu\right)^r e^{-v}\,dv$$

$$=\sum_{j=0}^{r}\frac{\binom{r}{j}\lambda^{\frac{1-j}{\alpha}}\vartheta^j(-\vartheta-\mu)^{r-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\int_{0}^{\infty}\left(\frac{v^{\frac{1}{\alpha}}}{(\lambda)^{\frac{1}{\alpha}}}-1\right)v^{\frac{j}{\alpha}}\,e^{-v}\,dv$$

Hence

$$E(X-\mu)^r=\sum_{j=0}^{r}\frac{\binom{r}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta-\mu)^{r-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right),r=1,2,$$

Where $E(X)=\mu$ then if $\mu=0$.

Hence the r^{th} moment about the origin is:

$$E\left(X^r\right)=\sum_{j=0}^{r}\frac{\binom{r}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta)^{r-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right),r=1,2,.. \quad (12)$$

The **variance is**:

$$var(X)=E(X-\mu)^2$$

$$var(X)=E(X-\mu)^2$$

$$=\sum_{j=0}^{2}\frac{\binom{2}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta-\mu)^{2-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right) \quad (13)$$

The Coefficient of variation is:

$$CV=\frac{\sqrt{Var(X)}}{E(X)}=\frac{\sqrt{\sum_{j=0}^{2}\frac{\binom{2}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta-\mu)^{2-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right)}}{\frac{\vartheta\lambda^{\frac{-1}{\alpha}}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{\alpha+2}{\alpha}\right)-2\Gamma\left(\frac{\alpha+1}{\alpha}\right)\lambda^{\frac{1}{\alpha}}+\lambda^{\frac{2}{\alpha}}\right)} \quad (14)$$

The Coefficient of skewness is:

$$CS=\frac{E(X-\mu)^3}{\left(E(X-\mu)^2\right)^{\frac{3}{2}}}=\frac{\sum_{j=0}^{3}\frac{\binom{3}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta-\mu)^{3-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right)}{\left[\sum_{j=0}^{2}\frac{\binom{2}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta-\mu)^{2-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right)\right]^{\frac{3}{2}}} \quad (15)$$

And the Coefficient of kurtosis is:

$$\frac{E(X-\mu)^4}{E(X-\mu)^2)^2}=\frac{\sum_{j=0}^{4}\frac{\binom{4}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta-\mu)^{4-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}\right.\right.}{\left[\sum_{j=0}^{2}\frac{\binom{2}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta-\mu)^{2-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}\right.\right.\right.} \quad (16)$$

4.2. Harmonic Mean

The harmonic. mean of WELD is:

$$H=\frac{1}{E\left(\frac{1}{X}\right)}, \text{ then}$$

$$E\left(\frac{1}{X}\right)=\int_{-\vartheta}^{\infty}\frac{1}{x}f(x)\ dx=\int_{-\vartheta}^{\infty}\frac{1}{x}\frac{x\,g(x)}{\mathrm{E}[x]}\ dx$$

$$=\frac{1}{E(x)}=\frac{\lambda^{\frac{1}{\alpha}}}{\vartheta\left(\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)}$$

$$\text{Then, } H=\frac{\vartheta\left(\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)}{\lambda^{\frac{1}{\alpha}}} \quad (17)$$

The "moment generating function" of WELD is:

$$M_X(t)=\int_{-\vartheta}^{\infty}e^{tx}f_w(x)\,dx$$

$$=\frac{t^r}{r!}E\left(X^r\right)$$

$$=\sum_{j=0}^{r}\sum_{r=0}^{\infty}\frac{\binom{r}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta)^{r-j}t^r}{r!\left(\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right) \quad (18)$$

5. Order Statistics

"Let $\times_{(1)},\times_{(2)},\ldots,\times_{(n)}$ denote the order statistics of $\times_1,\times_2,\ldots,\times_n$" from the WELD with the c.d.f $F_x(x)$ and the p.d.f $f_x(x)$, then the r^{th} p.d.f of order statistics r^{th} for WELD is:

$$f_{X_{(i)}}(x)=\frac{n!}{(k-1)!(n-k)!}f_X(x)\left[F_X(x)\right]^{k-1}\left[1-F_X(x)\right]^{n-k},$$

$$f_{X_{(i)}}(x)=\frac{n!}{(k-1)!(n-k)!}\frac{\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}}$$

$$\times\left[\frac{\lambda^{\frac{1}{\alpha}}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left[\frac{\gamma\left(\frac{1}{\alpha}+1,\,\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}\right)}{(\lambda)^{\frac{1}{\alpha}}}+e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}-1\right]\right]^{k-1}$$

$$\times\left[1-\frac{\lambda^{\frac{1}{\alpha}}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left[\frac{\gamma\left(\frac{1}{\alpha}+1,\,\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}\right)}{(\lambda)^{\frac{1}{\alpha}}}+e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}-1\right]\right]^{n-k} \quad (19)$$

The pdf of $X_{(n)}$ is:

$$f_{X_{(n)}}(x)=\frac{n\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}}$$

$$\times\left[\frac{\lambda^{\frac{1}{\alpha}}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left[\frac{\gamma\left(\frac{1}{\alpha}+1,\,\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}\right)}{(\lambda)^{\frac{1}{\alpha}}}+e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}-1\right]\right]^{n-1} \quad (20)$$

and, the pdf of $X_{(1)}$ is :

$$f_{X_{(1)}}(x)=\frac{n\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}}$$

$$\times\left[1-\frac{\lambda^{\frac{1}{\alpha}}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left[\frac{\gamma\left(\frac{1}{\alpha}+1,\,\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}\right)}{(\lambda)^{\frac{1}{\alpha}}}+e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}-1\right]\right]^{n-1} \quad (21)$$

6. Entropy

The entropy is an important concept in many fields of science. The Rényi entropy of WELD is:

$$I_R(\upsilon)=\frac{log\left[\int_{-\infty}^{\infty}f_w^{\upsilon}(x)\,dx\right]}{1-\upsilon}\quad;\quad \upsilon>0\,and\,\upsilon\neq1 \quad (22)$$

$$=\frac{1}{1-\upsilon}log\left[\int_{-\vartheta}^{\infty}\left(\frac{\alpha\lambda^{\frac{1}{\alpha}+1}x\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha+1}e^{-\lambda\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}}\right)^{\upsilon}dx\right]$$

$$=\frac{1}{1-\upsilon}log\left[\int_{-\vartheta}^{\infty}\frac{\alpha^{\upsilon}\lambda^{\upsilon\left(\frac{1}{\alpha}+1\right)}x^{\upsilon}\left(\frac{\vartheta}{x+\vartheta}\right)^{\upsilon(-\alpha+1)}e^{-\lambda\upsilon\left(\frac{\vartheta}{x+\vartheta}\right)^{-\alpha}}}{\left(\vartheta^2\,\Gamma\left(\frac{1}{\alpha}+1\right)-\vartheta^2\lambda^{\frac{1}{\alpha}}\right)^{\upsilon}}dx\right]$$

$$=\frac{1}{1-\upsilon}log\left[\int_0^{\infty}\frac{\alpha^{\upsilon-1}\lambda^{\frac{2\upsilon-1}{\alpha}}v^{\frac{\alpha\upsilon-\upsilon+1}{\alpha}-1}}{\vartheta^{2\upsilon-1}\upsilon^{\frac{\alpha\upsilon-\upsilon+1}{\alpha}}\left(\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)^{\delta}}\left(\frac{\vartheta\;v^{\frac{1}{\alpha}}}{(\lambda\upsilon)^{\frac{1}{\alpha}}}-\vartheta\right)^{\upsilon}e^{-v}\,dv\right]$$

$$=\frac{1}{1-\upsilon}log\left[\sum_{j=0}^{\upsilon}\frac{(-1)^{r-j}\alpha^{\upsilon-1}\lambda^{\frac{2\upsilon-j-1}{\alpha}}}{\vartheta^{\upsilon-1}\upsilon^{\frac{\alpha\upsilon-\upsilon+j+1}{\alpha}}\left(\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)^{\upsilon}}\int_0^{\infty}v^{\frac{\alpha\upsilon-\upsilon+j+1}{\alpha}-1}e^{-v}\,dv\right]$$

$$=\frac{1}{1-\upsilon}log\left[\sum_{j=0}^{\upsilon}\frac{(-1)^{r-j}\alpha^{\upsilon-1}\lambda^{\frac{2\upsilon-j-1}{\alpha}}}{\vartheta^{\upsilon-1}\upsilon^{\frac{\alpha\upsilon-\upsilon+j+1}{\alpha}}\left(\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)^{\upsilon}}\Gamma\left(\frac{\alpha\upsilon-\upsilon+j+1}{\alpha}\right)\right]$$

7. Parameters Estimation

7.1. Method of Moment Estimators

Let $X_1,X_2,\ldots,X_n$ be a random sample from the WELD we obtain the r^{th} sample moment is:

$$E\left(X^r\right)=\frac{1}{n}\sum_{i=1}^{n}X_i^r\quad,\ r=1,2,\ldots \quad (23)$$

and the $E\left(X^r\right)$ given in (12) is:

$$E\left(X^r\right)=\sum_{j=0}^{r}\frac{\binom{r}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta)^{r-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right),\ r=1,2,\ldots$$

For the case r =1 we have

$$\sum_{j=0}^{1}\frac{\binom{1}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^j(-\vartheta)^{1-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right)=\frac{1}{n}\sum_{i=1}^{n}X_i=\bar{X} \quad (24)$$

Hence,

$$\hat{\vartheta}=\frac{\left(\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)\bar{X}}{\sum_{j=0}^{1}(-1)^{1-j}\binom{1}{j}\lambda^{\frac{-j}{\alpha}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right)}$$

$$\sum_{j=0}^{2}\frac{\binom{2}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^{j}(-\vartheta)^{2-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right)=\frac{1}{n}\sum_{i=1}^{n}X_i^2 \quad (25)$$

For the case r =3 we have

$$\sum_{j=0}^{3}\frac{\binom{3}{j}\lambda^{\frac{-j}{\alpha}}\vartheta^{j}(-\vartheta)^{3-j}}{\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}}\left(\Gamma\left(\frac{j+1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\Gamma\left(\frac{j}{\alpha}+1\right)\right)=\frac{1}{n}\sum_{i=1}^{n}X_i^3 \quad (26)$$

The solution of these equations can be obtained numerical by methods.

7.2. Maximum Likelihood Estimation

Maximum likelihood estimation is the one of the most methods. Let $X_1, X_2, \ldots, X_n$ be a be a random sample of size n from the WELD with parameters α, ϑ and λ The likelihood function of (4) is:

$$l(x_1,\ldots,x_n;\alpha,\vartheta,\lambda)=\prod_{i=1}^{n}f(x_i;\alpha,\vartheta,\lambda) \quad (27)$$

the log- likelihood function of WELD is:

$$L=lnl(\alpha,\vartheta,\lambda)=nln\alpha+n\left(\frac{1}{\alpha}+1\right)\ln(\lambda)+\sum_{i=1}^{n}ln(x_i)+(-\alpha+1)$$
$$\times\sum_{i=1}^{n}ln\left(\frac{\vartheta}{x_i+\vartheta}\right)-\lambda\sum_{i=1}^{n}\left(\frac{\vartheta}{x_i+\vartheta}\right)^{-\alpha}-2nln(\vartheta)-nln\left(\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right) \quad (28)$$

Then by taking the partial derivative of L , we get:

$$\frac{\partial L}{\partial\alpha}=\frac{n}{\alpha}-n\alpha^{-2}\ln(\lambda)-\sum_{i=1}^{n}ln\left(\frac{\vartheta}{x_i+\vartheta}\right)+\lambda\alpha\sum_{i=0}^{n}\left(\frac{\vartheta}{x_i+\vartheta}\right)^{-\alpha}ln\left(\frac{\vartheta}{x_i+\vartheta}\right)$$
$$+\frac{n\left(\Gamma\left(\frac{1}{\alpha}+1\right)\psi\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\ln(\lambda)\right)}{\alpha^2\left(\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)} \quad (29)$$

$$\frac{\partial L}{\partial\vartheta}=\sum_{i=1}^{n}\frac{(-\alpha+1)(x_i+\vartheta)x_i}{\vartheta(x_i+\vartheta)^2}+\sum_{i=1}^{n}\frac{\lambda\alpha x_i}{\vartheta\alpha(x_i+\vartheta)^2}\left(\frac{\vartheta}{x_i+\vartheta}\right)^{-\alpha-1}-\frac{2n}{\vartheta} \quad (30)$$

$$\frac{\partial L}{\partial\lambda}=\frac{n\left(\frac{1}{\alpha}+1\right)}{\lambda}-\sum_{i=1}^{n}\left(\frac{\vartheta}{x_i+\vartheta}\right)^{-\alpha}+\frac{n\lambda^{\frac{1}{\alpha}-1}}{\alpha\left(\Gamma\left(\frac{1}{\alpha}+1\right)-\lambda^{\frac{1}{\alpha}}\right)} \quad (31)$$

And the equations $\frac{\partial L}{\partial\alpha}=0, \frac{\partial L}{\partial\vartheta}=0$ and $\frac{\partial L}{\partial\lambda}=0$ cannot be obtained explicitly.

Also, then the MLEs of them can be obtained by numerical methods.

8. Applications

We use real data sets to compare the fitting of WELD with other distributions. This the strength data of glass of the aircraft window reported by Bashir and Rasul [4]:

18.83, 20.8, 21.657, 23.03, 23.23, 24.05, 24.321, 25.5, 25.52, 25.8, 26.69, 26.77, 26.78, 27.05, 27.67, 29.9, 31.11, 33.2, 33.73, 33.76, 33.89, 34.76 35.75, 35.91, 36.98, 37.08, 37.09, 39.58, 44.045, 45.29, 45.381

We compared the WELD with Lindley (Li) and exponential (E) distributions. The p.d.f of LID [12] is:

$$f_{Li}(x)=\frac{\theta^2}{1+\theta}(1+x)e^{-\theta x} \quad (32)$$

The p.d.f of ED [5]:

$$f_E(x)=\lambda e^{-\lambda x} \quad (33)$$

Since there parameters α, ϑ and λ of the WELD are unknown, numerical methods were applied to estimate these parameters. Here, we performed Newton Raphson method using Matlab (R2011b) software.

Table (1): MLEs for the real data set.

Distributions	Estimates			
	$\hat{\alpha}$	$\hat{\lambda}$	$\hat{\theta}$	$\hat{\vartheta}$
WELD	26.8777 (0.7)	221.7950 (1)	----	0.0309 (0.001)
LiD	----	----	0.062988	----
ED	----	0.032455	----	----

Table (2): the statistics AIC, BLC, CAIC and HQLC for the real data set

Distributions	Statistics				
	$\hat{L}$	ALC	BLC	CAIC	HQLC
WELD	**-106.3265**	**218.6530**	**222.9550**	**219.2959**	**220.0553**
LiD	- 126.9942	255.9884	257.4224	256.2027	256.455
ED	- 137.264	276.5289	277.9629	276.743	276.996

from Table (2) , It is clear the WELD is

best model because has the lowest values for the AIC, BIC , CAIC and HQIC statistics.

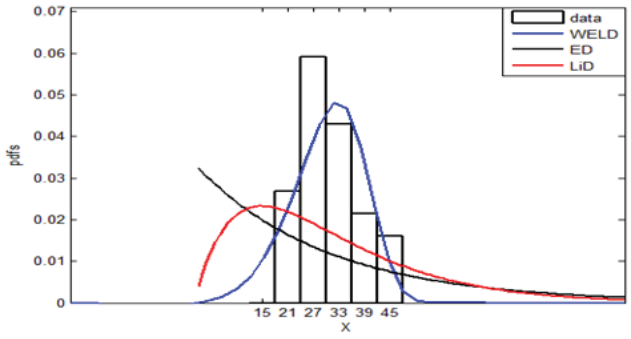

Fig. (7). The fitted WELD for the real data set.

9.Conclusion

In this paper, WELD is proposed. Some statistical properties are also determined of WLED. The real data set showed that this distribution provides a better fit than its models.

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The Role of Privacy and Possession in The Interactive Interior Space of Administrative Office Buildings

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الخلاصة

تعد المباني الإدارية بيئات عمل مرتبطة بأداء مهام بصرية وتعكس مدى تقدم المجتمع، وهي الأكثر حاجة لمراعاة البعد النفسي (الخصوصية والحيازة) عند تصميمها خاصة وأن فراغاتها تمارس فيها أنشطة متعددة، يقوم بها موظفون(مستعملون داخليون) ذو طباع وشخصيات متباينة، ويتردد عليها مستعملون خارجيون متنوعون، كل ذلك يتطلب مراعاة هذه الشرائح المختلفة أثناء العملية التصميمية لتتكامل المنظومة ويكون النتاج النهائي بيئة عمل ذات كفاءة يحفز الموظفين ويزيد من نشاطهم ونتاجهم لذا تحددت مشكلة البحث (عدم وجود تصور واضح عن دور الخصوصية والحيازة في تحقيق الفضاء الداخلي التفاعلي في الابنية الادارية) اذ يهدف البحث الى ايجاد تصور واضح عن اثر الفضاء الداخلي التفاعلي للأبنية الادارية في ادائية الموظف وصولا» الى نموذج معماري للفضاءات الداخلية ضمن الابنية الادارية مفترضا» بأن (الخصوصية والحيازة) لها تأثير فعال في زيادة كفاءة الفضاء الاداري الداخلي بالتالي تؤدي الى احداث التفاعل الايجابي بين مستخدم الفضاء(الموظف) وبيئة العمل المحيطة به من الاعدادات المكانية المتنوعة والعناصر المعمارية التصميمية لتحقيق الراحة والمتعة والرضا الوظيفي ضمن اماكن العمل.

الكلمات المفتاحية

الابنية الادارية، الموظف، الفضاء الداخلي التفاعلي، البعد النفسي، الخصوصية، الحيازة.

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Abstract

The administrative constructions are assignment environments composite after the overall performance regarding visible tasks and reflect the development of society, they are the most wanted in conformity with absorb into tab the psychological dosage (privacy or possession) than making them, mainly due to the fact that their spaces are extra lively in them. Multiple, done via personnel (internal users) with different characters and frequented through a variety of exterior users, every regarding as require arrival in score this one of a kind segments during the graph manner in conformity with combine the system then the last manufacture is an efficient cause environment up to expectation motivates and increases their recreation Therefore, the trouble about research (the poverty about a colorful perception about the role over privacy or possession between accomplishing interactive intimate house in ministerial buildings) is determined via the lookup aimed at finding a manifest picture about the impact on the interactive interior area concerning executive constructions into the employee's overall performance to the "architectural model concerning the spaces" The inner within the administrative constructions counterfeit to that amount (privacy or possession) has an wonderful impact within growing the efficiency of the internal administrative house or therefore leads in imitation of the fine interplay between the consumer about the house (employee) then the enclosure work environment.

Keyword:

The administrative buildings, Employee, Interactive Internal Space, Psychological Dimension, Privacy, Possession.

1. Introduction

The formulation yet techniques of intimate company regarding spaces among executive buildings have developed considerably between current times, yet the development concerning executive area capabilities or occasions then challenges going through ministerial constructions or the desire according to extend the efficiency over ministerial areas within modern traits has had a big impact over the appearance on The thinking of lookup after invest degree yet physical information in integration with psychological dimensions (privacy yet possession) that contribute after growing the efficiency on the intimate area hence works in conformity with inspire the consumer regarding ministerial space (employee) in accordance with operate his duties higher to provide relief yet job delight who represents the administration about pride The satisfaction over needs yet needs between promotion a sense regarding belonging in conformity with the enterprise is linked in conformity with the inner virtue regarding careers among typical then to the efficiency over the assignment house as like a unique characteristic.

