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Highlights

- Nuclear Power Plant
- Effect of Dynamic Stiffness
- Solar Parabolic Trough
- Performance of Paddy Grain

Discovering Thoughts, Inventing Future

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USA Toll Free Fax: +001-888-839-7392

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Contents of the Issue

i. Copyright Notice
ii. Editorial Board Members
iii. Chief Author and Dean
iv. Contents of the Issue

1. Proximity Control for Linear Features - Application for Ship Control in Closed Approach. *1-11*
2. Assessment of Profile Error for Efficient Solar Parabolic Trough. *13-16*
3. Nuclear Power Plant in Bangladesh and the Much Talked about Rooppur Project. *17-22*
4. Effect of Dynamic Stiffness on Performance of Paddy Grain Losses in Axial-Flow Thresher. *23-35*

v. Fellows and Auxiliary Memberships
vi. Process of Submission of Research Paper
vii. Preferred Author Guidelines
viii. Index

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Proximity Control for Linear Features - Application for Ship Control in Closed Approach

By Nguyen Xuan Phuong
Ho Chi Minh City University of Transport, Vietnam

Abstract- The paper devotes the proximity control for linear features that will apply for ship control in closed approach. In nautical practice of Vietnam, the ship has been encountered in the special situations, such as: coming approach ship to ship, ship to floating object, ship to mobile object... In order to solve this issue, the author presents his researches about task of the problem of the regulator of the optimal time; also he gives the solution of the problem of time-optimal controller for a linear system with constant parameters. Accordingly, the result is applied to design and create a control system to ensure the meeting of movements of ships.

Keywords: proximity control for linear features, ship control in closed approach, linear system with constant parameters.

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Proximity Control for Linear Features - Application for Ship Control in Closed Approach

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Keywords: proximity control for linear features, ship control in closed approach, linear system with constant parameters.

I. Introduction

In nautical practice of Vietnam, the ship has been encountered in the special situations, such as: coming approach ship to ship, ship to floating object, ship to mobile object,…In order to control the ship safely in these cases, this researcher has been developing the algorithm of proximity control for linear features which will apply for ship control in closed approach. For this purpose, it's applied the results obtained for the problem to the case of linear systems with constant parameters. Throughout this paper, an area Sand the origin of the phase space will be considered. This task will be called the problem of the regulator of the optimal time.

II. The Problem of Time-Optimal Controller for a Linear System with Constant Parameters

It developed a set of control models for ships in closed approach. The linear production is considered that there is a dynamic system[1, 4, 11, 12].

$$\dot{x}(t) = Ax(t) + Bu(t) \tag{2.1}$$

Where

- Status of system $x(t)$is an n-dimensional vector;
- Matrix A of the system is a constant matrix size n x n;
- The matrix coefficients of the control functions("gain") B is a constant matrix size n x r;
- The control $u(t)$is an r-dimensional vector

We consider that the system is completely controllable and components $u_1(t)$, $u_2(t)$,…, $u_r(t)$limited in size.

$$\left|u_j(t)\right| \le 1,\ \ j = 1, 2, ..., r \tag{2.2}$$

At a given initial time $t_0 = 0$ the initial state of the system is equal to

$$x(0) = \xi \tag{2.3}$$

Find the control $u^*(t)$ transforming the system from ξ to 0 at the minimum time.

We denote λ_1, λ_2,…,λ_n the eigen values of the matrix system A, and through b_1, b_2,…, b_r -column vectors of the matrix B

$$B = \begin{bmatrix} \uparrow & \vdots & \uparrow & \vdots & & \vdots & \uparrow \\ b_1 & \vdots & b_2 & \vdots & \cdots & \vdots & b_r \\ \downarrow & \vdots & \downarrow & \vdots & & \vdots & \downarrow \end{bmatrix} \tag{2.4}$$

The system is fully controllable. This means that the control transferring system(3.1) from any initial state ξ and the origin 0, exist. This occurs if the matrix size n × *(rn)*

$$G = \left[B \vdots AB \vdots A^2B \vdots \ldots \vdots A^{n-1}B\right] \tag{2.5}$$

It contains n linearly independent column vectors.

Entrance $y(t)$(3.1) is connected with its state $x(t)$ and the control $u(t)$by the equation:

$$y(t) = Cx(t) + Du(t) \tag{2.6}$$

The algorithm for calculating the optimal control is shown in the following block diagram in Fig.3.1

Author: Faculty of Navigation, Ho Chi Minh City University of Transport, Ho Chi Minh city, Vietnam. e-mail: Phuongnx1968@gmail.com

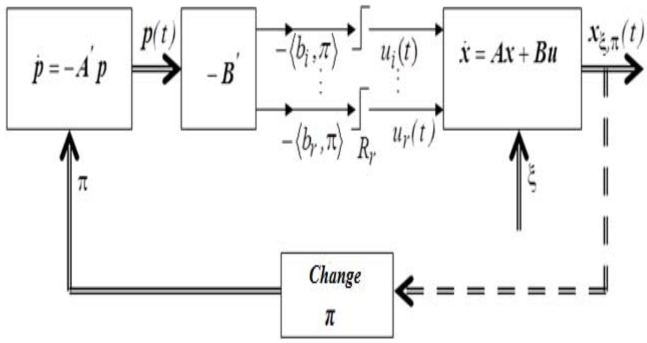

Fig. 3.1 : The structure of the algorithm is an open problem of optimal high-speed

Block diagram of an optimal feedback system is shown in Fig. 3.2. Functions $x_1(t), x_2(t),\dots, x_n(t)$measured at each time and are introduced into a subsystem, designated C("computer"). RF outputs are switching function $h_1[x(t)], h_2[x(t)],\dots, h_r([x(t)]$ which are then fed to the ideal relay $R_1, R_2,\dots, R_r$ for the control variables, time-optimal. Receiving and developing of functions $h_1[x(t)], h_2[x(t)],\dots, h_r([x(t)]$is the basis of the problem of optimal control.

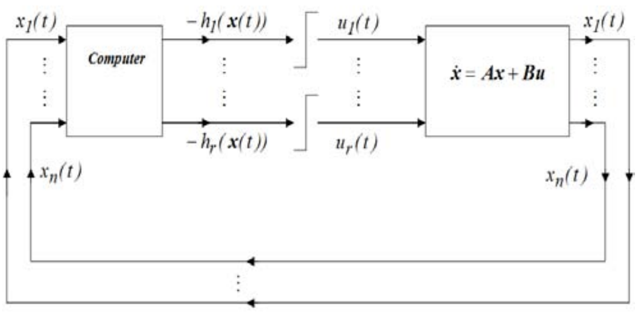

Fig. 3.2 : Structure of the time-optimal control systems with feedback

III. The Geometric Properties of the Optimal Time Control

a) The Surface of the Minimum Time

Previously, the author discussed the geometric nature of the problem of optimal time basing on the reachable states areas [2, 12]. Then we went from geometric considerations to the analytical results that obtained from the necessary conditions given by the principle of minimum. In this section we try to give a geometric interpretation of the necessary conditions. We assume that the task is normal [12].Note also that the material in this section is a specification of the above mentioned remarks.

Consider the surface of the minimum time, and we will treat the optimal control that causes the system to move along the surface of the minimum time in the direction of fastest decrease. After that we will be able to establish a correspondence between the additional variable gradient and surface of minimum time. Our arguments are inherently heuristic, since we are primarily interested in giving a geometric interpretation of the necessary conditions.

Let x -the state in the space of phase coordinates. Suppose that there is an optimal control(only) that send sx to 0. We denote the minimum time required for translation x to 0 through:

$$T^*(x) \tag{3.1}$$

We show that the minimum time $T^*(x)$ depends on the state of the x and does not depend explicitly on the time that

$$\frac{\partial T^*(x)}{\partial t} = 0 \tag{3.2}$$

It is true, as the time-invariant of systems, $\dot{x}(t) = Ax(t) + Bu(t)$ it implies that the minimum time may be only a function of state. In other words, if x is the state of the system at $t = 0$ and the minimum time required for translation x in 0 is $T^*(x)$ and x -state *while* $t = t_0$, then the optimal control will translate x into 0 at time $t_0 + T^*(x)$.

Since the time required to transfer the system from 0 to 0 is zero and we are considering only positive solutions times, it is obvious that $T^*(x)$ has properties as

$$T^*(x) = 0,\ x = 0 \tag{3.3}$$

$$T^*(x) > 0,\ x \neq 0 \tag{3.4}$$

In the future, for the gradient of function $T^*(x)$ of x we use the notation[11]

$$\frac{\partial T^*(x)}{\partial x} = \begin{bmatrix} \dfrac{\partial T^*(x)}{\partial x_1} \\ \vdots \\ \dfrac{\partial T^*(x)}{\partial x_n} \end{bmatrix} \tag{3.5}$$

We next consider some properties of the function $T^*(x)$. It is useful to consider $T^*(x)$ as the minimum time surface and present it graphically as shown in Fig. 3.3

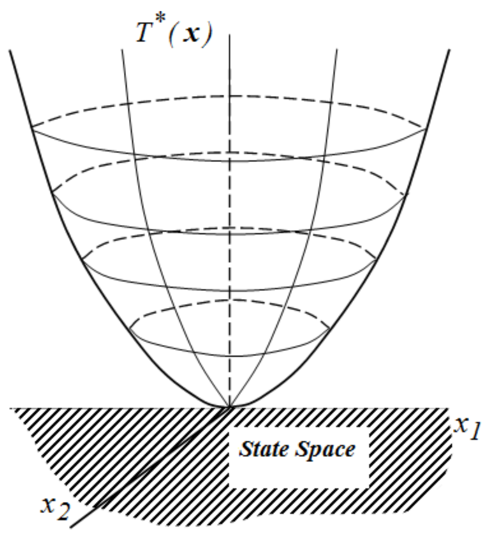

Fig. 3.3 : The surface of the minimum value (minimum time) $T^*(x)$ as a function of x

Next, we define the concept of minimum isochrones.

b) The Minimum Isochrones

Let $S(\tau)$-the set of states from which you can go to 0 for the same minimum time τ, $\tau \geq 0$. We call $S(\tau)$-minimal isochrone τ. This function $S(\tau)$ is defined by

$$S(\tau)=\left\{x: T^*(x)=\tau;\ \tau \geq 0\right\} \tag{3.6}$$

Suppose that $S(\tau)$ is the set of states from which you can go to the origin by using of the optimal control for a timeless than or equal to τ [3, 7]:

$$\widehat{S}(\tau)=\left\{x: T^*(x)\leq \tau;\ \tau \geq 0\right\} \tag{3.7}$$

Equations (3.5) and (3.6), we conclude that there is a subset $\widehat{S}(\tau)$ of $S(\tau)$. It can be sure that $S(\tau)$ is the boundary and closed $\widehat{S}(\tau)$ [4, 13].