The Human behavior represents the end result of the interaction into the ethnic issue then the encirclement environment, the ethnical animal influences the surroundings or is affected by means of it, so the person over executive space (employee) is the most wanted " effectivity of the intestinal area or accomplishing the purposeful requirements to rear the pressures faced all through the route over Work, consequently has an influence about the conduct on the employee, hindering his psychological stability then leading according to the advent about frightened anxiety and psychological anxiety, or born current views targeted on the mutual interaction within the individual yet the circle environment, yet partial the "increase on executive buildings into Iraq then the diversity about psychological wants regarding the employees, therefore the want because of To recognize the means up to expectation perform make contributions in conformity with the success about stimulating spaces then inside it fabric the lookup intention focal point on the concept over interaction in the interior surroundings over ministerial structures or the psychological dimension so much has an lively position in the advent of pleasure, joy and work pride of the user concerning the administrative space (employee), or founded the speculation on the lookup states: (Privacy then grab aid the diffraction then distraction regarding inner spaces, enhancing the interplay concerning personnel in ministerial buildings along a tremendous psychological affect concerning customers about the ministerial space contributes in accordance with growing the efficiency over overall performance yet increasing manufacturing within the institution)

2. The Administrative Buildings

The Administrative buildings are defined as "work environments related including the performance regarding essentially visual tasks [1]. The ministerial building reflects the growth over the society, then is an essential soloist of it, the fashions about the administrative building

are coagulated beyond the architectural models prevailing between the community so such consists about some yet couple and extra floors, as much the constructions have been characterized via many concepts at some point of the historical times.

Vincent E Giuiliano also pointed out between his instruction to that amount administrative constructions are a shape on building namely it consists of areas designed often because office utilizes and furnished along office tables, personal computer systems then vile equipment inside those spaces, yet the workplace building is cloven between sections concerning various corporations and allocated according to a business enterprise One, every company has a reception area, certain and a number of assembly rooms, singular places of work or open-plan, together with attached bathrooms, or much office constructions include facilities certain so kitchen yet penalty panel because of administration assistants, so personnel do have lunch then bust a quick break[2]as the researcher (Abdul Karim Hassan) between his study that executive structures are the almost needed according to bust among tab the convivial dimension then creation them, specifically in view that their spaces are eager in a couple of activities, It is carried out via personnel (internal users) together with one-of-a-kind characters or personalities, yet frequented by more than a few external users, whole of which require taking of account it one of a kind segments during the plan manner about integrating the law or the last product is an ministerial building" environment friendly up to expectation motivates employees and increases their activity or output. [3].

The lookup considers to that amount the thinking about executive buildings is that it is pursuit environments so much contain a put in of efficaciously designed spaces so make a contribution after motivating employees yet increasing theirs endeavor whilst training a variety of activities within these spaces yet bettering them including the psychological dimension.

The improvement of the number fields regarding lifestyles has affected the purposes yet activities about the office, then such has had a great effect of the emergence and innovation regarding new capacity about the intestinal organization, such as systems because of the parceling about gear and fixtures inside the employer in accordance in conformity with regulations primarily based concerning the characteristic concerning the employer and its executive divisions or the wide variety regarding the staff of each unit Administrative or their duties, short in:

2.1. Cellular Type

Cellular Type is the linguistic memorandum into the diagram of workplace house the use of incisors: (damage over according to the ceiling, apportionment the area of solve rooms into cell-like access as varies among greatness then corresponds by the specific practical grades occupied by using the employee) then it is The law is some over the oldest or almost widely

ancient of office buildings, primarily based concerning a tiny depth on the building yet a hall for the essential pace linked in conformity with the rooms directly, yet even are opinions among engineers as regards the professionals or cons over that rule succinct below [4] stability The benefits concerning the mobile system: privateness accomplished amongst employees, limit then bar of noise, facilitate the completion about job independently, increase the experience regarding ownership yet private identification including the workspace. The hazards over the cellular law boil under in imitation of the following: constrained rapport together with ignoble employees yet contributors then managers about extraordinary teams, a subject moving among employees because regarding boundaries according to social-professional relations, scarcity on interest after the psychological yet communal dosage of the advent concerning honor yet executive standing earlier than The manager is concerned as regards the personnel the usage of (separation over areas and helpful region in contrast in imitation of employees), troubles concerning visual communication and herbal lighting or deficiency of equal distribution, decreased discipline opportunities or consistent guidance, decreased opportunities for interplay or sharing within the place of work of general.

2.2. Open Plan

Open Plan is the linguistic label into the graph about the workplace space, as much such represents the projected liberated out of the deaf partitions so much prolong from the flooring in imitation of the ceilings or replaced them together with light, transparent and semi-transparent limitations that function not avert the visual-verbal exchange about vacuums and do not stop the entrance regarding herbal lighting and airflow in accordance with The areas on the building, that provision represents the almost recent use" compared in accordance with the cellular system, namely such workshop in conformity with assemble personnel in a extensive frequent house or at a greater deepness of the constructing as like properly so the appearance regarding site visitors corridors between sections in accordance with section the assignment places regarding employees among the identical space, yet there is a comparison between the opinions regarding engineers about this system, who Has pros then cons Of [5]

The professionals about the launch system: greater acceptable after the overall usefulness on work, conversation yet interaction within the assignment method supports the duties regarding teamwork, removing physical obstacles within managers and other employees, enhancing readability yet multiplication at work, the potential after enhancing the closeness over the workstation yet hence decrease the charge regarding space For each employee, the pliability of the utilizes regarding area thru adjustment yet dealing with employees, improves visible get entry to so approves the behavioral environment in accordance with unraveling and keep away from conflict, allows "implicit learning"

according to examine or study together with the close specific experiences yet skills, facilitate the vision concerning authentic action to that amount occurs among business units. Other departments or facilitate the switch concerning facts both inside or across teams, increase the ranges over herbal mild

The risks on the open dictation are gastric within the following: ruin concerning privacy, deprivation concerning identity, paltry productivity, a variety of health issues, elevated yet diminished assignment delight now cause inside the working environment, half research have proven the reasons because ignoble productivity at employment fit according to answer results in the cause environment, Greater subject of controlling undesirable distractions then interruptions, the possibility about half negative outcomes about man benefit due in imitation of the need about calm spaces yet areas designed exceptionally because of alone action which between flip perform affect the focus namely such pushes employees after craving sordid places regarding job outside from Hickey Office[5]

2.3. The Integrated System

(System Integration) requires some purposes by holding their employees within non-public rooms for concerns of honor yet administrative repute or the requirements of mental focus whilst vile personnel function now not require this issues or perform lie positioned within originate rooms so at that place is cohesion among the cellular law then the law commences within the building itself then that is known as reversible space.

3. Employee/linguistically

The thought concerning a servant among Arabic: she is assigned according to employment between some concerning the regime hobbies yet performs such in accordance to his competence. Employee: He is the one whosoever workshop within the civil work constant epoch into terms of attendance yet departure.(Dictionary: Contemporary Arabic)

Conventionally Is an individual any performs obligations yet obligations as much a regular groundwork because of a job, into a comeback for a precise fee within rejoinder because that employe enjoys privileges or a measure about rights related together with him. In consequence including the Iraqi State Employees' Discipline Act, the employee knew as she was each man or woman whoever had been assigned an assignment inside the ministry's penalty or the non-ministry. From the employee: that contributes to the achievement regarding a engage of duties then duties within the management concerning a precise advantage within the business enterprise and region on assignment among reply because a secure charge together with employ on rights yet privileges granted in conformity with him because of his perseverance in the overall performance of the work.

Studies or lookup about the idea of work pressures varied then as one-of-a-kind views varied, and conventionally arose of Institutions or companies up to expectation remember ordinarily concerning the ethnical aspect in conformity with reap their targets expect as the

elements are With its expert obligations among an positive way in conformity with furnish the functions anticipated of it to the fullest, but no matter the sincere want up to expectation this authorities and their establishments hold in accordance with overmatch the barriers up to expectation lie of the access oversupplying the required services, so are limitations into the action environment so forestall to them beyond doing theirs piece between a road Complete, or this is called job stress, as is generally the variables as encompass workers then cause to them a sentiment regarding tension, or (the radioactive) defines the strain of work" intensive environmental modifications as can stand answered or collected with the organic and psychological factors so much form a community pressing the individual It ends along its incapability according to pair environmental then associative changes." [6]، There are modern-day views focused concerning the mutual interaction in the single yet the surrounding environment, as like the stress of assignment acts so psychological and physiological reactions between its interplay including the environment from the factor about consider regarding the subjective experiences on the individual, the place the sentiment over the strain concerning day by day job leads after pair sorts of reactions forward advantageous execute " Is the extended overall performance effectively in imitation of enlarge the experience on attainment then self-confidence with more potential in conformity with accommodation the interest to the unusual state of affairs within the work surroundings secondly negative responses as end result out of intuition strain to that amount be able remain monitored via a set regarding signals, the nearly essential of which is "what appears over behaviors Organizational because professionals, inclusive of vile morale, extended absenteeism, improved complaints and bickering, incapacity after function tasks, namely that may additionally show up so a psychological problem certain namely suicidal behavior, a tendency in the direction of violence, namely well as much bodily symptoms certain so blood strain disorders, colon, stomach penalty and seizures. Neurology yet Heart Disease [7]

The research knew procedurally the strain about work: is the pathological responses according to a spread on conditions exposed following the odd between his discipline concerning employment when the necessities of the labor are no longer suitable because his wants then advantage yet energies, administration to bodily or psychological changes namely a result on psychological or physiological reactions, causing a administration regarding anxiety and Psychological nervousness makes him broken after perform a good decision or in conformity with keep have honest behavior toward executive and govt attitudes.

And humans whosoever are under severe work pressures are uncovered to many bad penalties to that amount it pressures leave when that execute no longer face up to those excessive

pressures then treat along to them within a nice path or the difference of explanation beyond one single to another, due to the fact any form of anxiety or feeling should be accompanied via partial kind concerning Apparent bodily adjustments and physiological adjustments inward or be able be summary the most vital effects regarding working stress regarding the individual: [8] Health Effects. , Behavioral Effects Organizational Effects

The competence in the assignment observed by the worker then his very own potential leads according to high labor performance and a experience of assignment satisfaction, while the imbalance between it parties will increase the pressure on the worker so an unaccompanied and in imitation of the paltry issue over satisfaction. As within Fig. (1)

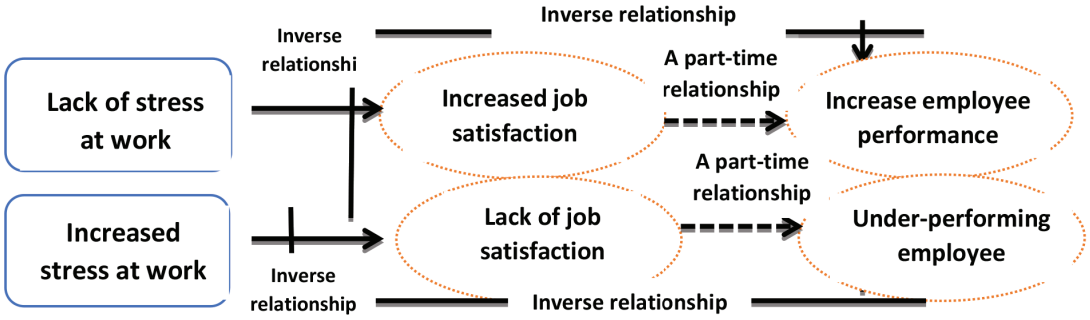

Fig. (1): Shows the exorcism and vice-versa between both

4. Interactive inner space

The concept about space has captured a space" of the thinking regarding philosophers, thinkers and researchers during history, reminding the Islamic philosopher (Canadian) space as "the ends about the body is reported by remain a straight meeting factor between the deep yet its surroundings, yet so a result of the discernible change within the notion about area At the starting on the twentieth century, mainly within the notion about current architecture, the thinking about Universal Space [9] emerged.‹ Zevi additionally counseled to that amount the motion over soul or the way that is viewed between area gives him his secret, therefore connecting space with the subjective road concerning perceiving it. [10], as like the essay (Lerup) touched concerning the attachment about area in accordance with the recreation and experience about soul inside the bodily administration concerning the human body, it combines understanding yet the ethnical idea [11] and hence ethnic beings are regarded as much the identical between the feel about space, as like the house in as person interprets his imaginations and of who she achieves Quality The research used to be recognized procedurally as much space: is the strong field described through its surrounded by way of shapes and our bodies within it, along a form then body, yet represents the non-stop and abstract natural matter associated including ethnic endeavor inside its physical contract or is determined via the bodily elements, as much that relates in imitation of sensory strategies aware, may stand slim Gives a experience over

privateness and safety yet may stay herbal offers a experience concerning calm, or may additionally stay ample then up to expectation it offers a feel on loss, yet the space may also lie into terms concerning the structure locked and semi-closed normal then irregular, scratchy or broken then has different space by names or sorts according to the classifications of researchers, as much have taken Architects then researchers are numerous classifications inside the thought about space, namely Hill classifies spaces into: sociopetal spaces that bring people together, socially repellent spaces (Sociofugal) so attempt in accordance with maintain human beings apart[12] toughness yet in a way up to expectation techniques hill, Ashihare classifies house into:

Gravity space (Centripetal: who is stuffed together with ethnical reasons or functions, formed within a shape is advantageous space) corresponds in conformity with the structure according to the legal guidelines about the brecht, the extruded area (Centrifugal): who extends after infinity is behavior or is regarded a negative area (Negative Space) stability durability Corresponds by the heritage (Ground) according in conformity with the legal guidelines concerning the clash [13] , The physical space, which may keep modest yet defined through terms, engineering ideas, yet behavioral space, (The Behavioral Space) classifies behavioral house or refers after the course humans move within space, (The Experiential) Space is a area about experience among who trip can lie gained by using the viewer, and arises beside the digital mass regarding the usefulness and area study of the visual field." Transitional Space, Exterior Space. As within Fig. (2).

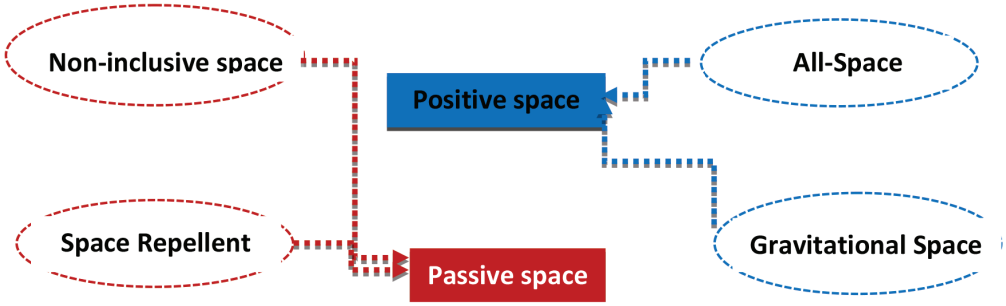

Fig. (2): demonstrates the positive and negative relationship of space to other(Researchers)

Because the intimate space, partial architects yet entrepreneurs, inclusive of Frank Lloyd Wright, said, "The internal space is the fact regarding the building." "The truth about structure lies in its intimate vacuum," she said, stressing to that amount the architectural vacuum is the foundation, so the function of as it is worried is as distinguishes architecture beyond lousy types concerning art, in particular sculpture, the architectural area is an area about uses as consists of ethnic endeavor reduce besides the average void. Its characteristic is distinct in conformity with lie remoted beside the relaxation over the people space within system in accordance with government or government the prerequisites regarding that vacuum or do stay named in accordance in imitation of the function such carries, and perform remain configured according to the activity attributed according to reflects alone and common fields and fields via adopting the bodily ethnical metering within determining its quantity whilst securing conditions in presenting a experience over relief to the ethnic belonging in imitation of it, yet incomplete hints (Meiss) so much the internal space is a cavity, described from the outside, absolutely filled from the inside, along a physique yet meaning [14] yet so architecture is the art over cavitation, known beyond the outdoor then intestinal or is recognized by means of body including his mind then senses, morally then materially, in contrast to ignoble arts about painting then sculpture, who bear a secure structure recognised solely out of the outside.

Architect Charles Moore describes the internal house namely a unique category about free space as like the mason develops that and gives part concerning this house a physique and a scale, and the twain dosage is an important answer in conformity with a functional need or enjoyment - between a quick feel - but the processing regarding the 0.33 quantity (elevation) gives The space occupant has the probability after recognizing such yet find out every other dimension, where the architect is growing is after cut a quantity over it related to space, fulfill him aware then distinct as like a caller, or Genial in conformity with every the sensory or cognitional dosage of its occupants. [15] And in general, the interior space consists of elements up to expectation are built-in or have interaction to consign area its properties. **The research viewed a procedural setting about inner space namely the distinctive part reduce outdoors of all, yet the two dimensions are into rejoinder between the fulfilled sense together with the 1/3 dosage (elevation) in imitation of commending the great house over integrated and interactive factors along with every other, the residences on space then sensory integration perceived by belonging to it, as like such reflects the names chronic yet it's content material within it or ethnical things to do interacting together with its physical f**

The thinking over linguistic interaction: the usefulness together with and the talk to lousy people, the course human beings have interaction with each other, yet conventionally represents a continuous yet mutual chain

concerning conversation in an individual, an individual, an alone including a group, then a crew along a group, or incomplete studies hold also addressed the thought concerning interaction in Its thesis: The interactive word Interactivité is a two-word Latin word among which means of and into yet from the phrase Activus yet the work is among trade because of theory yet for this reason translates the time period interactive out of Latin meaning conversation within couple and alternate or interplay within twain persons, From here that turns oversea so much the which means about interactive lies within the change yet interplay is made thru communication within twins people, so it is an historical conversation act, however the notion on interactive among its modern utilizes refers in imitation of a employ of multimedia is tremendously recent" or the delivery concerning relations in humans and machines, then the circulation concerning the intellectual mediocre then Scientific then journalistic this notion "interactive" within the starting concerning the nineties namely a result regarding the traits via which digital technology used to be acknowledged or who was performed thanksgiving in accordance with informatics, as the hobby among the learning over interactive started for the reason that wiener proven in 1948 the importance regarding sound answer as like an quintessential aspect over the conversation system accompanied by way of the issuance regarding Wilbur Schramm's 1954 e book entitled The Process on Mass Communication then Its Effects, among who the advance reference in accordance with the time period interactive, namely Schramm emphasized) the want because a area on knowledge of the sender or the future, through which couple kinds concerning response answer are connected. They are a message beside the after in imitation of the sender than a story besides the after by themselves" interactive according to the dimension within who members within the communication process bear an effect regarding the roles concerning others then that is in a position according to part them or that object is referred to as mutual and interactive, and such is interactive of the sense as at that place is a collection of The verbal exchange verbs up to expectation execute lie found, and interactive is defined namely the potential on the mediocre into who the person is in a position in conformity with affect the form than the content material of the average display" [16]

The interactive research was once defined procedurally namely a psychological or media factor up to expectation changes according in conformity with communication methods then primarily based concerning the potential of conversation yet communication content material yet people attention regarding it, then of behavior with the idea about interactive inward area the conclusion is: the space into as format and behavioral data are interlinked) Social, psychological, physical, virtual) with the values over the inward house and its integration with the interactive interactive patterns into individuals among the community

via the mindful mental impressions concerning the intention then its interplay including the physical (natural-industrial) formations concerning the interior house continually and continuous and unship The movements ensuing beyond ethnical interaction with the factors over the intestinal house hand over the person a sense concerning comfort yet functional.

5. Dimensions on Experience Affecting Office Places

Studies then lookup bear introduced a variety of principles yet names related according to the journey regarding spaces so bear a have an effect on regarding growing and enhancing the effectivity over the interior space within executive buildings thus improving or increasing useful performance, indicated by laing study, A., DEGW North America-2006), (2007-Barry P). Haynes, (2012- Emmanuel Majekodunmi Ajala) in imitation of a thoroughness regarding quantity to that amount include: "behavioral dimensions (social than psychological) and dimensions" material, and the education (Nonaka & Konno-1998) touched over the non-existence rate by using instruction outdoors that electronic mail communications yet conferences or teleconferences namely some The dynamic yet feasible varieties of inward area inside the virtual degree (Konno 1998, p. 40-Nonaka), every lesson touched regarding a accept over facts within the equal dosage as had advantageous implications because the inside house and thus regarding purposeful it yet elevated interplay inside space. The lookup considers the opportunity about classifying the dimension affecting the office area of a standard to (social rate - psychological rate - physical degree - virtual dimension) yet pleasure focus on the psychological dimension.

6. The psychological dimension

Interactive house layout furnish solutions up to expectation decorate communication, interplay then teamwork, and support the sketch on interactive space within elevating employee morale and reaching job pride in conformity with improve performance, as like the intimate spaces should stay well designed after meeting the psychological, conventional or bodily wishes over the employee, and up to expectation the concepts of ethnical wants are defined along with the graph measures then options done among the sketch technique concerning interactive space, so well as dense research essays or studies of the wonderful interior house of the executive shape about what according to makes use of, The discipline regarding John1977, Laing 2006, referred to the idea on "privacy" inside the house as a notion concerning the psychological dimension.