We prove that the set of $\widehat{S}(\tau)$ is strictly convex. Let x_1 and x_2-two different states at the τ–minimum isochrones.

$$x_1 \in S(\tau),\ \ x_2 \in S(\tau) \tag{3.8}$$

In view of normality, we know that there are only optimal control $u_1^*(t)=-SIGN\left\{B^{'}p_1^*(t)\right\}$ transform x_1 to 0, and $u_2^*(t)=-SIGN\left\{B^{'}p_2^*(t)\right\}$ transform x_2 to 0. Thus, the equations should be valid:

$$x_1=\int_0^{\tau} e^{-At}BSIGN\left\{B^{'}p_1^*(t)\right\}dt \tag{3.9}$$

$$x_2=\int_0^{\tau} e^{-At}BSIGN\left\{B^{'}p_2^*(t)\right\}dt \tag{3.10}$$

Suppose that x -on the condition (open) segment joining x_1 and x_2, as shown in Fig. 3.4.Choose:

$$0<\alpha<1 \tag{3.11}$$

and consider the state of x, defined by the relation:

$$x=\alpha x_1+(1-\alpha)x_2,\ \ \alpha \in (0,1) \tag{3.12}$$

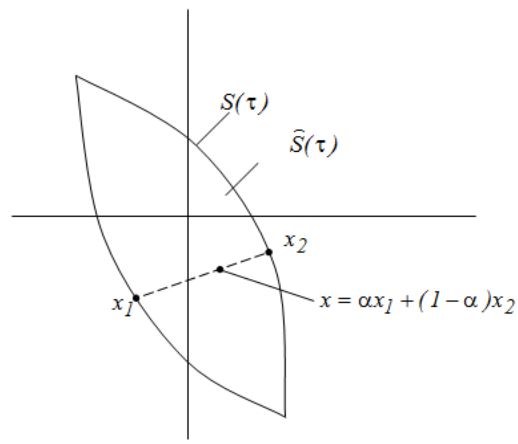

Fig. 3.4 : Illustration convexity

From (3.12), (3.10) and (3.9), we obtain:

$$\begin{aligned} x=\int_0^{\tau} e^{-At}B\Big[\alpha SIGN\left\{B^{'}p_1^*(t)\right\}+ \\ +(1-\alpha)SIGN\left\{B^{'}p_2^*(t)\right\}\Big]dt \end{aligned} \tag{3.13}$$

Now let $u^*(t)=-SIGN\left\{B^{'}p^*(t)\right\}$ optimal control, sending x to 0 and $\tau^{'}$-the corresponding minimum time $(T^*(x)=\tau^{'})$. We show that

$$\tau^{'}<\tau \tag{3.14}$$

To prove this, we note:

$$x_1=\int_0^{\tau^{'}} e^{-At}BSIGN\left\{B^{'}p^*(t)\right\}dt \tag{3.15}$$

From (2.14) it follows that the control

$$\begin{aligned} \alpha u_1^*(t)+(1-\alpha)u_2^*(t)=\alpha SIGN\left\{B^{'}p_1^*(t)\right\}+ \\ +(1-\alpha)SIGN\left\{B^{'}p_2^*(t)\right\} \end{aligned} \tag{3.16}$$

converts x to 0. However, this control is not optimal in performance, since it is not a vector whose components are functions of the type of sign. To prove this, let us assume that at some time $\hat{t}$ we have:

$$u_1^*(\hat{t}) = \begin{bmatrix} +1 \\ -1 \\ \vdots \\ -1 \end{bmatrix}, \; u_2^*(\hat{t}) = \begin{bmatrix} -1 \\ -1 \\ \vdots \\ -1 \end{bmatrix} \quad (3.17)$$

From here you can get

$$\alpha u_1^*(\hat{t}) + (1-\alpha) u_2^*(\hat{t}) = \begin{bmatrix} 2\alpha - 1 \\ -1 \\ -1 \\ \vdots \\ -1 \end{bmatrix} \quad (3.18)$$

But since $0 < \alpha < 1$, we have the inequality:

$$-1 < 2\alpha - 1 < +1 \quad (3.19)$$

and therefore the control(3.17)cannot be the optimal time. If this control is not optimal and transform s x to 0 during τ, then the optimal control will require τ' < τ. Thus the statement(2.14) is proved. We have seen that S(τ) is a border of $\hat{S}(\tau)$. Consequently, the state $x = \alpha x_1 + (1-\alpha) x_1$, $\alpha \in (0,1)$ is an element of the interior $\hat{S}(\tau)$ and therefore the set $\hat{S}(\tau)$ is strictly convex.

c) The Heuristic Geometric Proof

Note that the minimal isochrones τ "grow" with the τ increase [2, 12, 18]. Suppose that τ_1–τ_2 two arbitrary time, wherein τ

$$0 < \tau_1 < \tau_2 \quad (3.20)$$

Then we can show that:

$$0 \subset \hat{S}(\tau_1) \subset \hat{S}(\tau_2) \quad (3.21)$$

Value for inclusion (3.21) means that the minimum isochrones s increase their "distance" from the origin with increasing time, and this increase is "smooth". To clarify this provision, we will give a heuristic geometric proof.

Suppose that ξ-state when $t = 0$, and assume that for transfer ξ to 0 by means of optimal control $u^*(t)$takes time $0 \le t \le \tau$. Thus $\xi \in S(\tau)$. Fig. 3.5shows the optimal trajectory x^*connecting ξ with 0. Let $\varepsilon > 0$ -small positive time. Consider the state $x^*(\varepsilon)$ when $t = \varepsilon$.

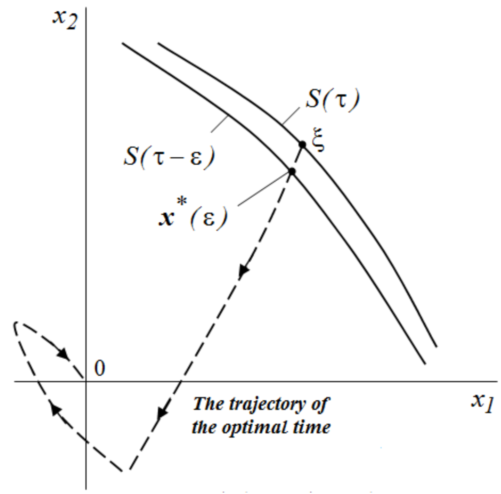

Fig. 3.5 : Minimum isochrones S(τ)and S(τ-ε), ε>0. – Optimal path from x*(ε) to 0is a part-optimal path from to 0

According to the principle of optimal control $u^*(t)$ to $\varepsilon \le t \le \tau$ have optimal control taking the $x^*(\varepsilon)$ to 0 in a minimum time $t = \varepsilon$. Thus $x^*(\varepsilon) \in S(\tau - \varepsilon)$. Since the phase trajectory is continuous, $\varepsilon \to 0$ then the state $x^*(\varepsilon)$ is committed to ξ. If you repeat this experiment for all, $\xi \in S(\tau)$ then you may find that isochrones $S(\tau)$ and $S(\tau - \varepsilon)$ "approaching each other closer" when $\varepsilon \to 0$.

Let us now discuss the geometric properties of optimal control $u^*(t)$. Suppose that ξ-the initial state, and $\xi \in S(\tau)$. Fig. 3.6 shows that there is a region X_ξ of phase space where the gradient $\dfrac{\partial T^*(x)}{\partial x}$ is defined for all $x \in X_\xi$.

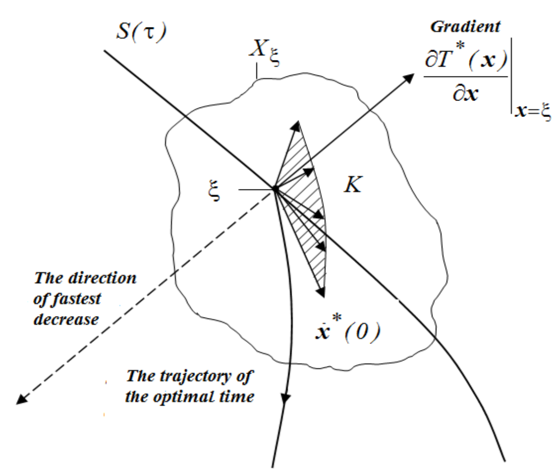

Fig. 3.6 : Optimal Control $u^*(0)$ flushes vector, which is aimed, as far as possible to be more precise, in the direction of fastest decrease

Global Journal of Researches in Engineering (A) Volume XV Issue II Version I Year 2015

In other words, the components of the gradient vector:

$$\nabla T^*(x) = \frac{\partial T^*(x)}{\partial x} = \begin{bmatrix} \frac{\partial T^*(x)}{\partial x_1} \\ \vdots \\ \frac{\partial T^*(x)}{\partial x_n} \end{bmatrix} \tag{3.22}$$

It is well-defined functions for all $x \in X_\xi$. Gradient *T** at. The vector $\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi}$ determines the direction of the most rapid changes in the function *T*(x)*at the point . As shown in Fig. 3.6 gradient is normal to the curve $S(\tau)$ at the point $x=\xi$ and directed from "origin". The direction of the vector $-\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi}$ (shown in phantom in Fig. 3.6) determines the direction of "fastest decrease" on the surface *T*(x)* at a point. So, if we construct the surface *T*(x)* and put it in a ballpoint , it begins to roll down the surface *T*(x)* in the direction of the vector .

If *t= 0* we have:

$$\dot{x}(0) = A\xi + Bu(0),\ u(0) \in \Omega \tag{3.23}$$

The direction and magnitude of the vector $\dot{x}(0)$ is obviously dependent on a vector $A\xi$ that depends on the state ξ, and the vector *Bu(0)*, magnitude and direction of which can be selected within the constraints $u(0) \in \Omega$. If "try" all control *u(0)* of Ω, we get the set of vectors $\{\dot{x}(0)\}$ that form a cone K. We assume that this cone is shown in Fig. 3.6.Thus, the restriction $u(0) \in \Omega$ defines regional directions in Fig. 3.6, and we can do so that the vector $\dot{x}(0)$ is directed along $-\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi}$.

However, there is a vector $\dot{x}^*(0)$ pointing in the direction of fastest decrease under the restrictions imposed. We denote the control vector *u*(0)* such that:

$$\dot{x}^*(0) = A\xi + Bu^*(0) \tag{3.24}$$

Consider the difference between a vector $\dot{x}^*(0)$ from all the other possible vectors $\dot{x}(0)$? It is easy to see that $\dot{x}^*(0)$ satisfies(see. Fig.3.6)

$$\left\langle \dot{x}^*(0), \left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi} \right\rangle \le \left\langle \dot{x}(0), \left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi} \right\rangle \tag{3.25}$$

for all $\dot{x}(0) \in K$. Similarly, from (3.23) and (3.24), we find that for all $u(0) \in \Omega$.

$$\begin{aligned} &\left\langle A\xi + Bu^*(0), \left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi} \right\rangle \le \\ &\le \left\langle A\xi + Bu(0), \left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi} \right\rangle \end{aligned} \tag{3.26}$$

Or

$$\begin{aligned} &\left\langle u^*(0), B' \left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi} \right\rangle \le \\ &\le \left\langle u(0), B' \left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi} \right\rangle \end{aligned} \tag{3.27}$$

Thus, vector control *u*(0)*satisfying(3.27), sets the direction of fastest decrease(compatible with restrictions)along the surface of the minimum time *T*(x)*at the point $x=\xi$. This control *u*(0)*satisfying(3.27) must also satisfy the relation;

$$\left\langle u^*(0), B'\pi \right\rangle \le \left\langle u(0), B'\pi \right\rangle \tag{3.28}$$

Where π-arbitrary vector directed "outside" and the minimum normal isochrones $S(\tau)$ at the point ξ.

$$\pi = c\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi},\ c > 0 \tag{3.29}$$

for any positive constants *c*.

Physically, it should beat the point $x=\xi$ of optimal control *u*(0)*, because it makes the state of the system or the representative point in the phase space to move, maximizing the rate of change in the minimum time. If *u*(0)* -optimal control, the prerequisite is known that there is a variable *p*(0)*in which the relation:

$$\begin{aligned} &1 + \left\langle A\xi, p^*(0) \right\rangle + \left\langle u^*(0), B' p^*(0) \right\rangle \le \\ &\le 1 + \left\langle A\xi, p^*(0) \right\rangle + \left\langle u(0), B' p^*(0) \right\rangle \end{aligned} \tag{3.30}$$

For all $u(0) \in \Omega$

Or equivalent

$$\left\langle u^*(0), B' p^*(0) \right\rangle \le \left\langle u(0), B' p^*(0) \right\rangle \tag{3.31}$$

d) Remark

If *u*(0)*-at optimal control $x^*(0) = \xi$, the initial value *p*(0)*should be the same direction as the gradient $\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi}$, if it exists. The same can be expressed in a

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different way. The initial value *p*(0)* must be the outward normal to isochrones sSτat $x=\xi$.