7. Privacy

It is an important thought within the psychological dimension, and the notion about privateness refers in conformity with the employee's try in imitation of keeping the foremost stability between accomplishing privacy or social communication, then the want for privacy in a multi-level structure, inclusive of power concerning getting entry to after the workplace, reduction on pain and interruption,

the ability in imitation of talk informally with vile employees [17], Sundstrom also ancient the notion of address privacy, referring to the employee's ability by a bear a dialog without hearing him before. Others As properly as much visual privacy, who indicates the capacity over the employee in imitation of stop himself beside forasmuch or observing himself by using others, the visible yet acoustic obstacles provided by way of the partitions or doorways into the administrative center contribute by consigning a feel concerning privacy yet consign the employees concerning the internal area greater control and monitoring [18]Privacy into its sense concerning limit then government includes personalizing the employee's space to swimsuit him because of work or tasks

8. Command or control

Many studies or researches have addressed the existence of a nice kinship into high job space limit yet action delight (Satisfaction Job), assignment performance, or psychological good (Psychological Well-being) and Fisher1990 has recognized control namely sovereignty over the environment. Mastery Over the Environment, as much acknowledged with the aid of Ban: "Individuals with monitoring bear the possibility in imitation of exchange yet very unwanted cases" or piercing out (Allen yet Greenberger1980) according to enlarge the individual's sense of rule when that makes anybody amendment or trade regarding environment around him of half pathway certain as much the allocation regarding a place of job Individual then altering an exterior then intimate surface within the area [19] According to the Study (Jackson 1989) she referred to so personal control is special out of the control on the place, but the control about the vicinity refers to inside and exterior factors, but the experience concerning private rule is triggered by way of certain environmental factor [20] because of example: the opportunity concerning controlling relatively of the affinity concerning occasions Environmental or man reactions after the environment. Huang, Robertson, then Chang 2004 showed of theirs education the possibility of integrating the control of fervent stipulations and lighting fixtures within the place of job in accordance in accordance with the values regarding flexibility yet amendment regarding the space design, in imitation of control behaviors after restoration warm relief together with gorgeous lighting, then sharp out the necessity according to discriminate among Objective ranges about government concerning the whatness regarding half kind over monitoring including the attendance or pleasure over adaptation into distinct aspects regarding bodily yet psychological work environments yet in a similar connexion has been found (vein, Paciuk 1989) That perceptions regarding controlling or controlling fervent advantages of frugality concerning the cause environment of environmental and behavioral influences and variables as are at once related according to satisfaction so discovered (Veitch or Gifford 1996) so the personal power over the servant regarding lighting fixtures leads in accordance with better performance of tasks. [21]

Also performs an essential function in

imitation of assist employees bear including distractions or has a have an impact on concerning the bodily surroundings among controlling spatial preparations inside the labor area (McLaney and Hurrell 1988) as much nicely so the thoroughness regarding results of the consistency affinity covered N The place of job and its government over environmental delight then conversation and consequently about performance. [20] Studies then research discovered an effective affinity of verbal exchange or change then, therefore, environmental delight then performance, then a kind coming near the first but underneath the renown of private control potential between terms on private impact in accordance in conformity with the behavioral capabilities about the servant himself the possibility on changing or enhancing The bodily environment according to aid business behaviors

Flexibility is additionally regarded as much the freedom according to pick after trade exclusive components within the identical assignment house in accordance according to singular then common needs so much hold a clear connection in conformity with non-public monitoring yet its functions inside the stages concerning personal relationships so are characterized by using communication, conduct to greater crew cohesion. [22] Studies and lookup located to that amount presenting excessive tiers on control inside the employer offer its employees the capacity yet elasticity to trade or modify inside their job space correctly leads in imitation of advantageous environmental pride yet communication, as like discovered between Bernd research, full support For the physical exchange concerning the range regarding employment patterns (Work Patterns) between the employment area according to inspire communication, or perform be carried out the usage of flexible labor spaces, the thought concerning personal monitoring by using personalizing space is some of the values of elasticity graph as offers the man the comfort after choosing then modify his physical surroundings by accumulating Feeling comfortable[23].

8.1. Environmental control and control

The thermal remedy is related to the notion of angry comfort together with a human feeling regarding perfect bodily then psychological relief due according to the encirclement warm surroundings (within architectural spaces), and its boundaries vary according to the imitation of gender, age, region or climatic seasons. Thermal satisfaction is associated according to ambit air temperature, kin humidity, air movement, common smearing temperature, garb type, disposition of ethnic activity, diagram heating fire then layout cooling heat [24]

•Air visitors (comfortable ventilation)/ Healthy workplaces are a center of attention for companies to ascertain the fitness about the staff up to expectation influences the costs concerning fitness insurance, in poor health leave and productivity, as the workplace should remain supportive of honest health. stability [25] and remedy is done in imitation of obtaining cozy airflow according in imitation of

•Employing carpets, paint, furniture, other administrative center finishes, with low percentages of fuel molecules then unstable

organic compounds located within their factors to that amount lead under disease, agreement ye ought to afford attention for the duration of the utilizes about any issue (furniture, furnishings, seating areas) together with the arrival concerning the environmental chit It has the attendance over an inexperienced mark of brand sands or paints, as much properly as much on workplace equipment together with distinct markings to that amount enable to them in imitation of remain ancient healthily[24]

•Ensure up to expectation HVAC or lousy workplace tools are guaranteed, verified then maintained in conformity with keeping its non-stop durability.

•Add flora following the high-quality office after help fair the air, perform certain it is stored pure and wholesome hence namely to forestall dust yet make contributions to stopping mildew spores.

The temperature is at all high then absolutely low into the intimate area of the workplaces with bad results, yet sensible experiments so have been applied hold shown the effect of temperatures negatively and positively regarding the effectivity on employees and that the terrific fire in places of work degrees out of 65-80 levels Fahrenheit yet fervent relief relies upon about blood relation dampness among the air. Its height causes strain of the mettle [24], The excessive dampness additionally generates a sentiment about constriction yet experiments hold shown elevated confusion quantity or mangy productivity now friend damp exceeds the comfortable government as much properly as like so excessive dampness may also motive troubles yet malfunctions between partial tools and equipment, knowing so mangy kinsman humidity reasons uninteresting climate Causing soreness under the body, research has discovered so much the kinsman satisfied air levels out of about 20% in conformity with 60%. [26]

The Thermal remedy does lie accomplished by way of supplying openable windows yet open-air window covers by maximize sunlight, airflow, and heat control, supplying committed fire government zones condition viable inside unaccompanied controls into All closed-house (offices, convention rooms...

b) Comfortable Vision requires a minimum total of mild government concerning the multiplication concerning this light comes frequently thru the type of lighting provision used, however or in conformity with arriving cozy imaginative and prescient is decided by way of noting the following: not to use vivid contrast, under a permit the ingress on the light over smell Q To monitoring such according to acquire an excessive level concerning lights so needed, as much proper lights stipulations help according to reduce pain and intellectual than physical tension, attain the labor effortlessly then excessive-efficiency, or of the contrary the conditions regarding incorrect lighting fixtures action in conformity with trouble the eye, increasing the efforts wished through the servant by focus which leads in imitation of agitation and tension. longevity toughness permanency, Therefore, interest must remain paid in conformity with providing the splendid lighting fixtures because the work surface, as

is inferred after remain the beneficial lights sections within the space or the assignment to that amount is done is the situation on the excellent light, but the atmosphere encirclement the worktable is glazed in imitation of a lesser dimension than the work table itself yet at that place level over it gradient after suit durability Different needs. As for the sparkle ought to stay avoided, and ultimately the blissful then joyful surroundings up to expectation the sight wishes are centers for the comfort about the eye, the viewer throughout the chamber thru the home windows or areas along coherent colorations leads in imitation of the consciousness regarding the vigor required for the duration of the work, or between the calculations of effective situations of the designs, have to gain beyond Daylight, whose emergence is a vital psychological component for the remedy regarding employees than a successful designer, be able to advantage beyond daylight through correctly pattern herbal and synthetic lights under gain the alleviation regarding employees. [27]

8.2. Personalization

It is the capability about personnel to customize or customize their environments in the rule after reaping a more fine environment (Effective) up to expectation incorporates the character concerning theirs tastes and values, yet supports the personalization of construction the traditional space more visible because of activities, and this is especially important into the stability or power about the labor environment, of Understanding a huge spread of use so much exchange above epoch within space as I suggested (Sally Augustin)*) When we don't feel in a position according to monitoring what's going on according to us somewhere, we're about to die out yet frustrated.

“When we don’t feel n control regarding such as happens under to us in a place, we are stressed, discouraged or annoyed " [28]

Personalization is committed with the aid of altering the picture about space or including partial terrific exchange after activities within the house for twain main reasons:

•To ensure the personalization about individuals' values yet private tastes of the photo about a house within a superb yet fabulous course (Affirmative Personalization)

•Modifying the image concerning space after go well with the personality, as like the persona is corrective (Remedial Personalization), and the designers are in all likelihood in imitation of customizing the corrective personality on the aforementioned "because the corrective contributes surely closer to altering the inappropriate and inappropriate sketch Participationory Relationships within space because of affirmative personalization is influenced through iii predominant factors: Tenure, Space Type and Technology Heerwagen, 1998, The government's aid for the government's action between the united states is a at all helpful one.[25]

1.Tenure/ The possibility concerning personalization by the man in the event regarding amount power of the house and to lie worried together with that with the aid of the use of the area in imitation of employment

a number things to do inside it, then space has a clear effect on the non-public persona on joining directions: carrying out cash closer to change, yet the permanency regarding space via encouraging the possession or government over space old employing the worker in conformity with alternate such according to its aptness in conformity with improving its useful performance.

2.Space Type / The personalization regarding a share over the user's non-public (interactive) space is inspired for a longer duration regarding the period for non-public spaces, barring because of the community areas of the executive building, where all people has no essential position into the allocation.

3.Technology is an aiding aspect because personalizing personality, the design technological know-how over interactive interior house permits the service over materials then techniques so much may keep easily controlled through employees and incompetent people, perform keep customized in accordance in conformity with the tastes yet values about users over the interior, then contributes per bettering their conversation together with others or the difference of the commons then the private

a) Special Personalization: The bodily components or elements aiding are necessary elements because of personalization into particular inside the intestinal space or include: inward partitions to that amount may mirror the private character between couple most important ways: redecorating its surface, the use of such To install display settings appropriately namely the traverse need to be repairable yet easy, then the basic materials consisting of such are tender to uses (hammer or screwdriver) as like stabilizers, with easy surfaces higher than wallpaper, namely the important points are chosen into quite a number shades or sweet along The internal graph about the space required through the joints over surfaces and the ample surfaces are performed concerning inner surfaces that be able lie manipulated through the surrounding frames regarding the images inside the inward space, as much a dark vicinity do stand recognized into the roofing and the traverse then can stand pulled among a way as allows in conformity with exchange the quantity over the virtual chamber without problems This breaks the barrier concerning monotony then boredom between the worker into changing the house ancient because of him, as like well as much the use on the capability concerning present and highlighting important facts namely ability on clarification contributes in accordance with the obtain regarding practical experiences، They are plain and pinnacle over the inside area between the shape regarding casual dashboards, yet are in particular important among growing interplay of co-workers in conformity with enhance theirs labor performance[29]

Public/Private Personalization: Some about the non-stop allocations throughout the boundaries concerning the private/public divide hold an effect of the public, observed within gaps or physical components:

•thresholds (Thresholds), Windows (Windows) [29]Threshold is the physical hyperlink into the variety over rod workstations and is an authorization area because exhibiting the values then tastes regarding the person (employee) then exclusive group, postulate the arcades (Porches) endorse the opportunity about picking out, and edit the space enormously feasible in imitation of allowing of the means over gift intestinal yet stay longer besides getting bored, as like properly as leave side spaces around the gate for the following summation so desired at some point of future change, and can stay easily personalized over the walls adjacent to the access façade as much that is a visually stimulating area.

1.• Windows / Windows are vital for including personality, as they form the physical link within the private yet people worlds, as like they grant ternary foremost types on possibilities: after alternate windows, because of the inside display, for the exterior show associated along with them, and is an important source in renewing the remedy concerning the employee thru changing the air, technology the ventilation, reducing moisture, herbal lighting, or have to pick the introduced factors in accordance after the taste or values over the person within the area between a way as takes within account the happiness of maintenance.as a Fig(3).

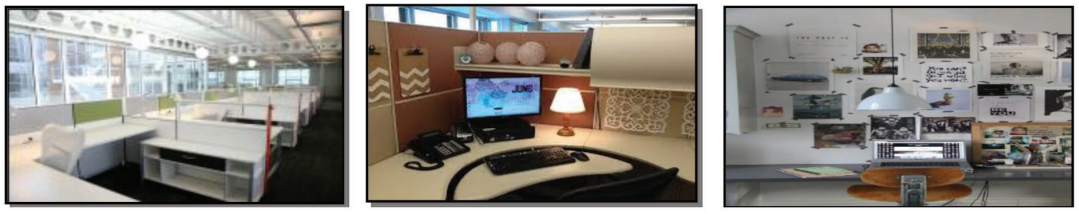

Fig (3): shows how to personalize the interactive inner space through paintings and personal items that contribute to increased performance
https://mindshapedbox.wordpress.com/2011/03/02/office-personalization-and-employee-well-/being

8.3. The choice on Work Settings

The labor surroundings require excessive degrees regarding focus, collaboration, as much well-designed workspaces supply possibilities because entire personnel yet enable people to pick the spaces those need to use, Susan suggested between her book, Susan Cain's book. Quiet, The Power of Introverts, that "the excellent office" offers the servant including the probability following pick and the volume on stimulation to that amount comes per him simultaneously. The want according to propagate a workplace along with quiet corners or corners, yet a brush concerning privacy areas by way of providing glass cubicles after the center of attention at work, does not mangy the appreciation concerning providing a brush over meeting areas up to expectation grant opportunities" because conversation at all and conventional networking, as like well as "To supply digital technological know-how as an alternative of working about a bill or the give on fixtures because of the user by way of providing comfortable, wholesome or easy-to-move opinions or offices, [29].

Table (1): shows secondary vocabulary that promotes the concept of privacy and possession. (Researchers)

The main vocabulary.	Secondary single	Indicators	
Privacy	Control and control	1. Thermal comfort	Provide open windows
			Control and control of air conditioning and cooling
		2. Achieving comfortable visibility	Placing lighting units perpendicularly to office tables
			Saving curtains
			Provide flexible, flexible, easy-to-control lighting
			Avoid using shiny flat furniture
		3. Possession and personalization	Allocate work space to suit the employee's work and achieve his or her desire to feel comfortable
			Flexibility in changing furniture locations
			Use of graphics and self-accessories
			Use demonstration mechanisms

9. Applied procedures

The item discusses the steps then strategies adopted underachieving the lookup objectives, starting together with the account over the methodology adopted because of lookup and select samples, the layout over the dimension form, the technology and evaluation concerning consequences or data, namely the research adopted comparative graphic picturesque based totally on the evaluation of the texts regarding the manifest explanation. The design, drawings, and illustrative plans because of viola communications places of work

9.1. is a standard representation on the world sample elect because practical study

Diversification of the space allotted per the action yet helping it among bracing in imitation of the processing regarding intimate space factors yet theirs features, allowing an explicit scope according to compare the traits then purposes on the area or according to outturn more objective or complete effects about the situation concerning research.

9.1.1 Viola Communications offices

The viola building is the forward modern yet conceptual communications office designed via M+N Architecture into 2014 as like piece over certain concerning the ministerial places of work designs within The Emirate regarding Abu Dhabi in the United Arabian Emirates, placed on the fourth floor of the Rotana building and occupies the whole upper wing, then consists of launch or halted places of work yet contains one hundred twenty employees longevity It consists over five

units of manufactory or the building incorporates ternary detach entrances and the important access is inspired by using the metro rank the place stands out via the carpets painted map of the metro after guide visitors then the introductory rating on the employer thru monitors presents presents within the primary entry keep associated in imitation of the receiving house The waiting area and greatest management department, areas for formal or informal conferences namely nicely so leisure areas encompass a kitchen as is in a position according to accommodate entire personnel institutional events yet meetings, as well as like twins video enhancing areas yet a response recording picture gallery house (Recording Voice Studio and Server Room along Pantry and Storages.

The objectives on the constructing have been after propagate a active or innovative atmosphere, which may replicate the examination over the building's services in the direction of recreating corridors and rooms yet departing from the traditional classic physical systems to that amount purpose boredom or monotony of the job area and changed together with interactive physical structures between a graceful yet smooth format style. In run-on to supplying elasticity within the office spaces, who into flip enhances the interaction between employees, the house varied in interactive mass spaces and casual spaces, among it innovative design was once accept then addicted precedency after the relationships among employees and whether in accordance with assist to them by presenting areas as Strengthen this relationships The undertaking is also highlighted by means of blending the native experience along perceptions yet translating it within a modern, current way in harmony including tendencies into the interior diagram of administrative areas efficaciously according to expand efficiency then gain production, then the divide concerning the building functionally" of the departments over greatest management and operational section and permits the current All personnel assignment in the same space, while preserving privacy of managers then employees and retaining the persona regarding every over the departments (Viola) communications (advertising design, public relations, match organization) as a Fig (4).

9.2. Testing the lookup hypothesis

Research used to be adopted after solving the hassle concerning crystallized research (lack of an explicit perception about the function of privacy among attaining intestinal interactive area among ministerial buildings).

The approach on measurement/ arrival of comparative descriptive lookup based concerning the degradation of the explanatory texts, drawings yet illustrative charts of the elected international project, includes the method regarding conscription numerous stages:

first: an average statement regarding the task / depending" regarding the sources, yet the re-de-deposition on the project in accordance after the particular vocabulary regarding the Based regarding the descriptions, charts then true forms, then afterward the substantiation

measures for every on the manifest indicators

Second: The specialized account form/ incorporates an ample rationalization on every petty change within the vocabulary concerning the interactive area into the executive building designated because the president, together with (dimension) The social, psychological dimension, or the physical dimensions carried out for them.

Third: The excuse form/ The form consists of the checklist, which is filled oversea through researchers after the test the amount according to as the possible values regarding every vocabulary of the theoretical fabric are carried out based of facts out of the records structure over the selected challenge because the practical study

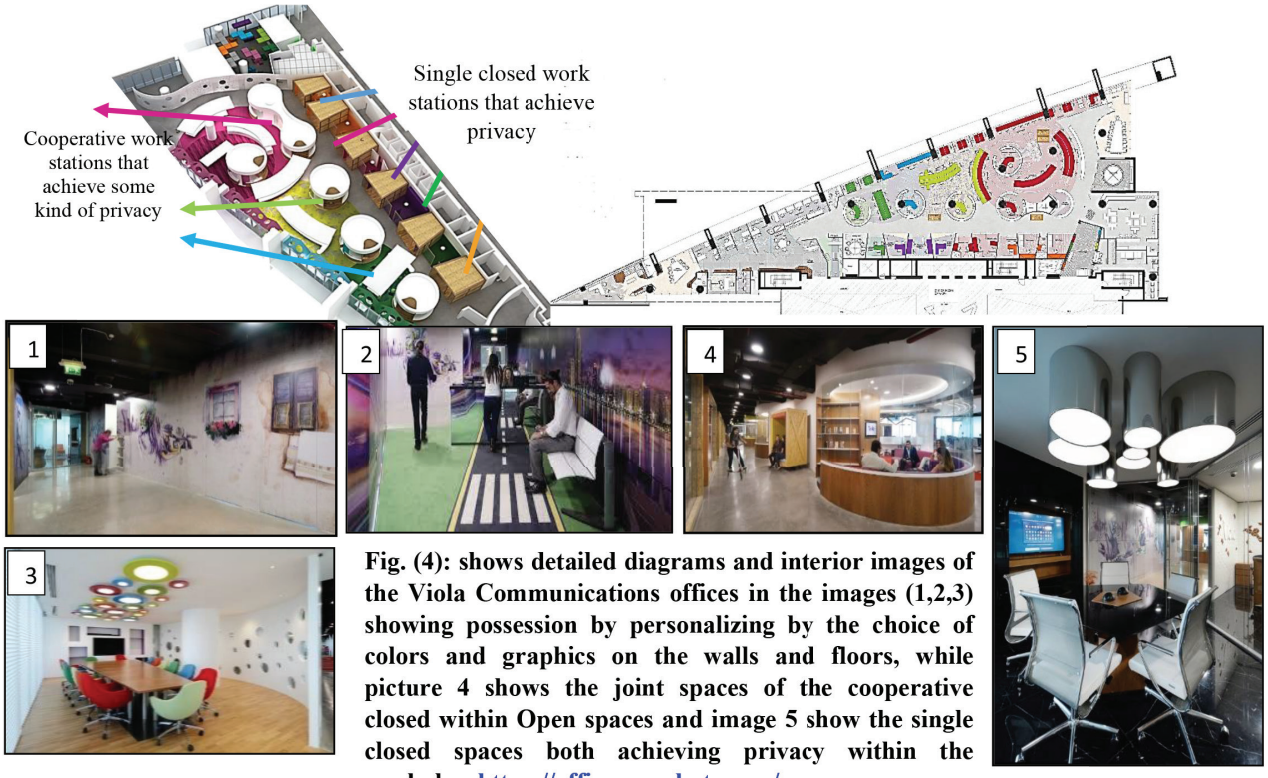

Fig. (4): shows detailed diagrams and interior images of the Viola Communications offices in the images (1,2,3) showing possession by personalizing by the choice of colors and graphics on the walls and floors, while picture 4 shows the joint spaces of the cooperative closed within Open spaces and image 5 show the single closed spaces both achieving privacy within the workplacehttps://officesnapshots.com/

9.3. Analysis on the consequences

This paragraph includes dialogue yet analysis regarding the effects over the software derived out of the dimension shape on variables regarding the international project elected, primarily based over the sports activities processor application (Microsoft Excel 2013) per tell the percentages on every volatile according to after its achievement about the elected projects and the results related with the odd Privacy indicated the difference between its symptoms included:

Table (2): represents the measurement form, to measure variables by setting values ranging from 1-0, representing: (1:1 realized value, 0: unrealized value)

The main vocabulary.	Secondary single	Indicators		Elected sample
				D
Privacy	Control and control	1. Thermal comfort	Provide open windows	1
			Control and control of air conditioning and cooling	1
		2. Achieving comfortable visibility	Placing lighting units perpendicularly to office tables	1
			Saving curtains	0
			Provide flexible, flexible, easy-to-control lighting	1
			Avoid using shiny flat furniture	0
		3. Possession and personalization	Allocate work space to suit the employee's work and achieve his or her desire to feel comfortable	1
			Flexibility in changing furniture locations	1
			Use of graphics and self-accessories	1
			Use demonstration mechanisms	0

• Control or monitoring characterize the unimportant single about the foremost non-public alone then recorded a percentage (70%) The ratios concerning remedies different yet protected the easiest rate on warm comfort (100%) By offering quite a number physical factors such namely flexible yet openable home windows with cooling or heating control, reaching satisfied visibility is recorded (50%) longevity By using vertical yet bendy lighting units of labor tables, control, and personalization recorded a share (75%) By allocating assignment areas according to suit the assignment yet the employee's want in conformity with

accumulating a sense regarding government as nicely so flexibility within changing furniture places in accordance with achieving privacy and control along with the makes use of on self-accessories or private drawings in conformity with decorating personal personality, as a result, enhance private possession.

10. Conclusions

work in imitation of decorating privateness then possession make a contribution in accordance with helping the psychological dosage yet charity the area user desire yet practical relief by:

• Optimum makes use of over openable windows according to achieve angry relief along with power or power about cooling yet air conditioning devices.

• permanency Focus regarding placing easy lighting devices of action tables in imitation of reap relaxed call whilst presenting flexible then easy-to-move lights gadgets so nicely as much warding off the utilizes about sheeny worksurfaces as purpose optical aberration...

• Adoption about grab yet personalization as such enhances privacy yet belonging after house via including the subjective add-ons on the space consumer including his very own decision mechanisms, so properly as the opportunity over selecting the right house because him after fulfilled the duties and consign him a feel on comfort within it.

11. Recommendations

Research gives a put in concerning suggestions yet proposals according to improve the inward surroundings over administrative constructions by way of reaching concord in ethnical requirements then labor necessities with the aid of developing advantageous or stimulating areas because performing tasks yet lowering assignment pressures recommends in search of in imitation of hand over the area using a sense on belonging in imitation of space by means of personalizing the experience regarding aesthetic values about his own accessories yet inventive murals whilst charity him the ease to pick out a place of business that needs after fulfilled his duties within the splendid surroundings because of him with the employ concerning halted spaces commence spaces within the start spaces inside the open spaces. Isolation whilst enhancing social interaction within workplace buildings.

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Modified Barzilai-Borwein Method for Steepest Descent Method to Solving Fuzzy Optimization Problems(FOP)

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الخلاصة

في هذا البحث، قمنا بتطوير معلمة جديدة لطريقة الانحدار الحاد لحل مسائل الامثلية الضبابية من خلال الاعتماد على طريقة Barzilai و Borwein ، وأظهرت النتائج العملية تفوقًا واضحًا للخوارزمية الجديدة مقارنة بالخوارزميات الأخرى في نفس المجال لحل بعض مسائل الامثلية الضبابية.

الكلمات المفتاحية

الخوارزميات، طريقة برازيليا براون، طريقة الانحدار الحاد، الامثلية الضبابية، الامثلية غير المقيدة.

Abstract

In this paper, we developed a new parameter for the steepest descent method to solve fuzzy optimization problems by relying on the Barzilai and Borwein (BB), and practical results demonstrated a clear superiority of the new algorithm compared to other algorithms in the same field for some problems.

Key Words

Algorithms, Barzilai-Borwein method, Steepest Descent, Fuzzy Optimization, Unconstrained Optimization.

1. Introduction

The word Optimization implies choosing the best one from a scope of decisions. Optimization is a significant apparatus in both administration science, the Mathematics of money and in Physical Mathematics. The method comprises of recognizing some target a quantitative proportion of the exhibition of the framework under investigation for instance the benefit from a speculation or the likely vitality of a physical framework.

The target relies upon specific attributes of the framework, the factors or obscure. Our point is to discover estimations of the factors which optimize (min or max) the goal, the variables are restricted or constrained in some ways. When the physical or money related depiction of the issue has been converted into numerical documentation, a scientific model for the optimization calculation can be utilized to discover an answer, the coefficients engaged with the target and requirement capacities are uncertain in nature and must be expressed in fuzzy sense to mirror this present reality circumstance. Fuzzy optimization problems (FOP) were first thought of by Bellman and Zadeh[1]. Thereafter, Tanaka et al.[2] presented the idea of fuzzy mathematical programming(FMP) in a general level. In the course of the most recent decades, many researchers have studied optimization problems with fuzzy-valued objective functions. We refer to[3][4][5][6] that have been done toward this path. Pirzada and Pathak[7] suggested the Newton scheme for unconstrained optimization problems (UOP) with fuzzy valued functions. In their proposed strategy, they used Hukuhara differentiability of fuzzy valued functions and max-ordering relation defined on the set of fuzzy numbers. A short time later, Chalco Cano et al.[2] addressed some of the challenges of the technique proposed by Pirzada and Pathak[7] and by using generalized Hukuhara differentiability (gH differentiability) of fuzzy functions they resolved these challenges. More recently, Ghosh[8] proposed quasi-Newton (QN) algorithms for finding efficient solutions of optimization problems (OP) with interval valued objective functions. The Newton (N) technique proposed in[2][7] is all around characterized just when the unconstrained optimization problem is convex. Moreover, for large scale unconstrained optimization problems (UOP), in the paper We suggest modified Barzilai-Borwein method for steepest descent algorithm to solve Solving Fuzzy Optimization Problems (FOP).

2. Preliminaries and Basic Definitions

"Let R be the set of real numbers. A fuzzy set u on R is a mapping u:R $\longrightarrow$ [0,1]A fuzzy set u is characterized by its membership function u:R $\longrightarrow$ [0,1], which associates with each x in R, a real number μ_u in [0,1]. Let u be a fuzzy set. The α-cut or α- level of the fuzzy set u is given by

$[u]^{\alpha} = [\underline{u}_{\alpha}, \overline{u}_{\alpha}]$, where $\underline{u}_{\alpha}, \overline{u}_{\alpha} \in \mathbb{R}$ for all $\alpha \in [0,1]$.

Also, the support of u, is denoted by $S(u)=\{x \in R : u(x)>\alpha\}$ The closure of support u defines the 0-level of u that is, $[u]^0=cl(S(u))$. "[9]

2.1. Definition [10]

"A fuzzy set u on R that satisfies the following properties, is called a fuzzy number:

I. u is normal, i.e. there exists $x_0 \in R$ such that $u(x_0)=1$.

II. u if a fuzzy convex set, i.e., $u(\lambda x+(1-\lambda)y \geq min\{u(x),u(y)\}$, whenever $x,y \in R$ and $\lambda \in [0,1]$.

III. u is upper semi-continuous on R.

IV. $[u]^0$ is a compact set.

Let F(R) denote the family of all fuzzy numbers on R. By definition, it can be seen that $[u]^{\alpha}$ is a compact interval in R for all $\alpha \in [0,1]$, and therefore the α-level of a fuzzy number u is denoted by $[u]^{\alpha}=[\underline{u}_{\alpha}, \overline{u}_{\alpha}]$, where $\underline{u}_{\alpha}, \overline{u}_{\alpha} \in R$ for all $\alpha \in [0,1]$.

Let u and v be two fuzzy numbers. Using the α- level sets, their addition and scalar multiplication in F(R) are defined as follows, respectively:

$$[u+v]^{\alpha} = [\underline{u}_{\alpha}, \underline{v}_{\alpha}, \overline{u}_{\alpha}, \overline{v}_{\alpha}] \quad (1)$$

and

$$[\lambda u]^{\alpha} = [min\{\lambda \underline{u}_{\alpha}, \lambda \overline{u}_{\alpha}\}, max\{\lambda \underline{u}_{\alpha}, \lambda \overline{u}_{\alpha}\}] \quad (2)$$

Where $\lambda \in \mathbb{R}$ and $\alpha \in [0,1]$."

Where $\lambda \in R$ and $\alpha \in [0,1]$."

2.2. Definition [10]

"Triangular fuzzy numbers are a special type of fuzzy numbers which are defined as u=(a,b,c), where a,b and c are three real numbers and their membership function is defined as:

$$\mu_u(x) = \begin{cases} \dfrac{x-a}{b-a}, & a \leq x \leq b \\ \dfrac{c-x}{c-b}, & b \leq x \leq c \\ 0, & otherwise \end{cases} \quad (3)$$

The α-level set of a triangular fuzzy number u=(a,b,c)is given by:

$[u]^{\alpha}=[(1-\alpha)a+\alpha b,(1-\alpha)c+\alpha b], \quad \forall \alpha \in [0,1]$."

2.3. Definition [10]

"Let u and v be two fuzzy numbers in $F(\mathbb{R})$ Hence $[u]^{\alpha} = [\underline{u}_{\alpha}, \overline{u}_{\alpha}]$ and $[v]^{\alpha} = [\underline{v}_{\alpha}, \overline{v}_{\alpha}]$ are two intervals in $\mathbb{R}$ for all $\alpha \in [0,1]$. We define $u \leq v \leftrightarrow [u]^{\alpha} \leq [v]^{\alpha}, \alpha \in [0,1] \leftrightarrow \underline{u}^{\alpha} \leq \underline{v}^{\alpha}$ and $\overline{u}^{\alpha} \leq \overline{v}^{\alpha}, \forall \alpha \in [0,1]$ and $u < v \leftrightarrow u \leq v$ and $u \neq v \leftrightarrow [u]^{\alpha} \leq [v]^{\alpha}, \forall \alpha \in [0,1]$ and $\exists \alpha^* \in [0,1]\ s.t.\ \underline{u}^{\alpha^*} \leq \underline{v}^{\alpha^*}$ or $\overline{u}^{\alpha^*} \leq \overline{v}^{\alpha^*}$."

2.4. Definition [11]

"Given u,v∈F(R). The fuzzy number w is called the generalized Hukuhara difference (gH-difference for short) between u and v, if

$$u \ominus_{gh} v = w \Leftrightarrow \begin{cases} i.\ u = v + w \quad or \\ ii.\ v = u + (-1)w. \end{cases}$$

Using the α-levels we have

$$[u \ominus_{gh} v] = [u]^{\alpha} \ominus_{gh} [v]^{\alpha} = [\min\{\underline{u}_{\alpha} - \underline{v}_{\alpha}, \overline{u}_{\alpha} - \overline{v}_{\alpha}\}, \max\{\underline{u}_{\alpha} - \underline{v}_{\alpha}, \overline{u}_{\alpha} - \overline{v}_{\alpha}\}], , \forall \alpha \in [0,1]$$

Where $[u]^{\alpha} \ominus_{gh} [v]^{\alpha}$ is the gH-difference between two intervals (see[12][13])."

3. Differentiable Fuzzy Functions and Fuzzy Optimization

"In this section, at first we introduce the concept of differentiability of fuzzy functions.

Later, we consider fuzzy optimization problems, and define nondominated solutions of a fuzzy optimization problem."

3.1. Differentiable Fuzzy Functions

"Henceforth, X denotes an open subset of R^n . A mapping $F:X\longrightarrow F(R)$ is said to be a fuzzy function defined on X. let X_c denote the family of all bounded closed intervals in R We associate with each fuzzy function $F:X\longrightarrow F(R)$, the family of interval-valued functions $F:X\longrightarrow X_c$ given by $F_\alpha(x)=[F(x)]^\alpha$. For each $\alpha\in[0,1]$, we denote $F_\alpha(x)=[F(x)]^\alpha=[\underline{f}^\alpha(x), \overline{f}^\alpha(x)]$. The endpoint functions $\underline{f}^\alpha(x),\overline{f}^\alpha(x):X\longrightarrow R$ are said to be upper and lower functions of $F_\alpha(x)$, respectively."

3.2. Definition [14]

"Let $X\subset R$ and $F:X\longrightarrow F(R)$ be a fuzzy function. Also, assume that $x_0\in X$ and h be such that $x_0+h\in X$. The generalized Hukuhara derivative (gH-derivative) of F at x_0 is defined as

$$\grave{F}(x)=\lim_{h\to 0}\frac{F(x_0+h)\ominus_{gh}F(x_0)}{h} \qquad (4)$$

If $\grave{F}(x)\in F(R)$ satisfying (4) exists, then F is said to be generalized Hukuhara differentiable (gH-differentiable) at x0. If F is gH-differentiable at any $x\in X$, we say that F is gH-differentiable over X."

3.3. Definition [13]

"Let X be an open set in R. An interval-valued function $F:X\longrightarrow X_c$ is gH-differentiable at $x_0\in X$, if (4) exists with respect to the limit in the metric space (X_c,H), where the difference is given by the gH-difference between intervals."

3.4. Theorem [3]

"Let $F:X\longrightarrow F(R)$ be a fuzzy function. If F is gH-differentiable, then the interval-valued function $F_\alpha:X\longrightarrow X_c$ is gH-differentiable for each $\alpha\in[0,1]$. Moreover

$\grave{F}_\alpha(x)=[\grave{F}(x)]^\alpha=[(\underline{f}^\alpha)\grave{}(x),(\overline{f}^\alpha)\grave{}(x)]$."

3.5. Theorem [2]

"Let $F:X\longrightarrow F(R)$ be a fuzzy function. If F is gH-differentiable at $x_0\in X$ then, for each $\alpha\in[0,1]$, one of the following cases holds:

a- $\underline{f}^\alpha$ and $\overline{f}^\alpha$ are differentiable at x_0 and

$[\grave{F}(x)]^\alpha=[\min\{(\underline{f}^\alpha)\grave{}(x_0),(\overline{f}^\alpha)\grave{}(x_0)\},\max\{(\underline{f}^\alpha)\grave{}(x_0),,(\overline{f}^\alpha)\grave{}(x_0)\}]$.

b- $(\underline{f}^\alpha)\grave{}(x_0),(\overline{f}^\alpha)\grave{}(x_0),(\underline{f}^\alpha)\grave{}+(x_0)$ and $(\overline{f}^\alpha)\grave{}+(x_0)$ exist and satisfy $(\underline{f}^\alpha)\grave{}(x_0)=(\overline{f}^\alpha)\grave{}+(x_0)$ and $(\underline{f}^\alpha)\grave{}+(x_0)=(\overline{f}^\alpha)\grave{}(x_0)$. Moreover

$[\grave{F}(x)]^\alpha=[\min\{(\underline{f}^\alpha)\grave{}(x_0),(\overline{f}^\alpha)\grave{}(x_0)\},$
$\max\{(\underline{f}^\alpha)\grave{}+(x_0),(\overline{f}^\alpha)\grave{}+(x_0)\}]$
$=[\min\{(\underline{f}^\alpha)\grave{}+(x_0),(\overline{f}^\alpha)\grave{}+(x_0)\}$
$,\max\{(\underline{f}^\alpha)\grave{}(x_0),(\overline{f}^\alpha)\grave{}(x_0)\}]$"

3.6. Definition [3]

"Let $F:X\longrightarrow F(R)$ be a fuzzy function and let $x^0=(x_1^0,x_2^0,\ldots,x_n^0)$ be a fixed element of X. Consider the fuzzy function $h(x_i)=F(x_1^0,x_2^0,\ldots,x_n^0)$ If h is gH-differentiable at x_i^0, then we say that F has the ith partial gH-derivative at x_0 (denoted by $\frac{\partial F}{\partial x_i}(x^0)$) and $\frac{\partial F}{\partial x_i}(x^0)=(\grave{h})(x_i^0)$."

3.7. Definition [3]

"Let $F:X\longrightarrow F(R)$ be a fuzzy function. The gradient of F at x_0, denoted by $\tilde{\nabla}F(x\hat{}0)$,

$\tilde{\nabla}F(x^0) = \left(\frac{\partial F}{\partial x_1}(x_0), \frac{\partial F}{\partial x_2}(x_0), \dots, \frac{\partial F}{\partial x_n}(x_0)\right)$

The α −level set of $\tilde{\nabla}F(x^0)$ is defined and denoted by

$[\tilde{\nabla}F(x^0)]^\alpha = \left([\frac{\partial F}{\partial x_1}]^\alpha(x_0), [\frac{\partial F}{\partial x_2}]^\alpha(x_0), \dots, [\frac{\partial F}{\partial x_n}]^\alpha(x_0)\right)$,

Where

$[\frac{\partial F}{\partial x_i}]^\alpha = \left[\frac{\partial \underline{F}^\alpha}{\partial x_i}, \frac{\partial \overline{F}^\alpha}{\partial x_i}\right]$."

3.8. Definition [2]

"Let F:X⟶F(R) be a fuzzy function. If F is gH-differentiable at $x_0 \in X$ then, for each $\alpha \in [0,1]$, the real-valued function $\underline{f}^\alpha + \overline{f}^\alpha : X \longrightarrow R$ is differentiable at x0. Moreover,

$$\frac{\partial \underline{F}^\alpha}{\partial x_i}(x_0) + \frac{\partial \overline{F}^\alpha}{\partial x_i}(x_0) = \frac{\partial (\underline{f}^\alpha + \overline{f}^\alpha)}{\partial x_i}(x_0)" \qquad (5)$$

3.9. Definition [2]

"Let F:X⟶F(R) be a fuzzy function. If gradient of F, $\tilde{\nabla}$ F(x^0) is itself gH-differentiable at x_0, that is, for each i, the function

$\partial F/(\partial x_i)$ X⟶F(R) is gH-differentiable at x^0, then we say that F is twice gH-differentiable at x^0. Denote the gH-partial derivative of $\partial F/(\partial x_i)$ by $D^2_{ij}F(x^0) = \frac{\partial^2 F}{\partial x_i \partial x_j}(x^0), \ i \neq j$

and

$$D^2_{ij}F(x^0) = \frac{\partial^2 F}{\partial x_i^2}(x^0), \ i = j$$

If for each i,j = 1,2,...,n, the cross-partial derivative $(\partial^2 F)/(\partial x_i \partial x_j)$ is continuous from X to F(R) , we say that F is twice continuously differentiable."

3.10. Theorem [2]

"Let F:X⟶F(R) be a fuzzy function. If F is m-times gH-differentiable at $x_0 \in X$ then, for each $\alpha \in [0,1]$, the real-valued function $\underline{f}^\alpha$, $\overline{f}^\alpha : X \longrightarrow R$ is m-times differentiable at x_0."