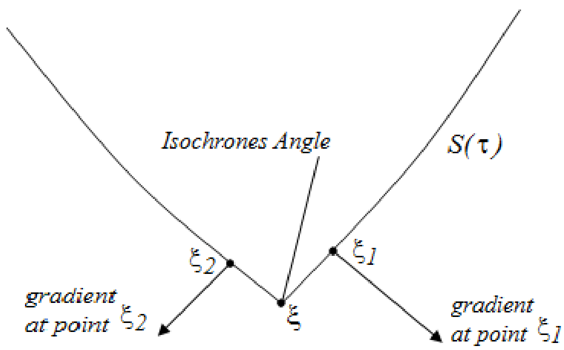

Fig. 3.7 : If a minimum angle ξ of isochrones, the direction of fastest decrease indefinitely

Let us discuss further the important case where the initial state is the "corner" of minimum isochrones. Assume that $\xi \in S(\tau)$, and as shown in Fig.3.7 is the angle isochrones; though ξ_1 -and ξ_2 are states near ξ in the isochronous $S(\tau)$. We say that ξ_1 is the "right" of, ξ and ξ_2 - to the left. The statement "ξ is in the corner isochrones $S(\tau)$" means that the gradient $\frac{\partial T^*(x)}{\partial x}$ with ξ undefined. As shown in Fig. 3.7, vectors $\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi_1}$ and $\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi_2}$ determined for all ξ_1 of the right ξ and all ξ_2 to the left of ξ , but

$$\lim_{\xi_1 \to \xi}\left\{\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi_1}\right\} \neq \lim_{\xi_2 \to \xi}\left\{\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=\xi_2}\right\} \tag{3.32}$$

Thus, if $x=\xi$ we cannot find the direction of the steepest gradient of decreasing just when $x=\xi$, as the latter is not defined. This means that optimal control at this point cannot be determined by a geometrical proof given in the preceding discussion. If, *p*(0)*however, there is a vector corresponding to ξ and *u*(0)* then (3.31) remains in force. When this line is lost between *p*(0)* and the normal to the minimum isochrone.

The preceding discussion was limited to the initial states located on this minimum isochrone. Note that the same comments by the principle of optimalityare true of any state on *x*(t)* the optimal trajectory to the origin.

Let *x*(t)*- the state on the optimal trajectory and let *p*(t)* –corresponding additional variable. Suppose $x^*(t) \in S(T)$. Then *p*(t)*-the outer normal of *S (T)* to a point *x*(t)*in case $\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=x^*(t)}$, if the gradient is defined.

IV. Conditions for the Existence of Optimal Control

a) The Particular Problem of Existence of Optimal Control to the Origin with a Heuristic Point of View

In this section is a discussion of consider the optimal control for the control system, which guarantees the existence of optimal control to the origin of any initial state in phase space [1, 15, 16].

The question of the existence of an optimal control when moving from an arbitrary initial state to an arbitrary area S is extremely complex. It is useful to consider the particular problem of existence of optimal control to the origin with a heuristic point of view.

Suppose that we are given a dynamical system is fully controlled and control is limited in size ratio $u(t) \in \Omega$. Using the assumption of controllability of the system, we can find at least one control that will translate any initial state ξ to 0 for a finite time. It may, however, prove that the initial state ξ is so far from the origin, which translate to0 can only control that do not meet the limit $u(t) \in \Omega$. In this case, there are initial states, which cannot be converted into offices 0 satisfying the constraints.

We can make the following observations: for a given plane controlled dynamical system $\dot{x}(t)=f\left[x(t),u(t)\right]$ and the area limitation Ω , n – dimensional phase space R_n can be divided into two subspaces and with the following properties:

1. If $\xi \in \Psi_\Omega$ there exists at least one admissible control transferring to 0for a finite time;
2. If $\xi \in R_n - \Psi_\Omega$, there is no optimal control taking ξ to any of the elements Ψ_Ω for the final time (and therefore cannot be translated ξ to 0 using a valid management).

In essence, the control is not limited to provide sufficient "push" to convert from a state $R_n - \Psi_\Omega$ to Ψ_Ω , and hence the origin.

From a physical point of view, control *u(t)* can add or take away power from the dynamical system. If we imagine the state *x = 0* as a state of zero energy, we can see that the system for which the set $R_n - \Psi_\Omega$ is not empty, in fact unstable. For this reason, it is believed that a stable, fully controlled dynamic system is characterized by the ratio $\Psi_\Omega = R_n$, and for unstable, there is a fully controlled system $\Psi_\Omega \in R_n$, but $\Psi_\Omega \neq R_n$.

The theorem is useful to confirm this and guarantees the existence of optimal control to the origin of any initial state, it can be formulated as follows.

b) The Optimal Control for the Control System

Consider the optimal control for the controlled system $\dot{x}(t) = Ax(t) + Bu(t)$ in accordance with the objective of movement [1, 12]. If the eigen values of A are not positive (negative or zero) real parts, then the optimal control to the origin exists for any initial state of R_n .

A rigorous proof of this theorem can be found in[17]. Consider the example of the essence of the proof of a distinct real eigen values, and the sole control variable *u(t).*

$$\left.\begin{array}{c} \dot{x}_i(t) = \lambda_i x_i(t) + b_i u(t),\ i = 1,2,...,n \\ |u(t)| \le 1 \\ \xi_i = x_i(0);\ i = 1,2,...,n \end{array}\right\} \quad (4.1)$$

The solution of (3.2-3.130) for any given formula

$$x_i(t) = e^{\lambda_i t}\left[\xi_i + \int_0^t e^{-\lambda_i \tau} b_i u(\tau)d\tau\right] \quad (4.2)$$

Suppose[1, 6, 15, 16]we found an admissible control $\hat{u}(t)$, for that $x_1(\hat{T}) = x_2(\hat{T}) = . = x_n(\hat{T}) = 0$. This means that the ratio:

$$\xi_i = -\int_0^{\hat{T}} e^{\lambda_i t} b_i \hat{u}(t)dt \quad (4.3)$$

Satisfied for all *i = 1, 2, …, n.*

Since[1, 11, 12], it can be concluded that $|\hat{u}(t)| \le 1$

$$\begin{aligned} |\xi_i| &= \left|\int_0^{\hat{T}} e^{-\lambda_i t} b_i \hat{u}(t)dt\right| \le \int_0^{\hat{T}} e^{-\lambda_i t}|b_i||\hat{u}(t)|dt \le \\ &\le \int_0^{\hat{T}} e^{-\lambda_i t}|b_i|dt = -\frac{|b_i|}{\lambda_i}\left(e^{-\lambda_i \hat{T}} - 1\right) \end{aligned} \quad (4.4)$$

For *i = 1, 2,…, n.* Assume that one of the eigen values, e.g.$\lambda_1$positive[it means that the system (3.10) is unstable]. From (3.3) we obtain:

$$|\xi_1| \le -\frac{|b_1|}{\lambda_1}\left(e^{-\lambda_1 \hat{T}} - 1\right) \quad (4.5)$$

from whence [1, 11, 12].

$$e^{-\lambda_1 \hat{T}} \le 1 - \frac{\lambda_1|\xi_1|}{|b_1|} \quad (4.6)$$

It is obvious that (3.6) cannot be satisfied for any real, positive and finite of $\hat{T}$, if the initial value of the coordinates ξ_1 of the inequality

$$|\xi_1| \ge \frac{|b_1|}{\lambda_1} \quad (4.7)$$

Thus, if, $\lambda_1 \ge 0$ and $|\xi_1| \ge \frac{|b_1|}{\lambda_1}$ it is impossible to find $\hat{T}$ such that $x_1(\hat{T}) = 0$ and therefore there is no optimal control.

If all the eigen values λ_i are not positive, it is easy to show that the equation (4.4) can be true for any $|\xi_i|$ and *i = 1, 2, …, n*, as you can pick up a large enough value $\hat{T}$. This, in turn, means that the optimal control exists for all initial states of the system.

c) The Optimal Control System

Consider the optimal control system:

$$\dot{x}(t) = a\,x(t) + u(t), |u(t)| \le 1,\ x(0) = \xi \quad (4.8)$$

If *a ≤ 0*, then[1, 13]optimal control to the state *x = 0* exists for all *ξ*. If *a > 0* the system is unstable. We find the region of initial conditions ΨΩ for which there is optimal control. If the optimal control *u*(t)* exists, and |*u*(t)*| = 1 we have:

$$\xi = -\int_0^{\tau} e^{at}u^*(t)dt$$

Where we find

$$\begin{aligned} |\xi| &= \left|\int_0^{\tau} e^{-at}u^*(t)dt\right| \le \int_0^{\tau}\left|e^{-at}u^*(t)\right|dt = \\ &= \int_0^{\tau}\left|e^{-at}\right|\left|u^*(t)\right|dt = \int_0^{\tau} e^{-at}dt = -\frac{1}{a}\left(e^{-a\tau} - 1\right) \end{aligned} \quad (4.9)$$

The ratio(4.9) is satisfied for some positive end, you must have $\xi \le \frac{1}{a}$

Thus, the scope of the initial values Ψ_Ω, for which there exists an optimal control of the origin is determined by the relation:

$$\Psi_\Omega = \left\{\xi : |\xi| < \frac{1}{a}, a > 0\right\} \quad (4.10)$$

If $|\xi| \ge \frac{1}{a}$ then there is an optimal control. Thus, the region is an open set containing the origin[1, 6, 9, 13,16].

V. The Hamilton-Jacobi Equation

a) The State on Optimal Trajectory and the Value of Optimal Control

Previously, they discussed changes in the minimum of time along the optimal path, and examined geometric properties of optimal control problem [2, 12]. In this section we relate these concepts together and study Hamilton - Jacobi equation for the problem of optimal performance. The purpose of this section is to show how you can use the overall results for the problem of optimal performance [1,14, 15].

Throughout this section we will deal with the optimal control to a normal system $\dot{x}(t) = Ax(t) + Bu(t)$ with field goal(the origin)$S = 0$. At the same time we use the following notation: if we set the state x, denoted by $T^*(x)$ the minimum time required for translation x in 0 and through u^*- the value of optimal control in the state x.

The specific objectives of this section are as follows:

1) To show how you can use the Hamilton - Jacobi equation to check whether the function $T(x)$ is found by solving the problem of optimal control to be equal $T^*(x)$;
2) To point out the difficulties that arise if the assumption that the optimal control is wrong;
3) Noted the difficulties associated with determining optimal control directly from the Hamilton - Jacobi equation.

Let us turn to a discussion of the use of the Hamilton-Jacobi, seeing it as a necessary condition. The general theory of the minimum principle can be deduced the following.

Let x^*- the state on-optimal trajectory and u^*- the value of optimal control at x^*.Since $\frac{\partial T^*(x)}{\partial t} = 0$ for any x, need $T^*(x)$to satisfy the relation:

$$1 + \left\langle Ax^*, \left.\frac{\partial T^*(x)}{\partial x}\right|_{x=x^*} \right\rangle + \left\langle u^*, B' \left.\frac{\partial T^*(x)}{\partial x}\right|_{x=x^*} \right\rangle = 0 \quad (5.1)$$

Provided $\left.\frac{\partial T^*(x)}{\partial x}\right|_{x=x^*}$ that exists.

This lemmais useful in the case when the problem of optimal control has been solved and we want to find out whether this function $T(x)$ is to be an expression that determines the minimum time as a function of the state. If this function does not satisfy the equation (5.1), at least at one point, it can be immediately excluded from the number of possible options for the minimum time. We show this in the following example.

b) The Minimum Time Function

Suppose that the linear system is described by the following equations:

$$\begin{bmatrix} \dot{x}_1(t) \\ \dot{x}_2(t) \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} x_1(t) \\ x_2(t) \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix} u(t) \quad |u(t)| \le 1 \quad (5.2)$$

We can be sure that the best is the control:

$$u^* = -1, \ for\ all\ x = x_\alpha = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \quad (5.3)$$

$$u^* = -1, \ for\ all\ x = x_\beta = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \quad (5.4)$$

Suppose that somehow we found a relationship:

$$T(x) = T(x_1, x_2) = \frac{1}{2} x_1^2 + x_2^2 \quad (5.5)$$

which expresses the minimum time as a function of state. This suspicion is not unfounded, because $T(x) > 0$ for all x, $T(0) = 0$ and $\lim_{|x| \to \infty} T(x) = \infty$.