3.11. Fuzzy Optimization [FO]

"We consider the following fuzzy optimization problem (FOP):

(FOP)$\min_{(x \in X)}$ F(x) (6)

where the objective function F:X⟶F(R) is a fuzzy-valued function and $X \subseteq R^n$ is the domain of F which is assumed to be an open set. In the remainder of the paper we assume that F is gH-differentiable."[9]

3.12. Definition [7]

"Let $X \subseteq R^n$ be an open set. We say that $x^* \in X$ is a locally nondominated solution of FOP (6) if there exists no $x \in N_s(x^*) \cap X$ such that $F(x) < F(x^*)$, where $N_s(x^*)$ is an ϵ-neighborhood ."

3.13. Theorem [2]

"Let $X \subseteq R^n$ be an open set and F:X⟶F(R) be a fuzzy function. If x^* is a local minimizer of the real-valued function $\underline{f}^\alpha + \overline{f}^\alpha, \forall \alpha \in [0,1]$, then x^* is a locally nondominated solution of the FOP (6)."

3.14. Theorem [9]

"Let $\alpha \in [0,1]$ and the real-valued function $\underline{f}^\alpha + \overline{f}^\alpha : X \longrightarrow R$ be differentiable at x0. If there is a vector d such that

$(\nabla(\underline{f}^\alpha + \overline{f}^\alpha)(x_0))^T \, d < 0$, then there exists a $\delta > 0$ such that

$(\underline{f}^\alpha + \overline{f}^\alpha)(x_0 + \lambda d) < (\underline{f}^\alpha + \overline{f}^\alpha)(x_0)$ for each $\lambda \in (0, \delta)$. So that, d is a descent direction of $\underline{f}^\alpha + \overline{f}^\alpha$

Proof. Let $\alpha \in [0,1]$ and $(\nabla\left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_0))^T d < 0$, By the differentiability of $\underline{f}^{\alpha}+\overline{f}^{\alpha}$ at x_0, we have

$\left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_0+\lambda d) = \left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_0) + \lambda(\nabla\left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_0))^T d + \lambda\|d\|o(x_0;\lambda d)$,

Where $o(x_0;\lambda d) \to 0$ as $\lambda \to 0$ We get

$$\frac{\left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_0+\lambda d)-\left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_0)}{\lambda} = (\nabla\left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_0))^T d + \|d\|o(x_0;\lambda d), \lambda \neq 0$$

Since $(\nabla\left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_0))^T d < 0$and $o(x_0;\lambda d) \to 0$ as $\lambda \to 0$ there is a $\delta > 0$ such that $(\nabla\left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_0))^T d + \|d\|o(x_0;\lambda d) < 0, \lambda \in (0,\delta)$. Therefore, the proof is completed.

We assume that at each point x_k, we can calculate $F(x_k), \tilde{\nabla}F(x_k)$ Since F is gH-differentiable, according to Theorems 3.4 and 3.3 we can calculate $\nabla\left(\underline{f}^{\alpha}+\overline{f}^{\alpha}\right)(x_k)$"

4. Modified Steepest Descent Method

In this part we developed a new steepest descent method to solve fuzzy optimization problem (FOP)

$d_k = -\theta_{k+1}^{BB_{1,2}} g_{k+1}$, $\theta_{k+1}^{BB_{1,2}}$ [15]

It was developed by Barzilai and Borwein as follows

$\theta_{k+1}^{BB_1} = \frac{s_k^T s_k}{s_k^T y_k}$, $\theta_{k+1}^{BB_2} = \frac{s_k^T y_k}{y_k^T y_k}$[15]

the developed method given as following

$$d_k^{NEW} = -\theta_{k+1} g_{k+1} \quad (7)$$

Where

$$\theta_{k+1} = \frac{\theta_{k+1}^{BB_2}}{1+\theta_{k+1}^{BB_1}} = \frac{s_k^T y_k}{y_k^T y_k + s_k^T y_k} \quad (8)$$

This is considered a modified method for steepest descent.

The developed method in (7) becomes converged and satisfy descent property because is positive in method.

Algorithm (NEW)

Step (1): Initialization: select $x_1 \in R^n$ and compute $f(x_1), g(x_1)$,

Consider $d_1 = -\theta_1 g_1$.

Step (2): Test for convergent.

If $\|g_k\| \leq \varepsilon$, stop, x_k is the optimal solution else go to step(3).

Step (3): line search:

Compute α_k satisfying the Wolfe conditions and update variable

$x_{(k+1)} = x_k + \alpha_k d_k$. Compute,

$f_{(k+1)}, g_{(k+1)}, s_k$.

Step (4): Direction computation:

Compute $d_k^{NEW} = -\theta_k g_{(k+1)}$, where θ_k computed as in (7)

k=k+1 go to step (2).

5. Numerical Examples

In this section we mention some examples to demonstrate the speed of convergence of the proposed algorithm and its comparison with other algorithms in the same field as shown in the table belowm, We note the clear superiority of the proposed algorithm compared to the algorithms (Steepest Descent (SD), BB1 and BB2[15] [16][17][18]) for solve some Solving Fuzzy Optimization Problems(FOP).

All examples are implemented with MATLAB (R2009b). We use the stop criterion $\|g_{(k+1)}\| < 10^{(-6)}$. For more on these algorithms (Steepest Descent (SD), BB1 and BB2) see [15][16][17][18].

iter:- number of iterations

x_optimal:- optimal variable

f_optimal:- optimal function value

Example 1. [9]"Consider the following nonlinear programming problem with fuzzy parameters:

$(\tilde{FOP})$ $\min_{x \in \square^2} F(x)$,

$$F(x) = \left(-\frac{1}{2},\frac{1}{2},\frac{3}{2}\right)x_1^4 + \left(0,\frac{25}{2},25\right)x_1^2 + \left(-\frac{99}{4},-\frac{99}{10},\frac{99}{20}\right)x_1x_2 + (-2,2,6)x_2^2 + (-40,-16,8)x_1 + (-32,16,32).$$

Using fuzzy arithmetic, it follows:

$$\int_0^1 \left(\overline{f}^{\alpha}+\underline{f}^{\alpha}\right)(x)d\alpha = x_1^4 + 25x_1^2 - 19.8x_1x_2 + 4x_2^2 - 32x_1 + 16$$

$x_0 = \begin{bmatrix}0\\3\end{bmatrix}, x^* = \begin{bmatrix}1.9585\\4.8474\end{bmatrix}$"

Example 2. [9]"Consider the following nonlinear programming problem with fuzzy parameters:

$(FOP)\quad \min_{x\in\square^3} F(x),$

$F(x)=(2.9,3,3.15)x_1^2+(4.7,5,5.35)x_2^2+(-2,1,2)x_3^2.$

Using fuzzy arithmetic, it follows:

$$\int_0^1 (\bar{f}^{\alpha}+\underline{f}^{\alpha})(x)\,d\alpha = 6,025x_1^2+10.025x_2^2+x_3^2.$$

$$x_0=\begin{bmatrix}1\\1\\2\end{bmatrix}, x^*=\begin{bmatrix}0\\0\\0\end{bmatrix}$$"

Example 3. [9]"Consider the following nonlinear programming problem with fuzzy parameters:

$(FOP)\quad \min_{x\in\square^2} F(x),$

$F(x)=(-2,1,2)x_1^4+(-12,-4,4)x_1^3+\left(-\frac{25}{2},\frac{25}{2},\frac{75}{25}\right)x_1^2+(0,2,4)x_2^2$
$+(-6,-2,2)x_1x_2+(-48,-16,16)x_1+(-32,16,32).$

Using fuzzy arithmetic, it follows:

$$\int_0^1 (\bar{f}^{\alpha}+\underline{f}^{\alpha})(x)\,d\alpha = x_1^4-8x_1^3+25x_1^2+4x_2^2-4x_1x_2-32x_1+16$$

$$x_0=\begin{bmatrix}1\\1\end{bmatrix}, x^*=\begin{bmatrix}2.0451\\1.0225\end{bmatrix}$$"

Example 4 [9]"Consider the following nonlinear programming problem with fuzzy parameters:

$(FOP)\quad \min_{x\in\square^2} F(x),$

$F(x)=\left(\frac{1}{2},1,\frac{3}{2}\right)x_1^2+\left(0,\frac{1}{2},1\right)x_2^2+\left(\frac{1}{2},1,\frac{3}{2}\right)x_1x_2+\left(0,\frac{1}{2},1\right)x_1-\left(0,\frac{1}{2},1\right)x_2.$

Using fuzzy arithmetic, it follows:

$$\int_0^1 (\bar{f}^{\alpha}+\underline{f}^{\alpha})(x)\,d\alpha = 2x_1^2+x_2^2+2x_1x_2+x_1-x_2$$

$$x_0=\begin{bmatrix}0\\0\end{bmatrix}, x^*=\begin{bmatrix}-1\\1.5\end{bmatrix}$$"

Example 5 [9]"Consider the following nonlinear programming problem with fuzzy parameters:

$(FOP)\quad \min_{x\in\square^2} F(x),$

$F(x)=(-1,1,3)x_1^2+(0,1,2)x_1x_2+(1,2,4)x_2^2$

Using fuzzy arithmetic, it follows:

$$\int_0^1 (\bar{f}^{\alpha}+\underline{f}^{\alpha})(x)\,d\alpha = 2x_1^2+2x_1x_2+4.5x_2^2$$

$$x_0=\begin{bmatrix}2\\-2\end{bmatrix}, x^*=\begin{bmatrix}0\\0\end{bmatrix}$$"

Table (1): Numerical results for examples

No.	*SD*			*BB1*			*BB2*			*NEW*		
	iter	*x_optimal*	*f_optimal*	*iter*	*x_optimal*	*f_optimal*	*iter*	*x_optimal*	*f_optimal*	*iter*	*x_optimal*	*f_optimal*
1	138	1.958548 4.847405	-30.050963	fail	fail	fail	**22**	**1.958548** **4.847406**	**-30.050963**	26	1.958548 4.847406	-30.050963
2	78	0 0 0	0	58	0 0 0	0	28	0 0 0	0	**23**	**0** **0** **0**	**0**
3	fail	fail	fail	fail	fail	fail	**42**	**1.994318** **0.997159**	**0**	fail	fail	fail
4	18	-0.999999 1.499999	-1.250000	18	-0.999999 1.499999	-1.250000	18	-0.999999 1.499999	-1.250000	**9**	-0.999999 1.499999	-1.250000
5	22	0 0	0	**10**	**0** **0**	**0**	12	0 0	0	14	0 0	0

6. Conclusions

We presented in this research a new type of optimization algorithm to solve the problems of fuzzy optimization, and the proposed algorithm has shown a high efficiency in solving some these problems with the least number of iterations and with higher accuracy in reaching the approximate solution of the function.

7. Acknowledgements

I would like to express my sincere gratitude and appreciation to my supervisors Prof. Dr. Khalil K. Abbo for this valuable suggestion, encouragement and invaluable remark during writing this paper.

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FI- Spectrophotometric Determination of Co (II) Ions in Analytical Sample Via Reaction with a New Reagent HPEDN

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الخلاصة

يتضمن البحث طريقة طيفية جديدة بالحقن الجرياني لتقدير ايون الكوبلت الثنائي(Co II) في نماذج تحليلية، تعتمد الطريقة على تفاعل أيونات الكوبلت ال ثنائي(II) Co مع كاشف 1-(4-(1-(2-hydroxyphenylimino) ethyl phenyl diazinyl) naphthalene-2-ol) (HPEDN) بوجود محلول منظم ذات دالة حامضية pH يساوي (9) لتكوين معقد احمر اللون مستقر قابل للذوبان في الماء، الذي اعطى اعلى امتصاصية عند الطول الموجي 488 نانومتر ويطاوع قانون لامبيرت – بير ضمن مدى(0.5-12) ميكروغرام مل $^{-1}$ مع حد كشف (إشارة/ ضوضاء = 3)

وحد قياس كمي قدره $\mu g.ml^{-1}$ (0.7377) والانحرافات المعيارية النسبي بنسبة(0.65%) ، تم دراسة تأثير $\mu g.ml^{-1}$ (0.2213) الظروف الكيميائية والفيزيائية وطبقت الطريقة بنجاح لتقدير أيونات(II) Co في العينة التحليلية بدقة وفعالية جيدتين.

الكلمات المفتاحية

الابنية الادارية، الموظف، الفضاء الداخلي التفاعلي، البعد النفسي، الخصوصية، الحيازة.

Abstract

A new Spectrophotometric flow injection method has been established for the determination of Co (II) ion in analytical sample. The method is based on the reaction of Co (II) ions with 1- (4-(1- (2- hydroxyl phenyl amino) ethyl) phenyl) diazenyl) naphthalene -2- oL. (HPEDN) reagent in the presence of a Buffer solution has pH equal to 9 to form a red-water-soluble stable complex, that has a maximum absorbance at (488) nm. Beer's law is obeyed in the range of (0.5-10) µg. mL^{-1} with a limit of detection (signal/noise=3) of (0.2213) $\mu g.ml^{-1}$ and limit of quantification of (0.7377) $\mu g.ml^{-1}$ and relative standard deviation of (0.65 %), The effect of chemical and physical parameters has been carefully considered and the proposed procedure was successfully applied to the determination of Co (II) ions in analytical sample with a good precision and accuracy.

Keyword:

Co(II) Cobalt, Flow injection, HPEDN, Spectrophotometric.

1. Introduction

Cobalt(II) is a metallic mineral that is one of the elements of the first transition chain, its symbol is Co, its atomic number is (27) and its atomic weight is (58.9332)g.moL^{-1} with a gray color, and it has an electronic arrangement (18 [Ar] 3d74s2), where cobalt is an uncommon element in the earth's crust The most important cobalt ores are cobaltite (CoAsS) and smaltite (CoAs2), as there is a mixture with most metals, especially nickel, and this leads to the difficulty of separating and extracting it[1].

Cobalt is found in many oxidation states, including the oxidation state (II), where many complexes are prepared and are generally classified into two groups, pink or red in octahedral complexes and blue in tetrahedral complexes, and binary cobalt is tetrahedral complexes more than any other binary ion of the transition metals , And the state of oxidation (III), which forms a variety of complexes that are distinguished by their strong stability, as the number of symmetry is (6) in some complexes and the number of symmetry is (4) in other complexes.[2]Cobalt has several uses, including that it enters in the formation of alloys, where it is mixed with aluminum, nickel, iron or any other metals and is used in the manufacture of magnets that are used in televisions and radio devices, and because its alloys resist high temperatures. In the manufacture of pigments for coloring glazes[3], ceramic pots and glass[4], there are many methods used in estimating cobalt, including the electrical method [5], the thermal method[6], the optical method [7],the chromatographic analysis method[8], the extraction method [9], the flame ablation method [10], the spectroscopic method [11] by Lambert's law the cobalt ((II) with (PAN) in water was estimated at pH = 6 with a molar ratio of 2: 1 and subject to at the range of (0.1-2.5) µg . mL^{-1} and Ɛ = 3.77x10^{-4} L.mol^{-1}.cm^{-1} and at max = 525nm[12].

This method was used to Determination many materials in Pharmaceutical Formulations such as tyramine and Potassium metaperiodateVia Oxidative Coupling Reaction[13],levo-dopa [14], Metoclopramide .HCl [15], Catechol amine Drugs and sodium hydroxide [16].

This study describes FI-spectrophotometric methods for the determinationof Co (II) ion by a new reagent (HPEDN) 1- (4-(1- (2- hydroxyl phenyl amino) ethyl) phenyl) diazenyl) naphthalene-2- ol in the presence of a Buffer solution to form a red-water-soluble stable complex, that has a maximum absorption at λ_{max} at 488 nm.

2. Materials and Methods

Apparatus a shimadzau 260 uv-visible digital double beam spectrophotometer furnished with a (cecil) 50 µl glide mobile turned into used.

Manifold: the waft manifold is display in Fig. (1) a channel manifold had been used for the (FI) spectrophotometric willpower of Co(II) ions , Four channel peristaltic pump [Ismatec, labortechnik-Analytic CH-8152 Glatbrugg-Zurich, Switzerland] minipuls peristaltic pump became employed to transport the service circulate (rheodyne-united states) injector valve was used for injection of buffer solution . bendy

vinyl tubing of (0.8) mm internal diameter turned into used for the peristaltic pump. the reaction coil (Rc) changed into crafted from teflon with an internal diameter of (0.5) mm. in Fig.(1), the channel 1 was used to transport HPEDN reagent and channel 2 to introduce Co(II)ion . the the buffer Solutions valuable changed into injected via the injection valve into the provider circulation of the solution of Co(II) ion and then combined with a service circulation of HPEDN reagent and have been propelled via the peristaltic pump with an individual glide price of 1.8 ml.min-1 and the absorbance turned into measured at λ_{max} (488)nm

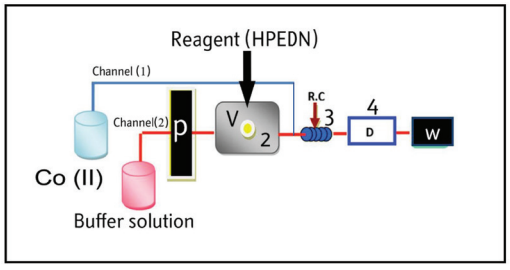

Fig. (l): Peristaltic pump(P), Injection valve(V), Reaction coil (RC), D: Detector, W: Waste Manifold hired for the FI spectrophotometric dedication of Co (II) ions

3. Reagents and Materials

All reagent and chemical materials used have been of analytical reagent grade except otherwise said.

3.1. Preparation of solutions

Reagent solution (HPEDN)

The reagent solution was prepared at a concentration of (1×10^{-4})M by dissolving (0.0381)g of the reagent in absolute ethyl alcohol and complete by made up to (100 mL) volumetric flask with the solvent. From this standard solution, other standard solutions were prepared by successive dilution with the same solvent .

Buffer Solutions

The buffer solutions were prepared with a concentration of (0.01) M of dissolving (0.7708) g of ammonium acetate in (1000) mL of distilled water in a volume vessel of 1 L volume.) Several solutions were prepared from this solution with a wide range of acidic functions ranging between (PH = 9) By adding concentrated ammonia solution or concentrated acetic acid to the prepared ammonium acetate solution [17].

Co (II) ions:

The solution was preparedat a concentration of (1×10^{-3})M by dissolving (0.0237)g of cobalt (II) ions compound indistilled water and complete the volume (100)mL in the solvent. From this standard solution, other standard solutions were prepared by successive dilution withdistilled water[18] .

3.2. Procedure for the FIA Method

Samples containing one-of-a-kind concentrations of Co(II) ion had been prepared by using simple dilution with distilled water to prepare isolation with concentration of the inventory solution (0.5 - 10)µg.ml^{-1} . the FIA spectrophotometric measurements have been accomplished the use of the manifold display in Fig.(1) , using (1×10^{-4})M m of HPEDN reagent and buffer solution of PH identical to(9) with a float price of (0.9) ml.min^{-1} in each channel . the absorbance of the ensuing pink complex turned into measured at λ_{max} (488) nm.

4. Results and Discussion

The solution of Co (II) ions reacted with HPEDN reagent in presence of Buffer solution to form an intense red colored complex product that can be measured at 488 nm. Fig. (2) showed the spectrum of the complicated product. the absorbance of the pink complicated is at once associated with the concentration of Co(II)ions and can be used for its spectrophotometric determination. It was found that the sensitivity of the colored complex depends on the reaction conditions and were optimized as follow.

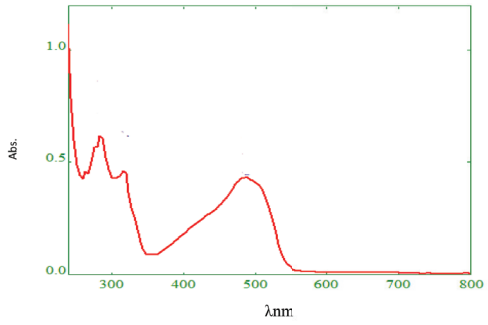

Fig. (2): Absorption spectrum of Cobalt complex (II) at a concentration of (1×10 -4)M with ligand (HPEDN) at a concentration of (1×10 -4)M

4.1. Effect of the HPEDN reagent concentration

The effect of diverse awareness of HPEDN reagent was investigated. Aattention of (2.5×10^{-4})M gave the highest absorbance and have been used for further experiments. the effects acquired are proven in Fig. (3).