We now show that our assumption is wrong.

First of all, we calculate the gradient $T(x)$.From (5.5) we find that this gradient is:

$$\frac{\partial T(x)}{\partial x} = \begin{bmatrix} \frac{\partial T(x)}{\partial x_1} \\ \frac{\partial T(x)}{\partial x_2} \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} \quad (5.6)$$

We calculate it by $x = x_\alpha$ and $x = x_\beta$:

$$\left.\frac{\partial T(x)}{\partial x}\right|_{x=x_\alpha} = \begin{bmatrix} 1 \\ 4 \end{bmatrix} \quad (5.7)$$

$$\left.\frac{\partial T(x)}{\partial x}\right|_{x=x_\beta} = \begin{bmatrix} 1 \\ 2 \end{bmatrix} \quad (5.8)$$

At the left side of equation (5.1) is equal to:

$$1 + \left\langle \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \end{bmatrix}, \begin{bmatrix} 1 \\ 4 \end{bmatrix} \right\rangle - 1 \left\{ [0,1] \begin{bmatrix} 1 \\ 4 \end{bmatrix} \right\} = \quad (5.9)$$
$$= 1 + 2 - 4 = -1 \ne 0$$

It can be concluded that the $T(x)$ ratio(5.4) cannot be a formula that expresses the minimum amount of time, because when $x = x_\alpha$ equation(5.1) is not satisfied. Let's see what happens if we experience $T(x)$ at $x = x\beta$. In its left-hand side of (5.1) is equal to:

$$1 + \left\langle \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 2 \end{bmatrix} \right\rangle - 1 \left\{ [0,1] \begin{bmatrix} 1 \\ 2 \end{bmatrix} \right\} = \quad (5.10)$$
$$= 1 + 1 - 2 = 0$$

This means that $T(x)$ satisfies the necessary condition of item 5.1with $x = x_\beta$, and on the basis of this test, we can conclude that *T(x)* may be the minimum time. However, the test for $x = x_\alpha$ excludes this possibility.

Suppose now that in determining the optimal control mistake. For example, we believe that.

$$u^* = +1, \textit{ for all } x = x_\beta = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \tag{5.11}$$

Then, instead of (5.10), we obtain:

$$\begin{aligned} &1 + \left\langle \begin{bmatrix} 0 & 1 \\ 0 & 0 \end{bmatrix} \begin{bmatrix} 1 \\ 1 \end{bmatrix}, \begin{bmatrix} 1 \\ 2 \end{bmatrix} \right\rangle + 1 \left\{ [0,1] \begin{bmatrix} 1 \\ 2 \end{bmatrix} \right\} = \\ &= 1 + 1 + 2 = 4 \neq 0 \end{aligned} \tag{5.12}$$

and could be removed from consideration *T(x)*. It is true that *T(x)* ≠ *T*(x)*, but on the basis of the expression (5.12) it is impossible to conclude, as incorrectly set $u^* = +1$ for x_β. In other words, if you make a mistake in determining the optimal control law, in the course of such checks can be excluded from consideration the correct dependence *T*(x)*.

In practice, this item (5.2) is not very useful, since the engineer often need to build an optimal feedback system, and not check if *T(x)*is equal this optimal *T*(x)* or not. Nevertheless, the use of the Hamilton - Jacobi is essential matters in theoretical studies and validates the results obtained by using the minimum principle.

Hamilton - Jacobi equation was largely seen as a sufficient condition. Let us now discuss the problem of solving the Hamilton-Jacobi and finding the optimal control. We know that the Hamiltonian of the problem of the optimal control [6, 16]:

$$H[x, p, u] = 1 + \langle Ax, p \rangle + \langle u, B' p \rangle \tag{5.13}$$

Since the system $\dot{x} = Ax + Bu$ is normal, what is normal and the Hamiltonian, and therefore the H-minimal control well:

$$\tilde{u} = -SIGN\left\{ B' p \right\} \tag{5.14}$$

From the relations(5.14) and (5.13), we obtain:

$$\begin{aligned} &H[x, p, u] = 1 + \langle Ax, p \rangle - \left\langle S\,GN\left\{ B' p \right\}, B' p \right\rangle = \\ &= 1 + \sum_{i=1}^{n} \sum_{k=1}^{n} a_{ik} x_i p_k - \sum_{j=1}^{r} \left| \sum_{k=1}^{n} a_{ik} x_i p_k \right| \end{aligned} \tag{5.15}$$

Consider the partial differential equation(Hamilton - Jacobi):

$$1 + \sum_{i=1}^{n} \sum_{k=1}^{n} a_{ik} x_i p_k \frac{\partial T(x)}{\partial x_i} - \sum_{j=1}^{r} \left| \sum_{i=1}^{n} b_{ij} \frac{\partial T(x)}{\partial x_i} \right| = 0 \tag{5.16}$$

Suppose that we were able to find a solution:

$$\hat{T}(x) \tag{5.17}$$

differential equation in partial derivatives(5.16), and

1) Function

$$\hat{T}(0) = 0 \tag{5.18}$$

2) The control vector:

$$\hat{u} = -SIGN\left\{ B' \frac{\partial \hat{T}(x)}{\partial x} \right\} \tag{5.19}$$

Substituting this solution into the equation system, we have:

$$\dot{x}(t) = Ax(t) - BSIGN\left\{ B' \frac{\partial \hat{T}[x(t)]}{\partial x(t)} \right\} \tag{5.20}$$

The solution of this equation:

$\hat{x}(t)$ with the initial condition $\hat{x}(0) = \xi$ (5.21)

It has property:

$$x\left[\hat{T}(\xi) \right] = 0 \tag{5.22}$$

In other words, the decision $\hat{T}(x)$ of Hamilton - Jacobi equation(5.16) defines the control of $\hat{u}$ [see. ratio(5.19)], which in turn produces the trajectory $\hat{x}(t)$, reaching the origin during $\hat{T}(\xi)$, where ξ-given initial condition. If so, then control is $\hat{u}(t)$ - optimal, at least with respect to the offices close to it, that $\hat{u}(t)$is locally optimal.

c) The Locally Optimal Control

Suppose we are given a system of first order [1, 13]:

$$\left. \begin{aligned} \dot{x}(t) &= 2u(t) \\ |u(t)| &\le 1 \\ x(0) &= \xi \end{aligned} \right\} \tag{5.23}$$

Require to translate an arbitrary initial state ξ to 0 in a minimum time. The Hamiltonian for this problem has the form:

$$H(x, p, u) = 1 + 2up \tag{5.23}$$

where the minimum control H is defined by:

$$\tilde{u} = -sign\left\{ p \right\} \tag{5.24}$$

Hamilton - Jacobi equation for this problem has the form:

$$1 - 2\left| \frac{\partial T(x)}{\partial x} \right| = 0 \tag{5.25}$$

We define two areas of X_1 and X_2 (one-dimensional) phase space as following:

$$\begin{rcases} X_1 = \{x : x > 0\} \\ X_2 = \{x : x < 0\} \end{rcases} \quad (5.26)$$

It is easy to see that the function;

$$\hat{T}(x) = \frac{1}{2}|x| \quad (5.27)$$

is the solution of differential equations in partial derivatives(5.25) for all $x \in X_1 \cup X_2$, because of:

$$\frac{\partial \hat{T}(x)}{\partial x} = \frac{1}{2} \, when \, x \in X_1 \quad (5.28)$$

$$\frac{\partial \hat{T}(x)}{\partial x} = -\frac{1}{2} \, when \, x \in X_2 \quad (5.29)$$

Note that:

$$\left.\frac{\partial \hat{T}(x)}{\partial x}\right|_{x=0} \text{ undefined} \quad (5.30)$$

And

$$\hat{T}(0) = 0 \quad (5.31)$$

Consider the control of $\hat{u}$, defined as:

$$\hat{u} = -sign\left\{\frac{\partial \hat{T}(x)}{\partial x}\right\} \quad (5.32)$$

from whence

$$\hat{u} = -1, x \in X_1 \quad (5.33)$$

$$\hat{u} = +1, x \in X_2 \quad (5.34)$$

and $\hat{u}$ undefined when $x = 0$ (5.35)

Assume that $\xi \in X_1$, then $\xi > 0$ As a result of the substitution of the expression (5.33) into (5.32), we obtain:

$$\dot{x}(t) = -2 \quad (5.36)$$

$$\hat{x}(t) = \xi - 2t; \; \xi \in X_1 \quad (5.37)$$

From (5.27) we have:

$$\hat{T}(\xi) = \frac{1}{2}\xi; \; \xi \in X_1 \quad (5.38)$$

Therefore,

$$\hat{x}\left[T(\xi)\right] = \xi - \xi = 0 \quad (5.39)$$

Further, for all $t \in \left[0, \hat{T}(\xi)\right]$ we have:

$$\hat{x}(t) = \xi - 2t > 0 \quad (5.40)$$

It means that:

$$\hat{x}(t) \in X_1 \quad (5.41)$$

Thus, the control is unchanged:

$$\hat{u} = -1 \quad (5.42)$$

And is an optimal time control for all $x \in X_1$

Similarly it is proved that, the control:

$$\hat{u} = +1 \quad (5.43)$$

is also the optimal time control for all $x \in X_2$

Thus, we find the area X_1 and X_2, such that $\frac{\partial T(x)}{\partial x}$ is quite defined.

VI. Conclusion

For this system, we did not encounter any difficulties in finding the optimal control using the Hamilton - Jacobi equation, as it was simple enough:

- To guess the solution of Hamilton - Jacobi, satisfying the boundary conditions[5, 10, 12, 14];
- Identify two areas of X_1 and X_2;
- Define that $x\left[\hat{T}(\xi)\right] = 0$.

If we try to find the optimal control for systems of higher order, at once confronted with the following challenges:

It is almost impossible to find a solution of the Hamilton - Jacobi systems higher than second order.

For the system n^{th} order, it is necessary to subdivide the phase space at least $2n$of areas X_1, $X_2, \ldots, X_n$, indicate that for the systems of higher than second order is extremely difficult. Therefore, at present the optimal design of feedback systems often is carried out by using the necessary conditions of the minimum principle, but not the sufficient conditions of the equation Hamilton - Jacobi.[12, 15].

In general, we can conclude that:

- A procedure for obtaining control for linear objects in closed approach which is provided in relation to the movement of vessels [7, 8].
- The analysis of the structure of the optimal control system obtained by the developed control algorithms, based on which we can design and create a control system to ensure the meeting of movements of ships. These results of further research will be presented in next article.

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Assessment of Profile Error for Efficient Solar Parabolic Trough

By Patoda Lalit, Dadaniya Akhilesh, Gupta Ashish & Singh Navdeep
SGSITS Indore, India

Abstract- Parabolic trough solar collector is providing nonpolluting energy for domestic and industrial application. Assessment of profile of manufactured parabola by precise instrument is basic need for high efficiency. This paper presented the assessment of parabolic profile by two dimensional linear scales having right angle to each other and compared the results with the analytical equation. Graphical view also presented for results measured by linear scales and analytical equation. The efficiency of the solar trough also can be increased by installing thermocouples at periphery of the receiver tube.

Keywords: parabolic trough solar collector, silica glass, error.