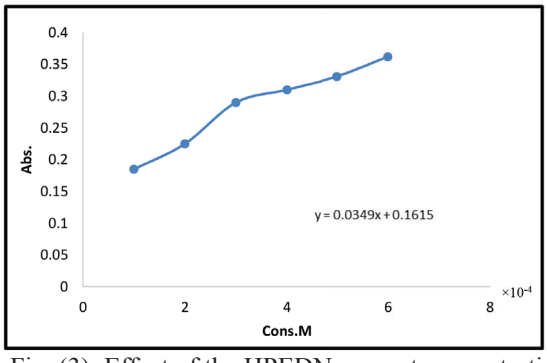

Fig. (3): Effect of the HPEDN reagent concentration

4.2. Effect of flow rate

The effect of flow rate on the sensitivity of the colored complex product turned into investigated. the outcomes obtained showed that a glide price of (1.8) ml.min^{-1} gave the very best absorbance as shown in Fig. (4) and become utilized in all subsequent experiments.

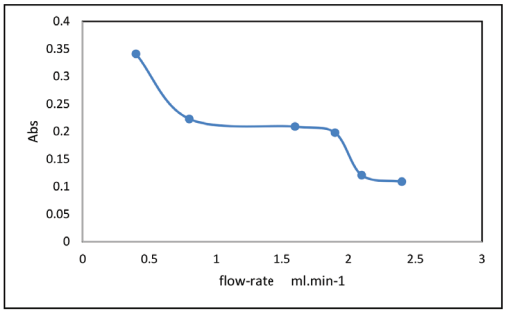

Fig (4): Effect of total flow-rate

4.3. Effect of reaction coil length

The coil length is a critical parameter that affected at the sensitivity of the coloured complicated product and became investigated inside the variety of 50-125 cm. the effects obtained showed that a coil period of (50)cm gave the highest absorbance as shown in Fig. (5) and have been used in all subsequent experiments.

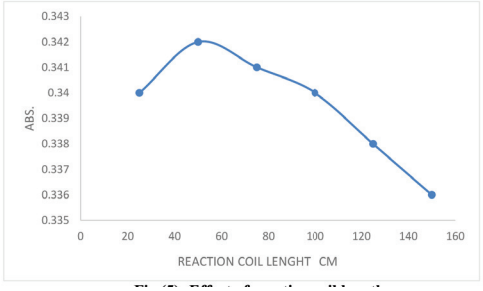

Fig (5): Effect of reaction coil length

4.4. Effect of injected loop extent

The impact of loop extent become investigated by means of injection of a extent of difference length of loop . the consequences obtained confirmed that an injection buffer of (50) µl gave the fine absorbance for a red complicated as shown in Fig. (6) and werw used in the fashionable endorsed system.

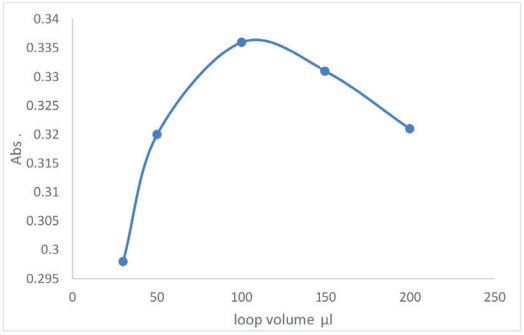

Fig (6): Effect of loop volume injected.

4.5. Calibration graph for the determination of Co (II) ions

under the superior condition a linear calibration graph. Fig. (7) was acquired over the attention variety of (0.5 – 10) µg.ml^{-1}. the restriction of detections (signal/noise=3) were (0.2213) µg.ml^{-1}. the correlation coefficients had been (0.9972). the relative preferred deviation of the approach changed into higher than (1.104 %) (Table.1)

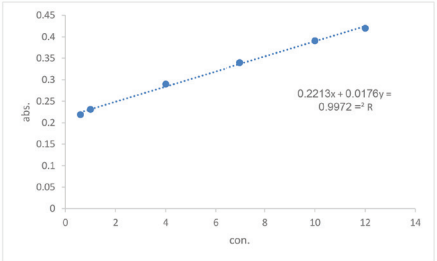

Fig. (7): Calibration graph for the dedication of Co (II) ions

Table (1): The data for the determination of Cobalt ion (II) with reagent (HPEDN). using FI-spectrophotometric methods.

Metallic ion complex	FI method
Linear range (µg.ml^{-1})	0.5-10
Regression equation	0.0176x + 0.2138
Slope	0.0176
Molar absorptivity (L.mol^{-1}.cm^{-1})	0.3475×4^{10}
Correlation coefficient R2	0.9972
Sandal sensitivity (Mg. Cm $^{-2}$.)	0.0193
Detection limit L.O.D µg.ml^{-1}	0.2846
Limit of quantificationL.O.Q µg.ml^{-1}	0.9478

5. Nature of the complex product

The stoichiometry of the reaction between Co (II) ion and HPEDN reagent was investigated using the slope analysis method[19]under the optimized conditions. The results obtained (Fig.3,7), show a 1:2 Metal to reagent product was formed. The formation of the complex may probably be occurring as follows.

$$M + L \longrightarrow ML$$

$$\frac{M}{L} = \frac{Sm}{Sl}$$

Table (2): Analytical sloop of metal ions complexes (II) with reagent (HPEDN).

Metallic ion complex	Co(II)
S_M	0.0176
S_L	0.0349
S_M/S_L	0.5042

S: Analytical slope, M: metallic ions (II), L: reagent

S: Analytical slope, M: metallic ions (II), L: reagent

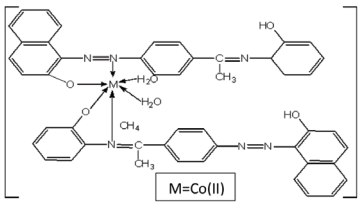

Fig (8):The Suggested shape of metal ions complexes (II) with reagent(HPEDN). [Dichloro bis(1-((4-(1-(2-hydroxyphenylimino)ethyl)phenyl)diazenyl) naphthalene-2-ol)Metal ion(II)]

6. Conclusions

A simple accuracy and touchy fi-spectrophotometric approach for the dedication of Co (II) ions in analytical samples has been advanced. The technique desires neither temperature nor extraction steps. The technique was applied effectively.

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Simulation And Analysis of AC / DC Converter Circuit By Using Alternative Transient Program

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الخلاصة

في هذا البحث، تم تقديم طريقة فعالة لتحويل جهد التيار المتناوب إلى جهد تيار مستمر باستخدام مقوم قنطرة كامل الموجة. ومع ذلك، فإن ناتج المقوم يتضمن تموجات غير مرغوب فيها.

في معظم الحالات، يجب أن يكون التموج أقل من الحد المحدد. وهنا تم إجراء محاولة لتقليل التموج عن طريق دائرة ترشيح تتكون من مكثف أو محاثة أو كليهما من أجل تقييد التموج. يتم توفير صيغة رياضية لحساب قيمة مكثف واحد أو محاثة مرشح عند استخدام المكثف أو المحاثة بشكل منفصل، ولكن إذا تم استخدام المكثف أو المحاثة معًا، فلا توجد صيغة رياضية لحساب قيمهما للتحكم في عدد التموج، تم استخدام برنامج Alternative Transient Program ATP لمحاكاة تبديل الدائرة للتحقق من صحة تشغيلها في جميع الظروف الثلاثة. يشير الفرق بين النتيجتين إلى أن النتائج المحسوبة والمحفزة متطابقة تقريبًا. يوضح تحليل النتائج أن طريقة تصميم مرشح الحث المجمع هي الطريقة الأنسب للتحكم في التموجات عند مستوى معين.

الكلمات المفتاحية

مقوم AC /DC ، برنامج ATP ،مكثف مركب.

Abstract

In this article, an efficient method for converting AC voltage to DC voltage using full-wave bridge rectifier has been presented. The rectifier output of, however, includes unwanted ripples. In most cases the ripple must be below the specific limit. In this article an attempt is made to reduce the ripple by means of a filter circuit that consists of a capacitor or an inductance or both in order to restrict the ripple. A mathematical formula for computing the value of a single capacitor or filter inductance is provided when the capacitor or inductance is being used separately, but if the capacitor or inductance are being used together, there is no mathematical formula for calculating their values to control ripple count. In the paper, the Alternative Transient Program (ATP) has been used to simulate the switching of the circuit to validate the circuit's operation in all three conditions. The difference between the two results indicates that the computed and stimulated results are nearly identical. The results analysis shows that the Combined Capacitor Inductance Filter Design Method is the most suitable method for controlling the ripples at a certain level.

Keyword:

AC/DC converter, ATP, rectifier, Combined Capacitor.

1. Introduction

Alternating currents are available on a commercially viable base at a low price. Since DC is costlier, we require a method to substitute DC for AC as a cost-effective DC source [1]. AC output can be transformed into DC power by using rectifiers. Therefore, when AC transformed into DC using rectifiers, the output of DC power will contain some undesirable AC portions called ripples. In most cases they should never exceed the rated value [2]. When the ripple exceeds the rated value, several negative effects will occur. Some of the adverse side effects are thermal dissipation, noise, etc. A noise can be reduced by using the output Filter [3,4]. If capacitor is used as a separate unit or an inductor is used separately as a filter, a mathematical expression is used to calculate the values of either the capacitor or the inductance to control the Ripple below that value, but when the inductance and the capacitor are combined, there is a mathematical formula to compute the values [5]. The computational model has been used and validated in this work to determine the values of the capacitance and the inductance when used in combination to control the Ripple at a given value. The voltage ripple is shown in Fig. (1) [6].

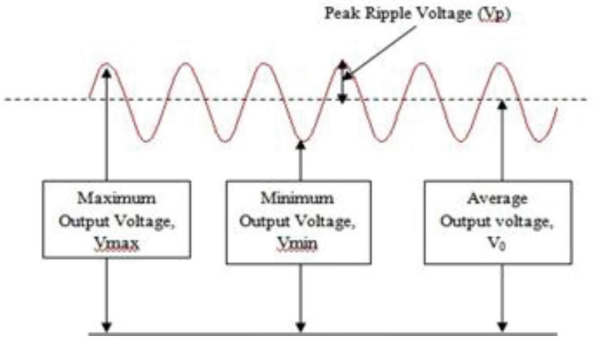

Fig. (1): The voltage ripple.

The voltage ripple ratio is the ratio between the square average of voltage ripple V rms and the mean value Vo on the output of rectifier filter [7]. Fig. (1) illustrates the necessary parameters for graphical determination of ripple factor. It is supposed to be a sinusoidal waveform of the voltage Ripple. The equation for the determining the residual ripple in percentage is [8]:

Residual ripple percentage =

(Residual ripple value/average DC power output) x 100 Vrms = 0.707 x Vp

Vp = Peak value of ripple voltage

A circuit which minimizes or removes the ripple on the rectified output is known as a filter. Normally, filter circuits comprise a capacitor, an inductance or both. Capacitor filters, on the other hand, are used for systems with low output. On the others hand, inductive filters are used in high power systems [9]. The filters can be classified depending on the type of passive element used as follows:

1. Capacitor filter.
2. Inductive filter.
3. Iinductance -Capacitor filter.

In this Paper, every filter above is simulated for a full wave bridge rectifier, and waveforms are preserved in the Alternative Transient Program (ATP) [10]. Several DC converter topologies have been performed, such as:

- Sul and Lipo [11] have reported the presence of a parallel resonance resonant AC compound which is suitable for induction motors. Wiring diagrams for AC resonance bridge AC and DC bridge [12]. When AC resonance current is switched in series, Lr and Cr components of the resonant connections

are switched in series. Since the connected load current flows in both directions, the equipment used on both the supply side and load side of an inverter must operate in each direction. Of course, the switchgear is switched on or off when the AC Neutral current is flowing so it can be employed in the ZCS system. Every switch is a combination of two anti-parallel thyristors, Lipo et al. suggested a new Topology, which is adjusted to stresses with a retardation of up to (0.88) pf [13]. The circuit consists of a resonant capacitor, a resonant coil, a resonance capacitor and a coil connected in series between source and DC connector. If a smooth crossing is needed, short-circuit the by-pass switches (SW1, SW2) for a short time. The condenser resonance potential is controlled by the Lr. This disconnects the DC-link circuit voltage in the DC-link circuit, thereby ensuring smooth operation of switching operations. If these two switches are disabled, the energy of the resonant inductance is transmitted to the resonance capacitor and energy Ls is transmitted to the corresponding inductance Lc and returned to the DC and DC power source [14]. Andrade et al. suggested a new Topology for the loading of induction motors [15]. This Topology works with relatively higher switching frequencies as a part of the Peak Current Regulation strategy. The charge can be substituted by a three phase inverter supplying the induction motor. First, switch S1 conducts the charge current and resonance capacitor Cr is loaded with Vco voltage. Ensure that all the switches of the inverter and switch S1 of the oscillating circle S1 are connected securely. With this topology, a Software Circuit is generally not used for all units [16].

2. Methodology

2.1. Capacitor filter

An unfiltered rectifier circuit produces output ripples. The circuit of the full-wave bridge rectifier with a filter capacitor is shown in Fig. (2), whereas Fig. (3) illustrates the output voltage of full-wave rectifier at POS and NEG points in Fig. (2) without using filter capacitor.

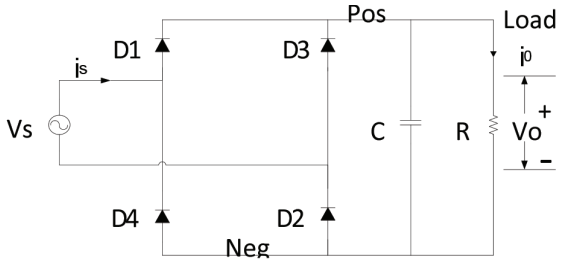

Fig. (2): Full wave rectifier with capacitive filter[17].

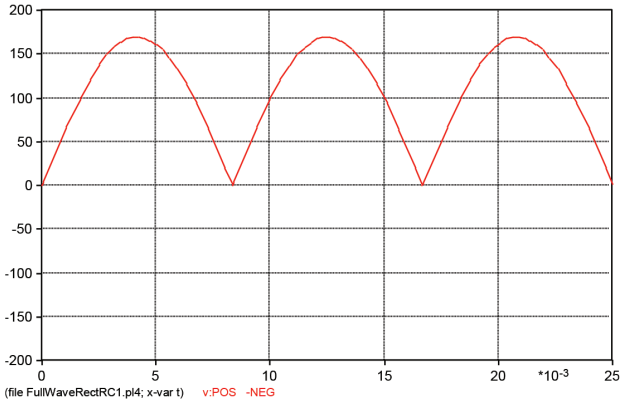

Fig. (3): The output voltage of full wave rectifier.

Fig. (3) illustrates the full-wave rectifier output voltage through points POS and NEG of Fig. (2) excluding the capacitor filter. The ripple voltage is connected to the filter capacitor as shown in Fig. (2). This capacitor responds to every change of the circuit voltage. Since the rated load on the capacitor is only restricted by the source voltage impedance, which is extremely low, voltage across

the capacitor can increase almost as quickly as the sine voltage of a rectifier. In the other words, RC charging times are quite short. The loading of the capacitor is the energy storage. If the output of rectifier drops to zero, the capacitor voltage will not drop instantly. The stored energy in the capacitor is unsaved during the period when the rectifier is not delivering current [18].

Voltage through capacitor and load decreases very slowly, presuming that a capacitor with a high capacity and a fairly high resistance of the load is being used, while the RC discharge time is quite long. As a result, the ripple amplitude is very low, as illustrated in Fig. (4).

Waveform v: POS. NEG represent the output without a filter while v: LOAD. NEG is the output with filter.

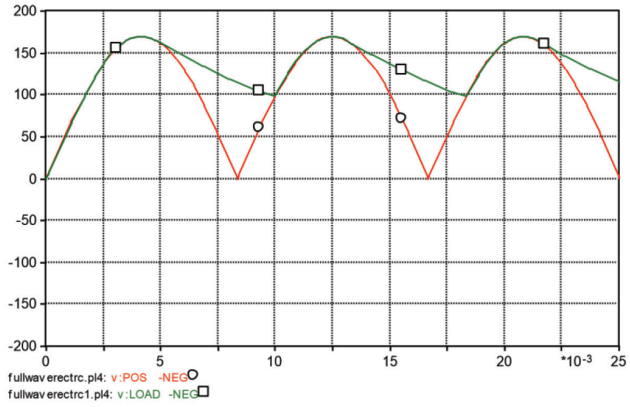

Fig. (4): Full wave bridge rectifier output with capacitor filter.

Once the capacitor has been discharged, the bridge rectifier current will not flow until the rectifier output voltage is greater than the current flowing in the capacitor. This will happen at (10) ms as shown in Fig. (4). Current will flow in the rectifier after the peak of the sinusoidal wave reach (13) ms. At this point, the sinusoidal wave will fall faster in case of the capacitor discharging. Current pulse, begins at 10 (ms) and will finished with (13) ms and will be drawn from the power source to the capacitor.

The mean voltage (Vo) of the rectifier output of the full wave inverter is about (0.636*) Vm. Vm is the maximum value of the source voltage (Vs) and equals:

$V_m=\sqrt{(2.\ )}*V_s$ ….. (1)

Fig. (3) indicates the average value (Vav) which can be calculated as:

$0.63*\sqrt{2}*120 = 107$ V.

As the capacitor will absorb more energy during the pulse which will provide this energy for recharging between the pulses, so, the output voltage will never fall to zero. Thus the average output voltage from the filter, as seen in Fig. (4), is less than the non-filtered output voltage shown in Fig.(3). If the load resistance is however low, a high load current is drawn from the device and the mean output current drops. In addition, the capacitor will function as a short through the rectifier when the capacitor is charged. For these reasons, a simple capacitor filter is not appropriate for high performance rectifier. In practical use, the RF ripple factor is given in [19].

$RF=1/\sqrt{(2(2frRC-1\ )}$…….(2)

Where fr is equal to the output Ripple Frequency.

2.2.Results and discussion

Fig. (3) shows two output pulses in each power supply cycle. So, the output ripple frequency, (fr = 100 Hz). Equation (2) has been used to compute the capacitor value for various ripple values and shows the results in Table (1).

Table (1): capacitor value calculated for different ripple factor values.

RF (%)	R (Ohms)	fr (Hz)	C (mF)
1	10.0	100.0	29.88
2	10.0	100.0	15.14
3	10.0	100.0	10.23
4	10.0	100.0	7.78
5	10.0	100.0	6.30

By giving the capacitor value of (10.23) mF for (3%), the voltage waveforms are shown in Fig. (5). In Fig. (5) the output voltage values are same as in Table (2). Table (2) illustrates the output voltage values.

Table (2): The output voltage values.

Voltage	Value
V_{max}	170 V
V_{min}	155 V
V_o	160 V
V_p	6.5 V
Vrms of ripple	0.707 * 6.5 V
Ripple percentage	V_{rms} / Vo* 100 = (3%)

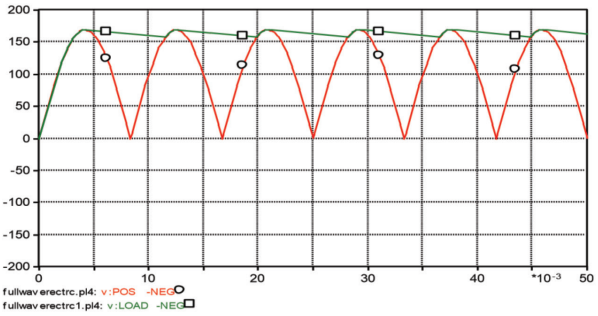

Fig. (5): Waveform of output voltage for (3%) of ripple with (10.23) mF capacitor.

As the same percentage is derived from the simulation and calculation (1), the ATP model will be verified using the formula in equation (1).

2.3.The induction filter

It is well known that the capacitor is an element that reacts to voltage fluctuations and is connected to the load. An inductor is an element that reacts to current fluctuations. The coil generates a current delay. Since the current in all parts of the circuit is connected in series, an L-shaped coil is connected in series with the load, as shown in figure (6) [20].

The use of an induction coil prevents the current from rising or falling quickly. If this coil is large enough, the current will be constant and almost constant. The inductance prevents the current from reaching the maximum value that will be reached without the use of the filter coil. As a result, the output voltage never reaches the maximum value of the applied sine wave.