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ASSESSMENTOFPROFILEERRORFOREFFICIENTSOLARPARABOLICTROUGH

Strictly as per the compliance and regulations of:

Assessment of Profile Error for Efficient Solar Parabolic Trough

Patoda Lalit [α], Dadaniya Akhilesh [σ], Gupta Ashish [ρ] & Singh Navdeep [Ѡ]

Abstract- Parabolic trough solar collector is providing nonpolluting energy for domestic and industrial application. Assessment of profile of manufactured parabola by precise instrument is basic need for high efficiency.This paper presented the assessment of parabolic profile by two dimensional linear scales having right angle to each other and compared the results with the analytical equation. Graphical view also presented for results measured by linear scales and analytical equation. The efficiency of the solar trough also can be increased by installing thermocouples at periphery of the receiver tube.

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I. Introduction

Solar thermal systems play an important role in providing non-polluting energy for domestic and industrial applications. Concentrating solar technologies, such as the parabolic dish, compound parabolic collector and parabolic trough can operate at high temperatures and are used to supply industrial process heat, off-grid electricity and bulk electrical power. In a parabolic trough solar collector, or PTSC, the reflective profile focuses sunlight on a linear heat collecting element (HCE) through which a heat transfer fluid is pumped. The fluid captures solar energy in the form of heat that can then be used in a variety of applications.

An attractive feature of the technology is that PTSCs are already in use in great numbers and research output is likely to find immediate application. Smaller-scale PTSCs can be used to test advances in receiver design, reflective materials, control methods, structural design, thermal storage, testing and tracking methods.

a) Types of Concentrating Collectors

Solar thermal energy systems are among the most promising of the renewable technologies. Three such concepts for bulk electricity production are the parabolic trough solar collector, and two others are, parabolic dishes and central receiver.

Author α σ ρ Ѡ: Department of Mechanical Engineering, Shri Govindram Seksaria Institute of Technology and Science (SGSITS), India. e-mails: lalit.patoda@yahoo.com, a.dadaniya@yahoo.com, ashishiitb99@gmail.com, gifty.singh@rediffmail.com

b) Parabolic trough collector

A high-temperature (above 360K) solar thermal concentrator with the capacity for tracking the sun using one axis of rotation. It uses a trough covered with a highly reflective surface to focus sunlight onto a linear absorber containing a working fluid that can be used for medium temperature space or process heat or to operate a steam turbine for power or electricity generation.

c) Parabolic Dishes

Parabolic dishes give in principle a point focus, the reflecting surface is a parabolic. 2D focusing gives a much higher concentration factor and mechanically stable.

d) Central Receiver

Also known as a power tower, a solar power facility that uses a field of two-axis tracking mirrors known as heliostat (A device that tracks the movement of the sun). The effect of many heliostats reflecting to a common point creates the combined energy of thousands of suns, which produces high-temperature thermal energy.

II. Literature Review

An attractive feature of the technology is that PTSCs are already in use in great numbers and research output is likely to find immediate application. Shortis, M. R. *et al.* (1996) has described the use of close-range photogrammetry to measure a range of solar concentrator components, from EuroTrough fabrication jigs, to concentrator sub-frames, to trough mirror facet surface deviations under varying gravitation loads, to structural distortions arising from differential thermal expansions in the structure, to small scale mirror facets and the subsequent processing of the photogrammetric data to provide optical and ray trace analysis of the facet performance. Thorsten A. Stuetzle (2002), A model predictive controller was developed for the SEGS VI plant model. Its task is to maintain a constant collector outlet temperature on different days of a year by adjusting the heat transfer fluid volume flow rate while solar radiation changes. The control algorithmic, which is based on Rawlings and Muske (1993), was introduced on the example of a simplified model. Lüpfert, E. *et al.* (2004) summarizes results in collector shape measurement, flux measurement, ray tracing, and thermal performance analysis for parabolic troughs. It is shown that the measurement methods and the parameter analysis give consistent results. Mokhtaria A. *et al.* (2007), the parabolic trough collector of Shiraz power plant with hot oil generation system is investigated experimentally over in summer period. The system operates under closed loop mode by recirculating the oil through a hot oil expansion tank. Variations of collector oil inlet and outlet temperature are measured and the maximum beam radiation during the experimental period was 735mW.

III. Experimental Set up and Procedure

The components of experimental setup are fabricated structure, plane mirror, and receiver tube as below in experimental setup picture1.

Fabricated structure: The structured is fabricated by mild steel hollow bar having square cross section .the toughness of this structure is very high and thermal expansion is very low which can bear high load and temperature .we have remind all the precaution during the fabrication of this structure, Some specified tolerances also we considered while manufacturing .

Plane mirror: The mirror we used for focusing the sun rays having high reflectivity (r=.99), it can reflect the sun rays very efficiently on the receiver tube .the dimension of this glasses have specified in this thesis later.

Receiver tube: We have wide range for receiver tube material such as copper, aluminum, mild steel etc. the major constraints during the selection of receiver tube is low melting point and low thermal conductivity of the metal so we have to select a metal which can bear high temperature and should have high thermal conductivity.

a) *Dimension of parabolic trough :*

1. Projected Area = $12.54*10^6$ mm^2
2. Dimension of glass (plane): Length=305mm, Width =76mm and Thickness =4mm
3. Dimension of receiver tube: Length =305mm, Dia. =76mm, and Thickness=4mm
4. Material of glass-Silica
5. Material of receiver tube-mild steel

Figure 1 : Experimental Setup

Figure 2 : Linear scales for measurement of parabolic profil

b) Manual method

We have fabricated a scale which can measure the error easily. In this setup we used two linear scales which measure the dimension horizontally and in vertical dimensions. The data collected during measurement, compared with standard data, and get error of parabolic trough.

c) Brief Procedure

First of all we level the scale and parabolic trough in a parallel plane with the help of leveling gauge (water level) than we set the center of parabola and the zero of scale and note down the 'y' coordinates corresponding to the 'x' coordinates. And finally we made table of x and y coordinates.

IV. Results

Analytical equation for parabolic profile $x^2 = 4 * 1500 * y$

Table 1 : Comparison between Theoretical and Measured Parabolic Profile

S. No.	X –Coordinate (mm)	Analytical Y-Coordinate (mm)	Experimental Y-Coordinate (mm)	Error(mm)
1	0	0	0	0
2	800	107	80	27
3	1500	377	345	32
4	2200	803	790	13
5	-800	107	96	11
6	-1500	377	354	23
7	-2200	803	764	39

Figure 3 : Graphical Comparisons between Theoretical and Measured Parabolic Profile

V. Conclusions

Measurement of error is very important function because of efficient working. This type of measurement processes is very cheap and easy to work. As we move away from center of parabola error increases in negative x-axis but there are no certain trends in positive axis, so we can conclude that this error depends on the human skills and manufacturing process. This error can be minimized by developing a high precise manufacturing process. Tracking of the trough should be precise for that thermocouple installed at periphery of receiver tube to maintain the higher efficient solar power.

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Nuclear Power Plant in Bangladesh and the Much Talked about Rooppur Project

By Khondokar Nazmus Sakib
Mawlana Bhashani Science and Technology University, Bangladesh

Abstract- Bangladesh is a land of about 16.5 core people. So, high population, industrialization and urbanization demands huge electric power. The government of Bangladesh now is in troublesome condition to provide huge electricity. The government of the country has already taken some necessary steps like hydroelectric power plant, coal based power plants, gas based power plants, oil based power plants and some power plants of renewable sources. But those are not sufficient according to the demand. That's why government is trying to introduce first nuclear power plant. "I believe it fulfills the nation's dream," Prime Minister Sheikh Hasina said this after laying the foundation stone of Bangladesh's first nuclear power plant on 2 October 2013 in Rooppur, Pabna. Some debate has already begun against this power plant. But to resolve energy crisis of Bangladesh government should introduce modern (generation 3+ VVER-1200, VVER TOI) nuclear power plant.

Keywords: bangladesh, RNPP, nonrenewable, nuclear power plant, safety.

GJRE-A Classification : FOR Code: 020202

NUCLEARPOWERPLANTINBANGLADESHANDTHEMUCHTALKEDABOUTROOPPURPROJECT

Strictly as per the compliance and regulations of:

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Abstract- Bangladesh is a land of about 16.5 core people. So, high population, industrialization and urbanization demands huge electric power. The government of Bangladesh now is in troublesome condition to provide huge electricity. The government of the country has already taken some necessary steps like hydroelectric power plant, coal based power plants, gas based power plants, oil based power plants and some power plants of renewable sources. But those are not sufficient according to the demand. That's why government is trying to introduce first nuclear power plant. "I believe it fulfills the nation's dream," Prime Minister Sheikh Hasina said this after laying the foundation stone of Bangladesh's first nuclear power plant on 2 October 2013 in Rooppur, Pabna. Some debate has already begun against this power plant. But to resolve energy crisis of Bangladesh government should introduce modern (generation 3+ VVER-1200, VVER TOI) nuclear power plant.

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I. Introduction

In recent times there has been a growing trend worldwide of adopting alternative source of energy in policy framework in the context of diminishing reserve of fossil fuel as well as the detrimental impact of its burning on environment and human health. Renewable and environment friendly energy sources come into consideration to tackle future energy crisis. Renewable energy sources like solar energy, wind energy etc. cannot cope with the huge consumption demands of industrialization and urbanization. In this perspective nuclear energy is considered as a suitable alternative, provided necessary safety measures are in place. Nuclear power plants are especially suitable for countries like Bangladesh having huge population and limited land area and resources. The prospect of nuclear energy had been recognized in policy plans of Bangladesh and necessary steps are being taken for early implementation of Rooppur Nuclear Power, Project at Rooppur, Pabna.

II. How Nuclear Power Plant Works

Just like a fossil (Coal, Gas, Diesel) fuel power plant, in nuclear power plant water is turned into steam, which in turn drives turbine generators to produce electricity. The difference between them is the source of heat. In nuclear power plant, when nuclear fission takes place, the produced heat turn water into steam. There is no combustion in a nuclear reactor. There are two types of nuclear reactors.

a) Pressurized Water Reactor (PWR)

In pressurized water reactor, water is boiled under high pressure so that water in reactor vessel does not boil but heats. This heated water transfers the heat to the water in the steam generator. Water in the steam generator then is converted to steam and then turns the turbine generator. The generator then produces electricity. Water from the reactor vessel and the water in the steam generator that is turned into steam never intermingle.

b) Boiling Water Reactor (BWR)

In Boiling Water Reactors (also known as BWRs), the water heated by fission actually boils and turns into steam to turn the turbine generator. In both PWRs and BWRs, the steam is turned back into water and can be used again in the process.

III. How Energy Released from Nuclear Fission

The sum of masses of the protons and neutrons that comprise the nucleus exceeds the mass of the atomic nucleus. The difference in mass is called mass defect. The mass defect is converted to energy in a nuclear reaction is given by Einstein's law:
$\Delta E = \Delta mC^2$.

This equation shows that lost mass (mass defect) will convert into energy. And by the same process we get the fission energy.

By fission process we extract nuclear energy from nucleus. In this process nucleus of an atom splits into smaller parts. Fission is a form of nuclear transmutation because the resulting fragments are not the same element as the original atom.

Author: Lecturer in Physics Mawlana Bhashani Science and Technology University. e-mail: sakib_58@yahoo.com

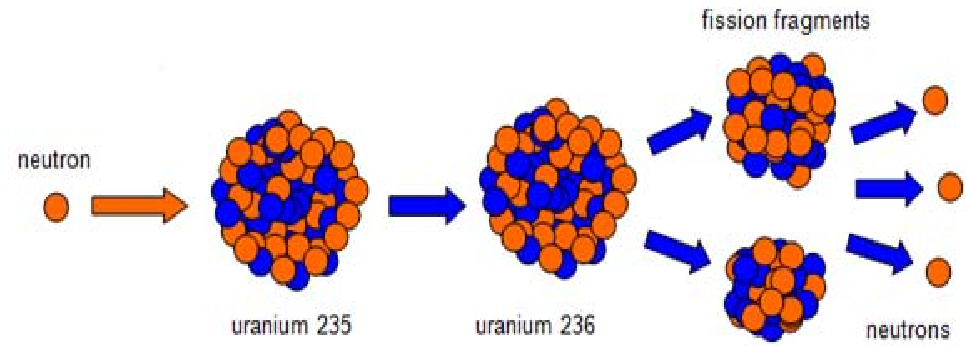

Figure: Nuclear fission

One of the fission products is represented as:

$$^{235}U + {}^{1}n = {}^{236}U = {}^{148}La + {}^{85}Br + 3{}^{1}n$$

The mass equation for the above reaction is given as (in atomic mass unit):

$$235.124 + 1.009 = 147.96 + 84.938 + 3.029$$

The mass deficiency on the right hand side of above mass equation is 0.207 atomic mass unit or 0.3436×10^{-27} kg. This mass will convert into energy.

The equivalent release of energy in view of Einstein's law:

$$\Delta E = \Delta mC^2 = 0.3436 \times 10^{-27} \times 9 \times 10^{16}$$

$$= 3.0924 \times 10^{-11} \text{Joules/atom}$$

Now, one kg of uranium will have approximate 26.029×10^{23}atoms. If it is assumed that all the atoms have undergone fission, the total amount of released energy will be:

$$E = 3.0924 \times 10^{-11} \times 26.029 \times 10^{23}$$

$$= 80.49 \times 10^{12} \text{joules/kg}$$

The above released energy is approximately equivalent to 2.7 million kg of coal, 2 million m^3 of natural gas and 1.78 million kg of fuel oil.

IV. Comparing Radioactive Waste to Other Waste

In countries with nuclear power, radioactive wastes comprise less than 1% of total industrial toxic wastes, much of which remains hazardous for long periods. Overall, nuclear power produces far less waste material by volume than fossil-fuel (Coal, Gas, Diesel) based power plants. The flue gas from combustion of the fossil fuels is discharged in the air. This gas contains carbon dioxide and water vapor, as well as other substances such as Nitrogen oxides (NO_x), Sulfur oxides (SO_x), Mercury, traces of other metals, and, for coal-fired plants, fly ash. Fossil fuel power stations emit CO_2, a greenhouse gas (GHG) which according to a consensus opinion of scientific organizations is a contributor to global warming as it has been observed over the last 100 years.

A 2008 report from Oak Ridge National Laboratory (ORNL) concluded that coal power actually results in more radioactivities being released into the environment than nuclear power operation. Indeed, coal ash is much less radioactive than nuclear fuel on a weight per weight basis, but coal ash is produced in much higher quantities per unit of energy generated, and this is released directly into the environment as fly ash, whereas nuclear plants use shielding to protect the environment from radioactive materials, for example, in dry cask storage vessels. An international organization has raised serious questions about the much-debated Rampal coal-fired power plant, saying it does not maintain the minimum social and environmental standards.

V. Nuclear Energy in Bangladesh

The nuclear power plant will be built at Rooppur, on the banks of the Padma River, in the Ishwardi subdistrict of Pabna, in the northwest of the country.

Figure 1 : Site location of Rooppur nuclear power plant.

The proposal was first raised in 1961. Government took 253.90 acre of land of current place at that year to build the plant. In 1963 the plant was approved. Discussions took place with the Canadian government in 1964 and 1966. Discussions with the governments of Sweden and Norway were also going on in those years. However, no real progress was achieved. After the independence of Bangladesh, the Government of Bangladesh started discussion with the Soviet Union in 1974 however, which was not successful.

Finally, In February 2011, Bangladesh got an agreement with Russia to build the 2,000 megawatt (MW) Rooppur Nuclear Power Plant with two reactors. The Rooppur Nuclear Power Project (RNPP) is estimated to cost up to US$2 billion, and is going to start operating by 2021.The inter-governmental agreement (IGA) was officially signed on 2 November 2011. Prime Minister Sheikh Hasina laying the foundation stone of Bangladesh's first nuclear power plant on 2 october 2013 in Rooppur, Pabna. Prime Minister Sheikh Hasina, gave the final go-ahead to the draft Nuclear Power Plant Act 2015.

But several separate issues were raised, from the unsuitability of the site to the obsolescence of the VVER-1000 model (Pressurized Water Reactor (PWR)) proposed, questionable financing arrangements and a lack of agreement with Russia over nuclear waste disposal. Besides, Bangladesh has no technical expertise or skilled manpower to undertake such a complex and high tech project. Generation 2 model Nuclear power plant falls in accident like in 1979 Three Mile island (US) accident, in 1986 Chernobyl (Ukraine) accident and in 2011 Fukushima (Japan) accident .Generation 2 type nuclear power plant was less protective from any type of natural and manmade disaster. Life span of this reactor was in between 25 to 30 years. It takes long time to build this type of reactor and its waste production rate is high. That's why VVER -1000 model was introduced and this model is known as generation 3 nuclear power plant. Russia went to build generation-3 VVER-1000 model nuclear power plant in India but this project face public resistance due to low grade instruments.

Bangladesh can take learning from this. Generation-3+ VVER-1200 model is more efficient, safe and modern then generation-3 VVER-1000. Bangladesh government may go for generation-3+ VVER-1200 model nuclear reactor which is also known as evolutionary reactor. This type of reactor fulfills the requirements of the IAEA and the EUR. VVER TOI model is more modern than VVER-1200. This VVER TOI model has some specific characteristics like, high endurance power in earthquake and tornado, high endurance power in aircraft crashes and flood, fuel efficient, less waste production etc. Russia is going to build this type of plant in their country and Turkey. Rooppur nuclear power project is likely to cost around $10 billion, more than three times the initial estimate of the government. The project's Russian developer Rosatom has been dropping hints since last year that the cost may go up to $10 billion. A couple of years ago the government had estimated that the plant would cost between $2 billion and $3 billion. Bangladesh is seeking 90 percent of the project financing from Russia. The loan will be repaid in 28 years with a 10-year grace period. But similar power plants being built by Russia in different countries are coming with a price tag between $10 billion and $13 billion.

Table 1 : Price list of nuclear power plants at different countries

country	plant	price
Finland	1200 mw plant	$6.5b
Hungary	1200 mw x 2 units	$3.5b
Turkey	1200 mw x 4 units	$20b
South Africa	1200 mw x 8 units	$50b
Belarus	1000 mw x 2 units	$10b
Vietnam	1000 mw x 2 units	$9b

The plant is located in an earthquake zone, that's why construction cost goes high. Additional safety installations also add up to the cost. In addition, lack of qualified nuclear power engineers, enterprises, employees increases the project cost. On top of that, the country has no industrial infrastructure and the transport system is absolutely rudimentary. Most of the materials to be used in the plant such as the quality assured high grade stainless steel, pipes, valves, pumps and other components will have to be imported and the cost will increase. This site is also vulnerable to flood and tornadoes.

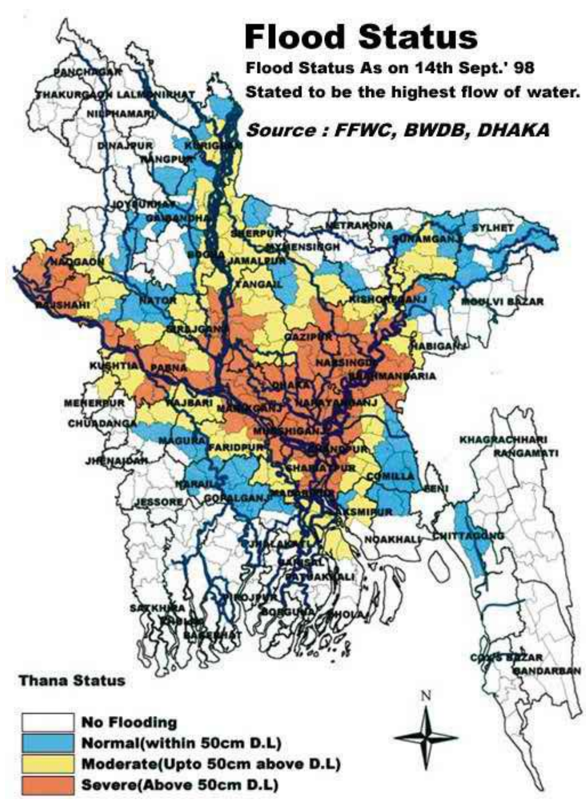

Figure 2 : Rooppur nuclear power plant

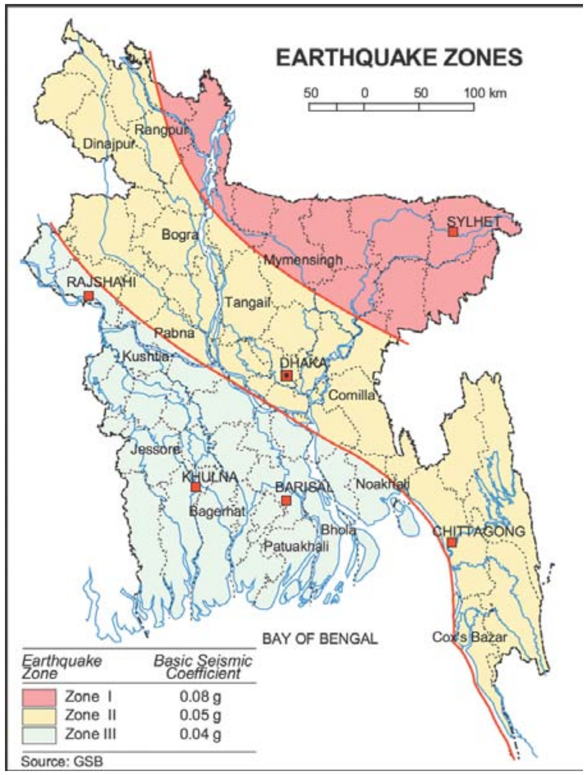

Figure 3 : Rooppur nuclear power plant

Site is located in the severe flood region. Site is located in the earthquake region.

When Pakistan had proposed the site, it was a sparsely populated area. In contrast, right now, it is a densely populated region. Ishwardi Upazila has population density of 1186 (per sq km). Any sign of an accident would necessitate an immediate evacuation of all the people in the 20 sq km area adjacent to the nuclear power plant. But to evacuate the whole population on a long term or lifetime basis from a 20 sq km area in the most densely populated country and relocate them will be a virtually prohibitive, most challenging and arduous task. Soil of Rooppur is soft in nature, that's why some initiative has to take to stable this soil.

We have to think about geopolitics. During the first half of the year, much of the water of the river is already withdrawn by India through the Farakka Barrage, leaving insufficient cooling water for the plant and other activities in Bangladesh. According to debate about nuclear power plant some advanced countries like Germany, Italy, Switzerland have all given up nuclear power plants and with Japan is tapering down nuclear power production after the Fukushima disaster, Bangladesh seems to be charging ahead recklessly. But we have to remember that still now 30 countries worldwide are operating 438 nuclear reactors for electricity generation and 67 new nuclear plants are under construction in 15 countries. In spite of these threats, nuclear power plant is the best decision to meet rapidly increasing demand and reduce dependence on natural gas. But these threats should be kept in mind.

VI. Result

From this research, the result is obtained that it is perfect time to introduce modern nuclear power plant for Bangladesh. Because this plant will be able to resolve the power crisis of Bangladesh and it will sustain for a long time. Bangladesh use natural gas and coal for most of its electricity production.

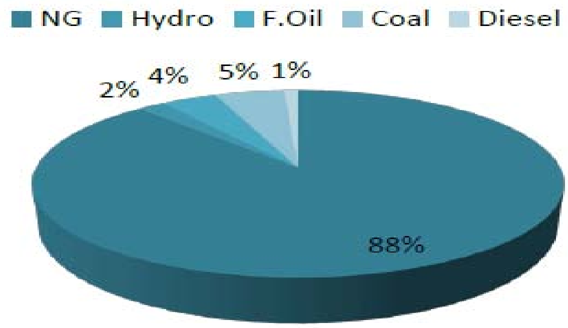

Figure 4 : Fuel consumption pattern of Power Generation.