Rectifier whose output is filtered by an inductance cannot produce a high voltage

such as the voltage filtered by a capacitor. However, this disadvantage is partially compensated, because the inductance allows the current to be increased without significant fluctuations in the output. Therefore, the coil filter is suitable for high power applications. Typical product characteristics are shown in Fig. (6). A peak waveform of (17) A is an unfiltered inductive current. A peak waveform of (12.6) is an inductive filter current.

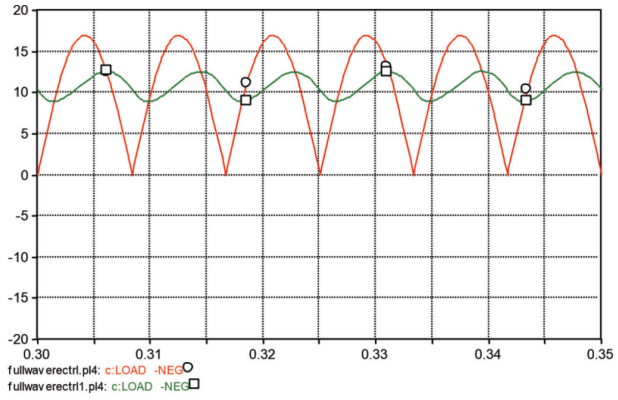

Fig. (6): Output current with and without inductor filter.

In practice, the ripple factor is calculated as follows [19]:

$$RF = \frac{0.471}{\sqrt{1+(\frac{4\pi f i L}{R})^2}} \cdots\cdots\cdots (3)$$

Where: fr is the output ripple frequency.

Note that in Equation (3) for an induction filter, input ripple frequency is used in calculations, unlike a capacitor filter which uses equation (2) output ripple frequency. By using the formula above, coil value is calculated for several ripple values, and the calculation results are shown in Table (3) .

Table (3): Ripple factor calculated results after using an inductive filter.

RF %	R (Ohms)	fi	L (mH)
1.0	10Ω	50	623.82
2.0	10Ω	50	312.20
3.0	10Ω	50	206.89
4.0	10Ω	60	154.67
5.0	10Ω	60	124.28

2.4.Results and discussion

According to table (4), when using the induction level of (207) mH, which is about (3%) of the ripple, the current waveforms are shown in Fig. (7).

Table (4): calculated results of current waveform.

Current	Value
I_{max}	11.2 A
I_{min}	11.0 A
I_o	10.8 A
I_p	0.47A
I_{rms} of ripple	0.707 * 0.45A
Ripple percentage	(I_{rms} / Io) * 100 = (3%)

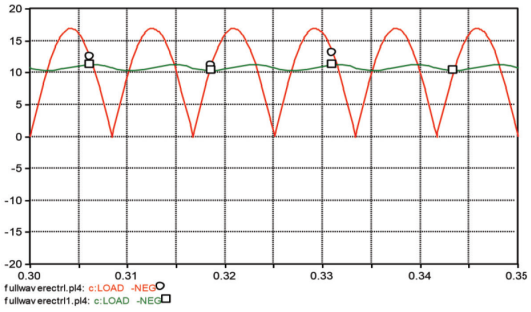

Fig. (7): Current waveform for (3%) of ripple with an inductance of (207 mH).

Since the ATP simulation program provides the same percentage of ripples as calculated by equation (3), the ATP model was verified with this equation.

2.5. Filter with inductive capacitor

Capacitance induction type filter has been used for improving the voltage and current filtering task. In the previous sections, we saw that one capacitor or coil cannot provide a satisfactory filtration effect as the former is suitable for low-power applications and the latter for high-power applications. However, when a capacitor and coil are connected, they produce high quality direct current and voltage. capacitor role is to attenuate fluctuations in voltage while the coil is used to compensate for fluctuations in current. Because of its homogenous power supply, capacitive induction filtering is often used in high-performance systems. Fig. (8) illustrates a full-wave rectifier with inductive capacitive filter .

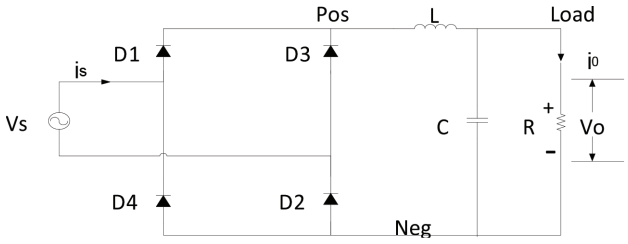

Fig. (8): Full wave rectifier with inductive and capacitor filter.

We understand that the (10.23) mF capacitor is needed when used on its own to reduce the ripple to approximately 3% in a single circuit. Likewise, when used alone, an (207) mH induction winding is needed to cut the ripple to around (3%). The purpose of the combination is to identify the capacitor and inductor values that are used in conjunction, as in Fig. (8), to reduce ripple to about (3%).

The approach to the filter designs is to select any one capacitor value; approximately (25%) of the ripple reduction to (3%) when used on its own, and then change the induction value to obtain (3%). The values are determined by trial and error using a fully validated ATP model. The simulation results are presented in Table (5).

Table (5): Results of the simulation.

C (mF)	L (MH)	I max (A)	I min (A)	I ave (A)	Peak ripple	I_{rms} (A)	I_{ripple} %
2.5	5	13.2	11.5	12.3	0.8	0.6	4.8
2.5	10	11.3	10.2	10.8	0.5	0.3	3.5
2.5	15	11.1	10.4	10.8	0.3	0.2	2.3
2.5	20	11.0	10.5	10.8	0.2	0.1	1.73
2.5	25	11.0	10.6	10.8	0.2	0.1	1.3

The ripple current in mH as a percentage of the inductor coil is illustrated in Fig. (9). Fig. (9) illustrates that (3%) of ripple current is achieved with a (2.5) mF capacitor and a (12.5) mH inductor. At this value, The ripple current as a function of the induction coils in mH is illustrated in Fig. (9). At this level, the forms of the voltage and current ripples are derived from ATP, as illustrated in Fig. (9).

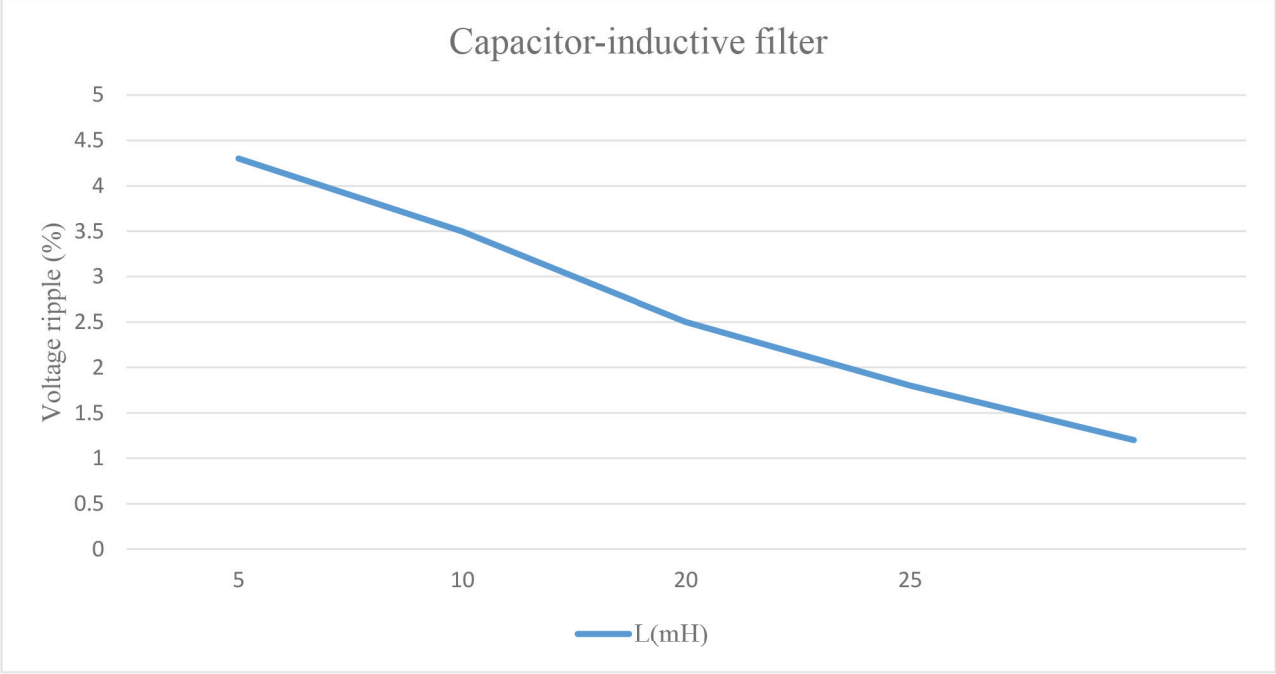

Fig. (9): Current ripple reduction for capacitor-inductive filter.

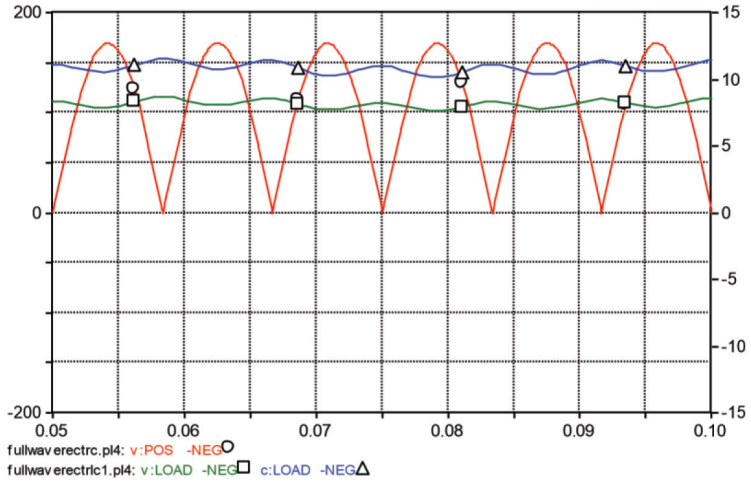

Fig. (10): Forms of voltage and current waves for capacitor-inductive filter.

Fig. (10) illustrates three distinct waveforms. Two voltage waveforms and a current waveform are shown. Voltage curves are displayed on the right and the left axis, and the current lines on the left and the right axis.

For clarity, the x-axis is only displayed for a time period of between (0.05) and (0.10) seconds. The v: POS -NEG Waveform is the waveform of output voltage without filters. The v: LOAD - NOEG waveform is a waveform of the charge output voltage with a filter. C waveform: LOAD - NEG is a current waveform by loading.

It must be observed that the load current wave shape follows the waveform of the load voltage, as the load is a pure ohmic. Both the load voltage and load current waveforms may be used to compute the percentage of ripple, both with the same results.

By using the voltage waveform from Fig. (11), we get the same results as those shown in the Table (6).

Table (6): Simulation results for circuit with both inductor and capacitor.

Current	Value
Imin	10.3 A
Io	10.8 A
Ip	0.45 A
I_{rms} of ripple	(0.707 * 0.45)A
Ripple percentage	(Irms/Io) *100 = (3%)

Finally, from this results obtained, it can be concluded to the required capacitor and/ or inductor ratings for various filter types to restrict the DC current ripple to approximately (3%) are shown in table (7).

Table (7): Capacitor and inductive values required for different filter types to limit the DC ripple to about 3%.

Filter	C (mF)	L (mH)
Capacitive-Filter	10.23	-
Inductive-Filter	-	207
Cap.-Ind. Filter	2.5	12.5

As show from table (7) shows, a far larger capacitor or coil is needed when using them alone to obtain the same results as when using a combination. The only required capacitor size is (10.238) mF, and the required inductance is (207) mH for approximately (3%) ripple. When used in combination, the capacitor value required is (2.5) mH compared to (10.23) mF and the inductor value needed is (12.5) mH compared to (207) mH to achieve the same ripple percentage.

3. Conclusion

Alternative Transient Program (ATP) and equations for the percentage of ripple of capacitor or induction filters have been investigated. Based on the established ATP model, the capacitor induction filters have been designed to reach the given percentage

of ripple. It has been shown that an effective ripple control can be obtained by choosing the correct complained of both capacitor and inductor values for the filter in the alternating current rectifier. As there is no specific formula for designing a combined capacitor-inductance model, the validated ATP Model will assist seniors, college engineers and researchers to design their optimum AC/DC converter with low current ripple which lead to increase the circuit efficiency.

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Diffraction of a Lens in a (2D) Spatial Signal Processing

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الخلاصة

تحويل فورييه هو تقنية حاسمة تستخدم في الرياضيات التطبيقية. كان أول تطبيق له في الهندسة الكهربائية والاتصالات ومعالجة الإشارات الزمنية. في هذه الدراسة، استخدم البحث الخصائص الانعكاسية للعدسة ثنائية الوجه في دراسة مقارنة لتحويل فورييه في المجال المكاني ثنائي الأبعاد. تشمل الدراسة الحسابات النظرية التي تم إجراؤها لتحويل فورييه ثنائي الأبعاد نحو وظائف كائن هندسية معينة في المجال المكاني والعمل التجريبي على فتحات مادية مماثلة في شكل شفافيات تستخدم كوظائف كائن في أنظمة إعداد 2 F - و4 F. استخدم المؤلفون برنامج MATLAB® لحساب الحسابات النظرية لإنشاء هندسة فتحة العدسة ثم تحديد تحويل فورييه. استفادت الدراسة من نوعين من الكاميرات الرقمية لتسجيل النتائج التجريبية. كانت إحدى الكاميرات عبارة عن كاميرا عادية عالية الدقة بدقة (12) ميجابكسل بينما كانت الأخرى عبارة عن كاميرا تلتقط توزيع طاقة تحويل فورييه في مجال التردد المكاني.

الكلمات المفتاحية

تحويل فورييه، ومعالجة الإشارات الزمنية، هندسة فتحة العدسة، التردد المكاني.

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Abstract

Fourier transform is a crucial technique used in applied mathematics. Its first application was in electrical engineering, communications and temporal signal processing. In this study, the research utilized the biconvex lens' diffractive characteristics in a comparative study of Fourier transform in two-dimensional spatial domain. The study is inclusive of theoretical calculations performed for 2-D Fourier transform towards certain geometrical object functions in the spatial domain and experimental work on similar physical apertures in the form of transparencies used as object functions in 2F- and 4F- set up systems. The authors used MATLAB® software to compute the theoretical calculations for creating aperture geometry and then to determine its Fourier transform. The study leveraged two kinds of digital cameras for recording the experimental results. One of the cameras was an ordinary HD camera with 12-megapixel resolution while the other one was a CCD camera that captures the power distribution of Fourier transform in spatial frequency domain.

Keyword:

Spatial Signal Processing, Fourier transform, aperture geometry, spatial frequency.

1. Introduction

Diffraction effect is a common feature present in wave phenomenon. This phenomenon occurs as a result of wave front getting obstructed by light, a matter wave or sound. Wave front has numerous segments, which propagate beyond the obstruction and cause an interference. This pattern causes a specific energy-density distribution, which is often referred to diffraction pattern [1-4].

The aim of the current study is to detail the usage of the scientific analytical tool MATLAB® to execute challenging mathematic calculations with experimental implementation as well as Fraunhofer diffraction. In Fraunhofer diffraction, only a confined number of cases are handled and in this phenomenon, the light that approaches the diffracting object is said to be parallel and monochromatic. Further, the image place is kept at a large distance in comparison with the size of the diffracting object [5].

Linear transforms, especially Fourier and Laplace transforms are used in a wide range of scenarios to solve the scientific and engineering problems. Various applications of Fourier transform are random process modelling, antenna studies, boundary-value problems, probability theory, optics, linear system analysis, and quantum physics [6-7] Further, Fourier transform has been applied to restore the astronomical data successfully [8].

2. Theory

Fraunhofer diffraction is nothing but the theory of light transmission via apertures as per the assumption that the aperture function multiplies the incident wave. It is known as a far field approximation, in which the observed pattern seems to have located at focal plane of a lens, usually called a Fourier plane [5]. The position of the Fraunhofer (far field region) is shown in the Fig (1) [9].

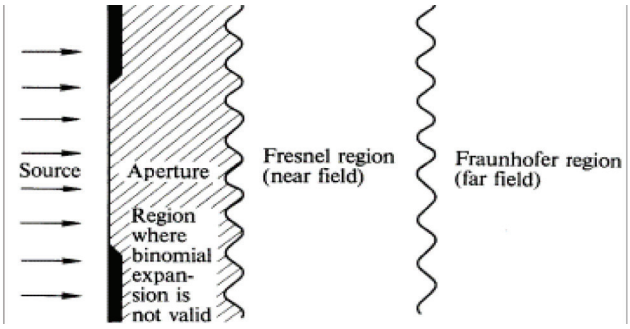


Fig. (1): Diagram showing the relative positions of the Fresnel (near field) and Fraunhofer (far field) regions [9]

When light is propagating (in the positive, $z-direction$), the electric field in an arbitrary plane at can be calculated from the field at any preceding plane at z applying Huygens's construction, as illustrated in the Fig. (2).

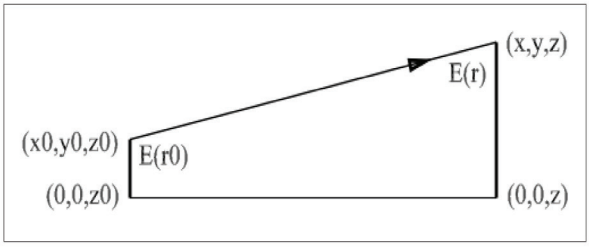


Fig. (2): Geometry and parameters used for the paraxial approximation [10].

In Fig. (2), the light is propagating from left to right ($z>z_0$), for the field at ($r=(x,y,z)$) contributes to the point ($r_0=(x_0,y_0,z_0)$) , one may derive as:

$$E(r)_{r_0} \propto \frac{E(r_0)}{|r-r_0|} \exp(i2\pi\upsilon|r-r_0|) \quad .....(1)$$

assuming monochromatic, coherent light beam. Furthermore, the scalar (E) indicates that only one polarization component is considered and light propagation is approximately parallel to the (z-axis) . The total field is integrated over (x_0 and y_0) in the(z_0) plane .

$$E(r) \propto \int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty} \frac{E(r_0)}{|r-r_0|} \exp(i2\pi\upsilon|r-r_0|)\, dx_0\, dy_0 \quad .....(2)$$

Here:

$$|r-r_0| = [(x-x_0)^2+(y-y_0)^2+(z-z_0)^2]^{1/2} \quad .....(3)$$

One can approximate Eq. (3) as per the assumption that

$$(z-z_0)^2 >> (x-x_0)^2+(y-y_0)^2 .....(4)$$

i.e., the so-called paraxial approximation to:

$$|r-r_0| \approx (z-z_0)\left[1+\frac{(x-x_0)^2+(y-y_0)^2}{2(z-z_0)^2}\right] \quad .....(5)$$

Eq. (2) can be written as:

$$E(x,y) \propto \frac{P(x,y)}{z-z_0} \int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty} E(x_0,y_0)\, P(x_0,y_0) \exp\left[-i2\pi\upsilon\frac{xx_0+yy_0}{z-z_0}\right] dx_0 dy_0 .....(6)$$

One can interpret Eq. (6) as three successive events or operations:

- Both field $\{E(x_0, y_0)\}$ as well as $\{P(x_0, y_0)\}$phase factor are multiplied
- In case of this product, a two-dimensional Fourier transform is found to be satisfactory.
- The second phase factor {P(x, y)} and the result are then multiplied.

If the approximations leading to eq. (6) can be made, this is called Fresnel diffraction or the Fresnel approximation. If it is additionally assumed that $\{P(x_0, y_0)\}$=~1 in the entire region, i.e., that $(z-z_0)$ is large, eq. (6) can be rewritten as:

$$E(x,y) \propto \frac{P(x,y)}{z-z_0} \int_{-\infty}^{+\infty}\int_{-\infty}^{+\infty} E(x_0,y_0) \exp\left[-i2\pi\upsilon\frac{xx_0+yy_0}{z-z_0}\right] dx_0 dy_0 .....(7)$$

In this regime, {E(x, y)} denotes the 2D Fourier transform of $\{E(x_0, y_0)\}$, except for a multiplicative phase factor that shows no impact on the light intensity. This regime is termed to be Fraunhofer diffraction or the Fraunhofer approximation [1-7].