But these sources of energy create serious environment pollution, and these sources will finish one day. Because, these sources are not renewable sources. That's why Bangladesh has to go for alternative power sources. Already Bangladesh has started to use some renewable energy sources those are environment friendly. But these sources produced small range of energy. So by considering the entire problem regarding nuclear power plant, Bangladesh should go for modern (generation 3+ VVER-1200, VVER TOI) nuclear power plant. Initial coasting may be high but thinking about future safety Bangladesh government should go for modern nuclear reactor.

VII. Conclusion

Now a days for lower Greenhouse Gas Emission, Efficiency, Reliability, Cheap Electricity, Low Fuel Cost, Easy Transportation nuclear energy has got top most priority. But we have to remember the accidents of nuclear power plant, like in 1979 Three Mile island (US) accident, in 1986 Chernobyl (Ukraine) accident and in 2011 Fukushima (Japan) accident were devastating. Now a days it has become very challenging to generate sufficient electric power for Bangladesh to meet the energy demand with its rapid growing population and industrialization.

The Government of the country is trying to lessen the power crisis by taking several initiatives like small (10-20MW) power plants, coal based power station, IPP (Independent Power Producer), QRPP (quick rental power plant) and small scale renewable energy plants. But these are not a permanent solution. Moreover, QRPP and IPP are mainly oil and gas based, which are very costly and these are also not very efficient. Besides coal based power station are required very large space, its initial cost is high and create serious environmental threat to the surroundings. In this perspective nuclear energy is considered as a suitable alternative for Bangladesh, provided necessary safety measures are in place and we can hope that this plant will resolve energy crisis of Bangladesh. Initial coasting may be high but thinking about future safety and efficiency Bangladesh government should consider modern nuclear reactor.

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Effect of Dynamic Stiffness on Performance of Paddy Grain Losses in Axial-Flow Thresher

By Than Than Htay, Htay Htay Win, Zin Ei Ei Win & Myint Thein
Mandalay Technological University, Myanmar

Abstract- The shaft of the thresher must be stiffness and strength to thresh efficiently for long duration. The objective of this study is to carry out the dynamic stiffness analysis of the shaft for thresher and performance of the thresher. The threshing scheme is used to change the operating speeds and moisture content of the paddy field (grain). Dynamic stiffness and performance were analyzed by using Hooke's law. To enhance the threshing efficiency between dynamic stiffness of the shaft for thresher and losses as an unbalance weight was attached on the shaft. The analysis can be used for un-threshed losses and total losses. Performance due to dynamic stiffness was developed based on experimental performance. The most total grain losses of 12.263% were recorded at threshing thresher speed of 5.31 m/s at experiment. At 17% moisture content, un-threshed grain is 2.01% and threshing capacity is 97.99%.

Keywords: *dynamic stiffness, moisture content, shaft, speeds, threshing, thresher.*

GJRE-A Classification : *FOR Code: 240599p*

EFFECTOFDYNAMICSTIFFNESSONPERFORMANCEOFPADDYGRAINLOSSESINAXIAL-FLOWTHRESHER

Strictly as per the compliance and regulations of:

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Keywords: dynamic stiffness, moisture content, shaft, speeds, threshing, thresher.

I. Introduction

Performance test has based on dynamic analysis of the thresher. There are many sorts of the threshers to use for Combine Harvesters. This axial flow thresher is applied because it can give good performance for threshing and the least losses. Then, performance of that thresher is used by based on the shaft stiffness for this one.

The shaft is matched at the centre of it. While the shaft is operating with three forward engine speeds, the thresher will also do at the same condition. Based on the speeds, how the link of threshing losses and speeds at any positions that placed the unbalance weight on the shaft is considered.

Because of the high operating speeds and the performance from the shaft to the thresher, dynamic stiffness becomes a major design consideration. The need for dynamic analysis is especially important in the thresher of the shaft where an effective and efficient strength shaft is crucial in expending the shaft life. In the highest engine speed, the total threshing losses are very high.

It is therefore essential to be able to estimate the dynamic stiffness and ensure that the shaft can withstand such high model enables the thresher-shaft designer to modify the strength configuration for the optimum rate at high speeds level.

The result is impressive in that analysis but mathematical and dynamic model are complicated to consider. It is therefore proposed in this study a technique with consideration of any unbalance weight attachment in various speeds.

II. Methodology

a) Machine Configuration

There are many sorts of the threshers in threshing the grain. This combine harvester operated axial-flow thresher was produced from KUKJE Machinery Co., ltd. (Korea). This thresher performs based on the shaft stiffness in this study. The shaft is matched at the centre of this thresher. While the shaft is operating with three forward engine speeds, the thresher also operates at the same condition.

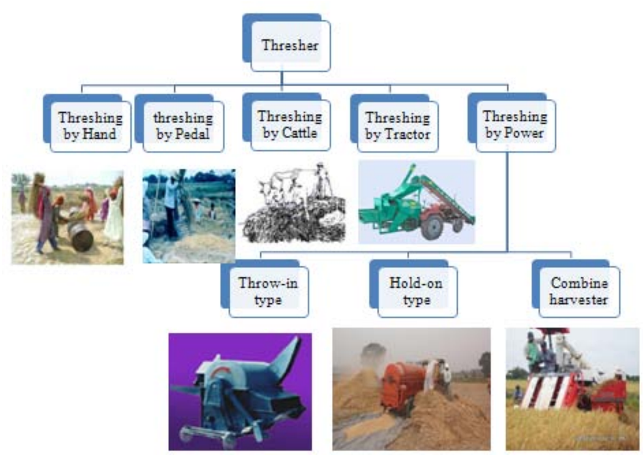

Figure 1 : various kinds of threshers as period

Various kinds of threshers are shown in Fig. 1. As well as harvesting method, threshing is the important practice which can affect the quantitative and qualitative losses of rice. In Myanmar's rice fields, four main types of paddy thresher are used, i.e; manual, tractor operated cross-flow type, small thresher equipped with wire loop threshing drum and combine harvester operated axial-flow thresher.

Recently, DKC-685 combine harvester operated axial-flow thresher adopted in many rice fields because of its easy application and better output for paddy thresher. It has wire-loop type peg-tooth. And,

Author: Department of Mechanical Engineering, Mandalay Technological University, Mandalay, Myanmar
e-mail: phil.tth@gmail.com

four comb types is attached entry of the thresher. All peg-teeth and drum (cover) are bolted by nuts at the threshing cylinder. It threshes the grain by axially. These are used for threshing the paddy crop. And, many different kinds of peg-tooth design and the shaft for this are applied to get good performance.

Based on the speeds, the un-threshed and total grain losses also relate by any positions that placed the unbalance weight on the shaft. Dynamic Stiffness is a function of the excitation frequency. Hence, dynamic analysis is a simple extension of static analysis. All rotating shafts deflect during rotation.

Also, using thresher and its shaft in this machine are shown in Fig. 2 (a) and (b).

Figure 2 : (a) Thresher and (b) Shaft

b) Experimental Field performance

This study was carried out during 2013. And, Mechanization Training Centre (Meiktila) was chosen as a site to perform the paddy field. Two different performance systems were used to thresh paddy grain, namely, the DKC-685 Combine Harvester, with storage type (tank) , harvester to cut the crop and Thresher with axial wire loop (peg-tooth) type.

The specification of the used machine tabulates in Table (1). Results data of the thresher from the design consideration are expressed in Table (2) to apply for the next determination. The evaluation of threshing systems involves a number of experiment approaches and the dynamic stiffness into the following categories.

Table 1 : Specification of machine

Parameter	Dimension	unit
L×W×H	4430× 1860×2330	mm
Total displacement	2392	cc
Power / Revolution	52 (70)/2800	kW(hp) /rpm
Number of reaping lines	4	Row
Reaping width	1485±50	mm

Table 2 : Parameters of Thresher (DKC-685 Combine Harvester)

Type	Values	unit
Outside diameter of Thresher	0.43	m
Length of thresher	0.6576	m
Diameter of shaft	0.075	m
Length of shaft	0.2334	m
Thresher Weight	105.6931	N
Threshing Speed	5.31	m/s
Threshing Power	2.1141	kW
Threshing Torque	14.94	N-m
Torsional Moment	14.9433	N-m
Total Weight (UD)	69.5038	N
Total Mass	7.085	kg

i. *Thresher performance*

This thresher performance for all different types under study was evaluated measuring an un-threshed grain losses and total grain losses. A local long-grain paddy variety widely cultivated in Myittar Township was used for the performance. Physical characteristics of the variety are list in Table (3). The crop was cut 45-55 cm above the ground and collected for the experiments. The paddy moisture content at harvesting and threshing was measured using moisture meter. Four levels of paddy moisture contents of 25, 21.5, 20 and 17 % (w.b.) were considered for the tests. Determination of grain moisture content accurately is important before decision of harvesting, storage and milling as shown in Table (4) [10Ath].

Table 3 : Physical characteristics of paddy variety used in the experiment

Item	Description	Unit
Paddy grain	3438.61	kg/acre
Plant height	80.8	cm
100 grains mass	2.62	g
Length of panicle	6.9	cm
Length of grain	8.0	mm
Width of grain	1.9	mm
Slenderness ratio	3.4	-

Table 4 : Importance of measuring moisture content (Courtesy: IRRI)[10Ath]

Operation	Desired Moisture Content	Primary losses
Harvesting	20-25 %	Shattering if grain is too dry
Threshing	20-25 % for mechanical threshing < 20% for hand threshing	Incomplete threshing Grain damage and cracking/ breakage
Drying	Final moisture content is 14% or lower	Spoilage, fungal damage, Discoloration
Storage	<14% for grain storage <13% for seed storage <9% for long term seed preservation	Fungle, insect& rat damage Loss of vigor Loss of vigor
Milling	14%	Grain cracking and breakage over milling

At each level of paddy moisture, six level of drum speed 5.89, 7.07, 8.25, 9.425, 10.603 and 11.781 m/s were examined. The drum speed was measured with a digital tachometer (Lutron DT-2236). At each test operate; five bundles of paddy crop were fed to the threshing chamber at a constant rate.

To obtain the percentage of broken grain, 10 samples of 100g were randomly chosen from the outlet of the thresher. The broken grains were separated by hand from the whole paddy grains and the weight of the broken grain was recorded. In order to determine the percentage of cracked grain, at each test runs, 10 samples of 50 grains were randomly selected from the outlet of the thresher and manually husked. The husked paddy grains (Ma Naw Thu Kha) were put on a crack tester and the number of cracked kernels was recorded [10Ali].

ii. *Workability*

The second parameter is workability, which is calculated consideration the dynamic stiffness of the shaft for thresher, mainly, the stiffness and mass of threshing period and potential threshing process.

iii. *Percentage of total grain losses (Tgl)*

Visual investigation and manual separation of 10 samples each of 100 grams were used to calculate percentage of damaged and un-threshed grains. And, grain yield was estimated by manual harvesting 5plots each of (1×1 m) with high care from random locations.

The harvested plants were threshed by the thresher; the threshed grains were weight for each sample.