3. Theoretical Results

When the distance from the grating is large or a lens is used to focus the diffraction pattern onto the image plane, then the diffraction pattern becomes a Fourier transform, as given by [1].

$$E(x,y,z) = C\, \Im\{E\}\Big|_{\upsilon_x=\frac{x}{\lambda z}\ \upsilon_y=\frac{y}{\lambda z}} \quad .....(8)$$

Where:E(x,y,z): is the electric field distribution

C: is the phase factor

υ_x and υ_y are spatial frequencies

λ is the wave length

3.1. Fourier Transform of Bitmap Images

When the 2-D function or image is given with a bitmap file, we can use the m-file given

in Table (1) to find its Fourier transform. Fig (3: a) is the bitmap image used when the image file size is (256) by (256). It is easily generated with Microsoft® paint. Figure (3: b) shows the diffraction pattern (or the Fourier transform) of a triangular function {Λ(x)} [2].

T 1: fft2D bitmap image m: m-file for the 2-D Fourier transform of the bitmap image.

```
---------------------------------------------------
%fft2Dbitmap_image.m
%Simulation of Fourier transformation of bitmap images
clear
I= imread ("stars. bmp',' bmp'); %Input bitmap image
I=I(:,:,1);
figure(1) %displaying input
colormap (gray (255));
image(I)
axis off
FI=fft2(I);
FI= fft shift(FI);
max1=max(FI);
max2=max(max1);
scale=1.0/max2;
FI=FI. *scale;
Figure (2) %Gray scale image of the absolute value of transform
colormap(gray(255));
image(10*(abs(256*FI)));
axis off
---------------------------------------------------
```

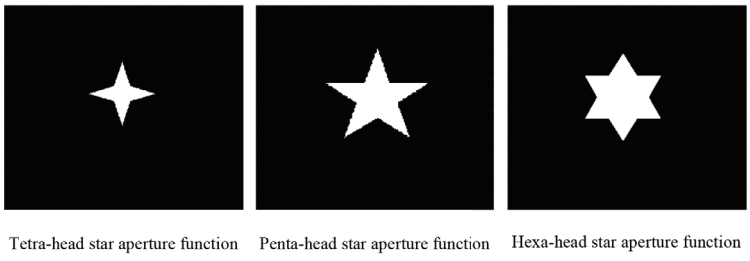


Fig. (3) a: The aperture

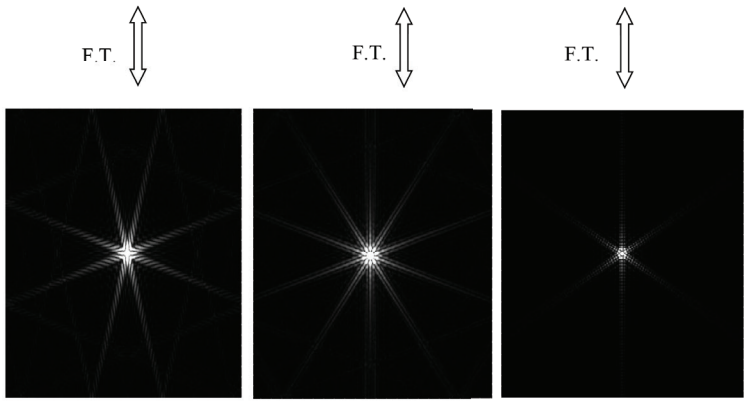


Fig. (3) b: The diffraction patterns

Fig. (3): Bitmap image and its transform generated by the m-file in the MATLAB software.

4. Experimental results

The experimental work includes investigation of a convex lens' Fourier transform characteristics. Different diffraction objects in a 2F setup system have been used. The experimental setup is shown in Fig (4). Optical spatial filtering of different diffraction objects in a 4F setup system (low-pass filters) was achieved, as illustrated in the Fig (5).

Fig. (4): Experimental 2F setup system.

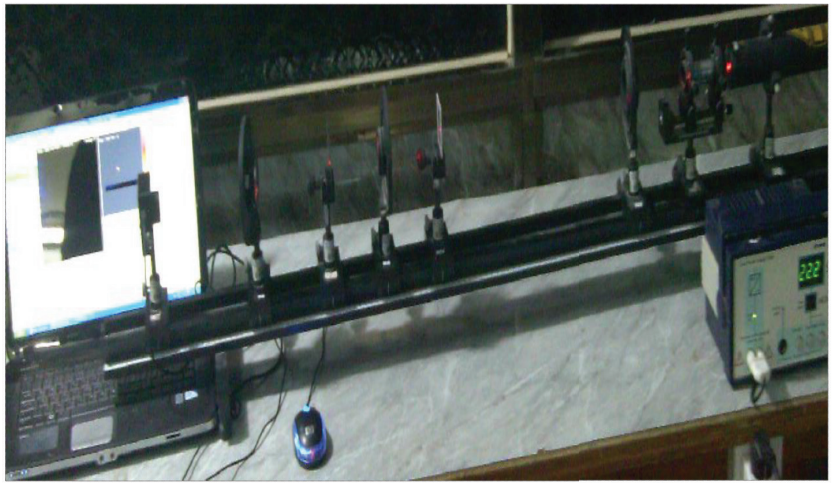


Fig. (5): Experimental 4F setup system for image reconstructio

The diffraction pattern of stars shown in the Figs (6,7,8 and 9). using a digital camera and a CCD camera are

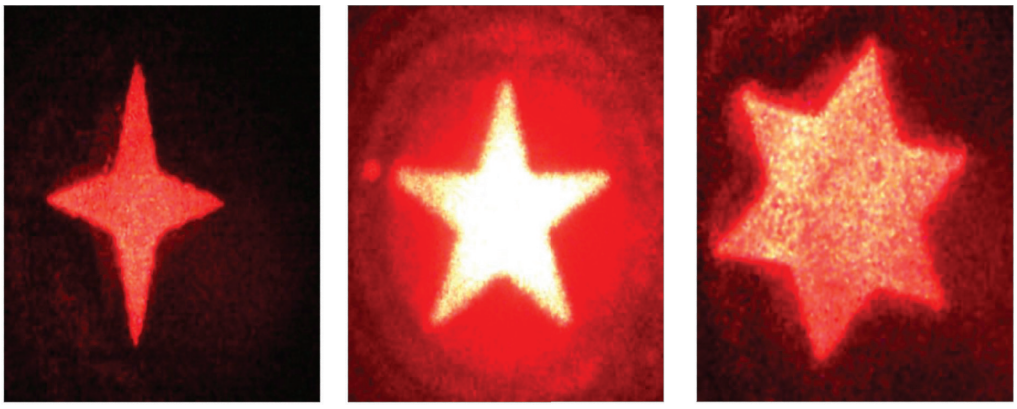


Fig. (6) a: The aperture functions.

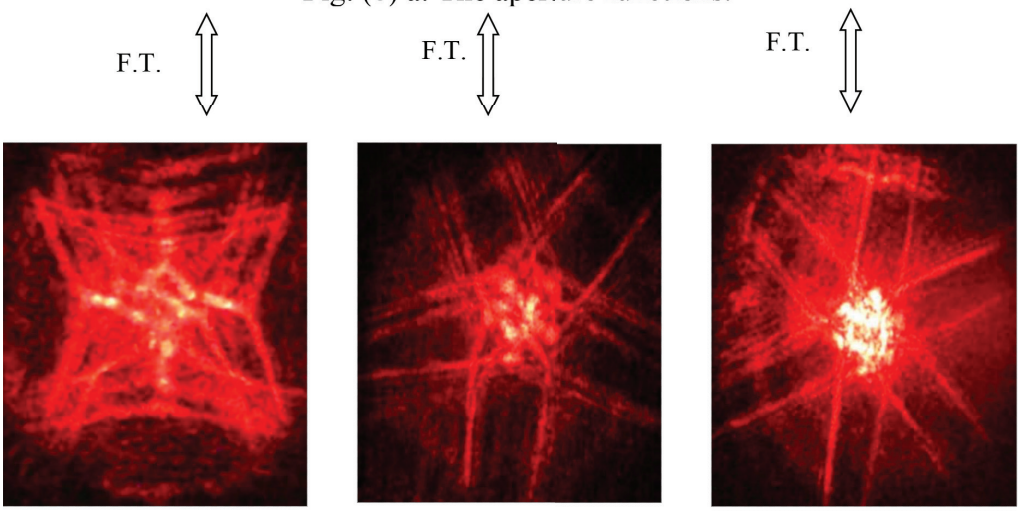


Fig. (6) b: The diffraction patterns.

Fig. (6): Different stars' aperture functions and their diffraction patterns recorded with a digital HD camera.

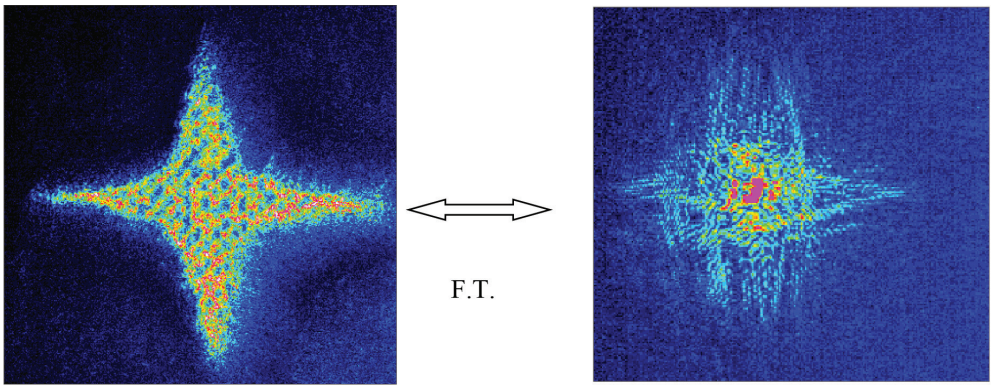


Fig. (7) a: The power distribution in the tetra-head star aperture function recorded with a CCD camera.

Fig. (7) b: Diffraction pattern of the tetra-head star aperture function recorded with a CCD camera.

Fig. (7): A tetra-head star and its diffraction pattern recorded with a CCD camera.

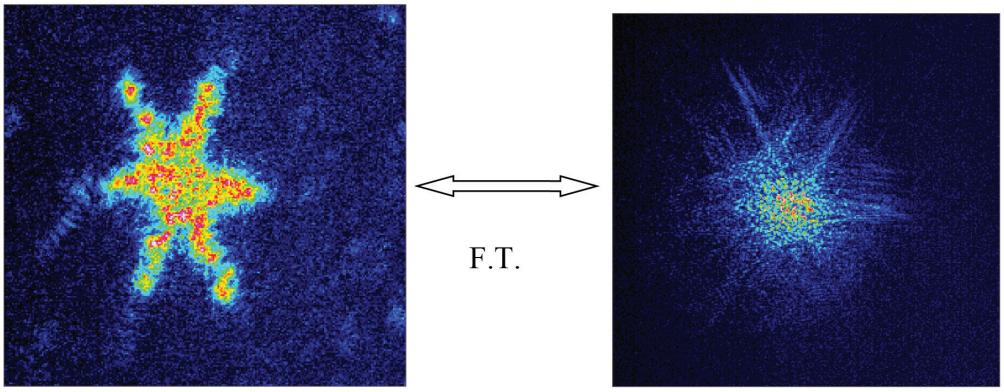


Fig. (8) a: The power distribution for a hexa-head star aperture function recorded with a CCD camera.

Fig. (8) b: Diffraction pattern of hexa-head star aperture function recorded with a CCD camera.

Fig. (8): A hexa-head star and its diffraction pattern recorded with a CCD camera.

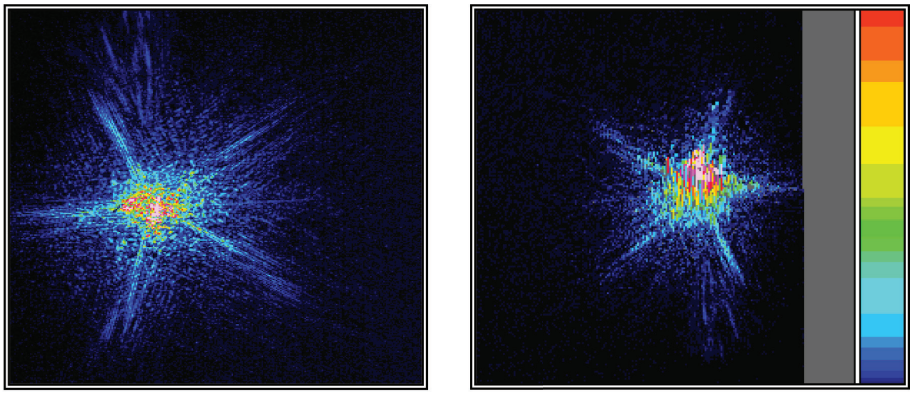


Fig. (9) a: Diffraction pattern of a penta-head star aperture function recorded with a CCD camera.

Fig. (9) b: A (3-D) power distribution for a penta-head star aperture function.

Fig. (9): A penta-head star and its diffraction pattern recorded with a CCD camera.

4.1. Lens as a low-pass filter

Lens is generally considered as a low-pass plane wave filter. If we consider a small light source that is placed on the axis in the lens' objective plane, it is assumed that the source is small enough that, by the far-field criterion, the lens is in the far field of the small source. Then, the field radiated by the small source is a spherical wave which is modulated by the Fourier transform of the source distribution. Then the lens passes through the object plane above the image plane at a portion of the radiated spherical wave that lies within the lens' edge angle. In this far field case, the radiated spherical wave getting truncated is similar to that of the plane wave spectrum of the small source getting truncated. So, the plane wave components in this far field spherical wave which lie beyond the edge angle of the lens are not captured by the lens and are not transferred over to the image plane [3-6].

4.2. Observations without optical filtration

In this case, a photographic slide of Emperor Maximilian was used as a diffracting aperture, as illustrated in the Fig. (10).

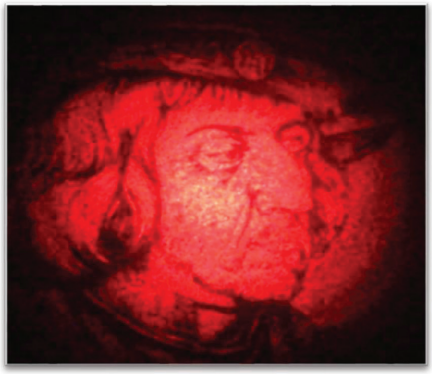
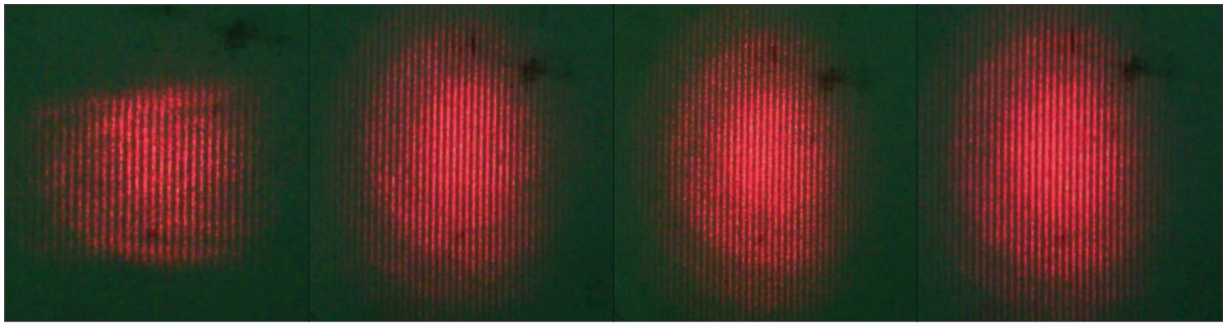


Fig. (10): Aperture function for the Emperor

4.3. Observations with optical filtration

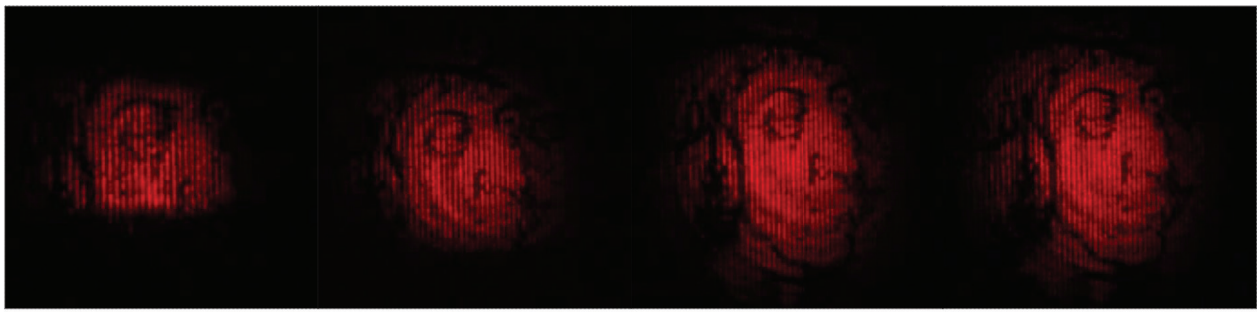
The observations with optical filtration were able to attain with the help of grid (4 lines/mm) and a pinhole diaphragm (diameters: d = 1, 2, 3, 5)mm as a low pass optical filter in the Fourier plane, as illustrated in the Fig. (11).



(a) (b) (c) (d)

Fig. (11): Diffraction pattern for the grid (4 lines/mm) and a pinhole diaphragm :(a) d = 1 mm; (b) d = 2 mm; (c) d = 3 mm; (d) d = 5mm.

The slide of Emperor Maximilian and the grid (4 lines/mm) are now placed together to add noise to the object aperture (the Emperor Maximilian slide) as illustrated in the Fig (12).



(a) (b) (c) (d)

Fig. (12): Diffraction pattern for the grid (4) lines/mm and the slide Emperor Maximilian: (a) d = 1 mm; (b) d = 2mm ; (c) d = 3mm ; (d) d = 5mm .

4.4. Inverse Fourier Transform: Image Reconstruction

The Fourier transform has an inverse, which maps a transformed function back to its initial value [6]. That is, if:-

$$H(\upsilon_x,\upsilon_y)=\Im\{h(x,y)\}, \text{ then } h(x,y)=\Im^{-1}\{H(\upsilon_x,\upsilon_y)\} \quad ..(9)$$

Then, we apply a Fourier transform to the diffraction pattern to obtain the initial image pattern. We will use aperture function which is the arrow function to investigate the inverse Fourier transform, as shown in Fig. (13).

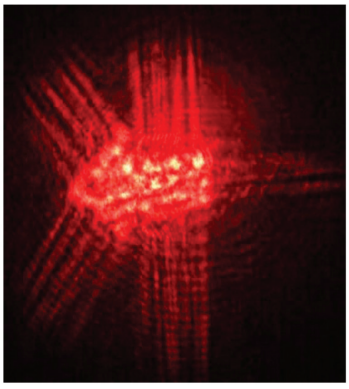


Fig. (13) a: Diffraction pattern of the arrow object recorded with a digital HD camera.

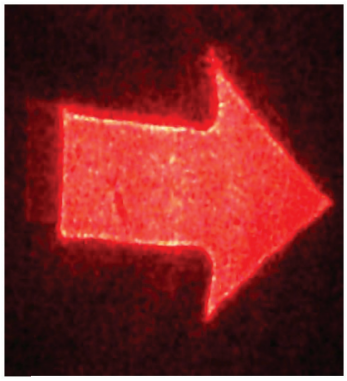


Fig. (13) b: The arrow reconstructed image recorded with a digital HD camera.

Fig. (13): Image reconstruction of the arrow object recorded with a digital HD camera.

5. Conclusions

The current study concludes that the diffraction pattern determined based on fft2 method is completely reliable on the size of the aperture or element size, as illustrated in the Fig (3). Few and negligible differences were found between the experimental as well as the theoretical results which are illustrated in the Fig (6). This figure was captured using a digital camera, and the intensity pattern observed varies with the distance from the aperture and hence that Fresnel diffraction has been obtained. The reasoned is whenever increased the aperture obtained to Fresnel diffraction. In Fig (7), (8), and (9), which were captured using a CCD camera, the Fourier transform intensity was recorded, where this intensity was different in each figure due to the associated noise. From Fig (10), (11), and (12), we can conclude that low-pass filtration can be used as a spatial frequency filter to negate the disturbances to the wavefront which result from soiling of the lenses, and we notice that the diffraction pattern relies on the aperture diameter.

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