The percentage of total grain losses was calculated from Equation (1), and (2) to determine of threshing efficiency, and then (3) for specific consumed energy:[09Els]

$$T_{gl} = P_d + U_{th} + P_{gl} \qquad (1)$$

Where,
(Pd) - Percentage of damage
(Uth) - un-threshed grains
(Pgl) - Percentage of grain losses

iv. *Threshing Efficiency (ηth)*

$$\text{Efficiency} = \left[\frac{(W_1 - W_2)}{W_1}\right] \qquad (2)$$

where,
W1 - weight of pure grain output (kg/hr),
W2 - weight of residual grain in the straw (kg/hr).

v. *Specific consumed energy (Se)*

The energy consumed was evaluated from the following formula,

$$S_e = 3.163 F_c / A_p \qquad (3)$$

Where:
Fc = fuel consumption, (L/h)
Ap = Actual system productivity = Wg × Pr , (kg/hr)

c) *Performance Analysis with Dynamic Stiffness*

Dynamic stiffness generally creates images of complicated equations with limited practical value. Vibration is merely a response to other conditions in a machine [09Els].

$$\text{Observed Vibration (Response)} = \frac{\text{Force}}{\text{DynamicStiffness (Restraint)}} \qquad (4)$$

As Equation (4) shows, vibration can only change as the result of two things: a change in force or a change in stiffness (or both). Also, dynamic stiffness is essential for the machinery specialist.

A change in unbalance is a force changing in a machine. When vibration is viewed as a ratio of forces to stiffness, the perspective changes and the focus becomes what has changed in the machine, the forces acting on its stiffness. A sudden reduction in vibration could signify an increased stiffness. If the excitation force acting on the shaft becomes higher, the Dynamic Stiffness of the shaft must also be increased by checking size of the shaft. Forces and responses (vibration) are vector quantities [08Moh].

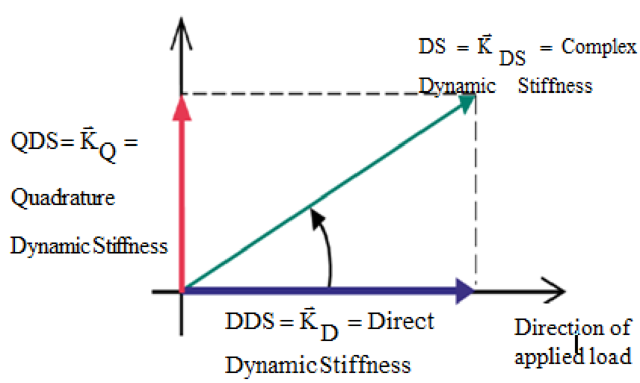

Figure 3 : The relationship between Complex, Direct, and Quadrature Dynamic Stiffness

It concern only with synchronous excitation forces in this study. The two orthogonal components of dynamic stiffness, Direct Dynamic Stiffness (DDS) determine how far the shaft moves in the direction of the applied force and Quadrature Dynamic Stiffness (QDS) determines how far the shaft moves to the side (orthogonal to the applied force). Fig. 3 shows the relationship between Complex, Direct and Quadrature Dynamic Stiffness.

i. *Synchronous Dynamic Stiffness*

Dynamic stiffness is the static spring stiffness of the mechanical system complemented by the dynamic effects of mass and damping. The thresher, shaft and damper are represented by mathematical modeling of dynamic stiffness in Fig. 4.

In Fig. 4, M refers to mass, D means damping, K also refers to spring, and λ is the circumferential average velocity ratio. Because of this dynamic motion, both the Quadrature Stiffness due to damping and the mass stiffness effects come into play.

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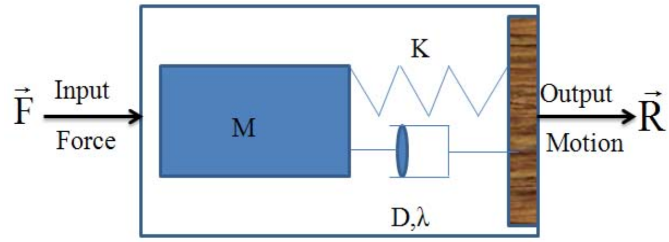

Figure 4 : Mathematical Modeling of Dynamic Stiffness

The force, F, and the response, R, are vectors, and they have both magnitude and direction. This Equation (5) based on Hooke's Law for spring [07Cha].

$$\vec{K}_{DS} = \frac{\vec{F}}{\vec{R}} \tag{5}$$

By Hooke's Law, Equation (5) can be expressed by (6).

$$F = K\,x \tag{6}$$

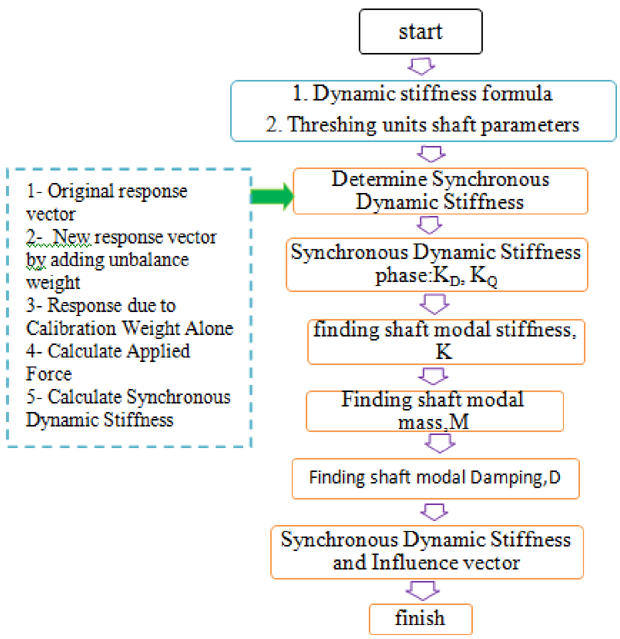

Figure 5 : Flow chart of the program for the developed Dynamic Stiffness

Dynamic stiffness can be used to estimate the dynamic forces acting in the thresher. There are five basic steps involved in determining Dynamic Stiffness. The above Fig. 5 is step by step flow chart to determine the dynamic stiffness and modal mass including modal damping.

d) Relation between dynamic stiffness and threshing losses based on positions and engine speeds

To determine natural frequency for the shaft with dynamic analysis, the total value of stiffness and mass of the shaft must be known. The natural frequency was calculated according to the following Equation (7) [05Joh].

$$\omega_n = \sqrt{\frac{K}{M}} \tag{7}$$

Natural frequency is denoted by ωn, K means spring stiffness of shaft and M refers to mass of shaft. The total value means adding the value from unbalance weight and design consideration. Variable frequency ratio is assumed for evaluate the operating frequencies. The following Equation (8) is used to calculate operating speed [08Rji].

$$V = 2\pi\omega r \tag{8}$$

Where,
V = angular velocity, m/s
ω = operating speed of shaft, rad/s
r = radius of shaft, m

Optimum threshing operations as well as good systems is needed to minimize the loss and obtain maximum efficiency. So, the relation between dynamic stiffness and threshing losses based on operating speeds is shown in Fig. (6).

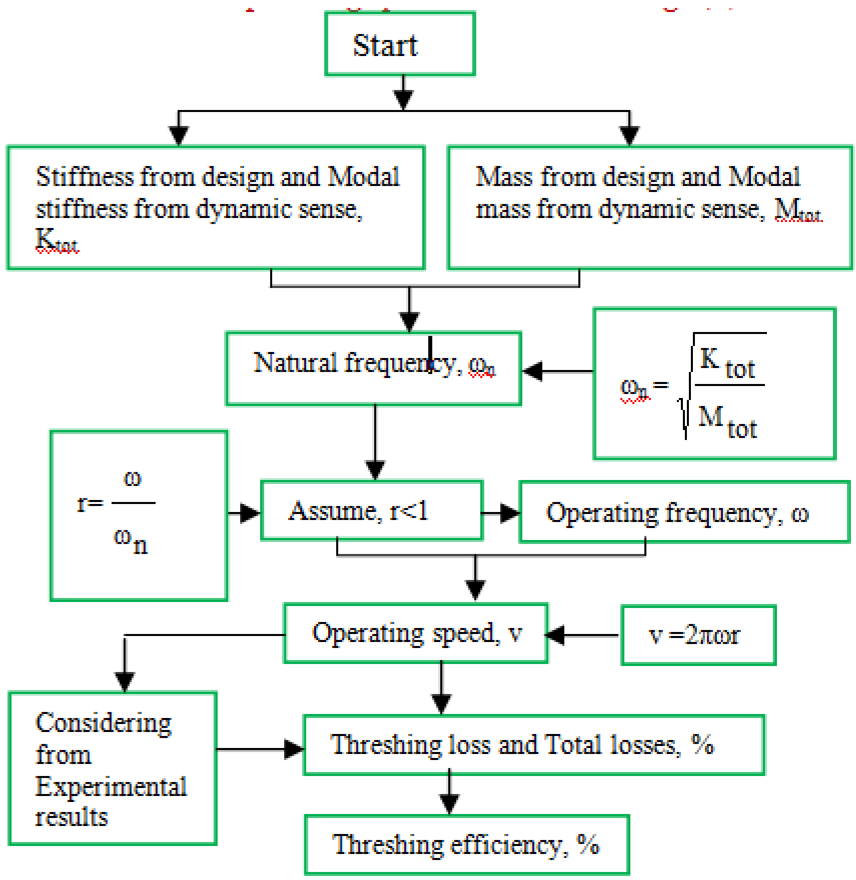

Figure 6 : Flow chart to determine for the relationship of dynamic stiffness and losses

III. Results and Discussion

To determine how to relate dynamic stiffness and grain losses is the main contribution. It is important to be stiff because the shaft is attached inside the thresher. Operating the shaft, the thresher also operates in same time. It threshes the grain from the straw as the speed of the shaft. When the speed becomes higher suddenly, the threshing grain can be crush and damage. Also, if the stiffness of the shaft is weak, the shaft can twist and cannot operate well. So, the grain losses can be found due to weak performance.

Therefore, it is vital to be stiff. In this paper, the stiffness of the shaft due to the attaching mass at any positions is determined. Moreover, the relationship of dynamic stiffness and grain losses are shown in the Fig (14, 15 and 16). To plot these, the relation of dynamic stiffness and losses via operating speeds is expressed in Fig (6). The required bode and polar plots are used to examine the response (vibration), dynamic stiffness and modal mass. These are shown in Fig. 7, Fig. 8 and Fig 9.

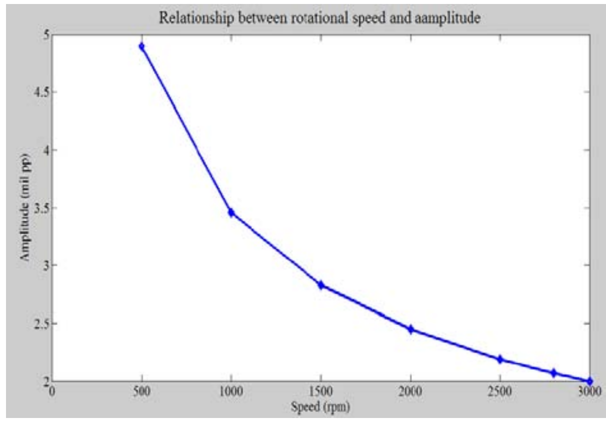

Figure 7 : Relationship between rotational speed and amplitude

Operating speeds are selected in relative natural frequency and frequency ratio that exhibit amplitude and phase variations that are acted by placing at various positions attached the unbalance weight. $A = \sqrt{\frac{12000}{N}}$ and $\theta = \omega t$ are used to do the following plots

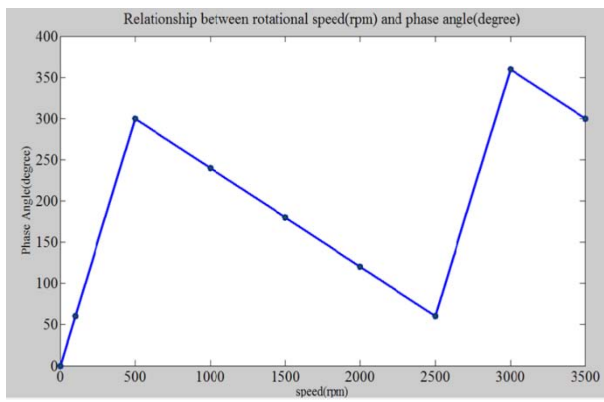

Figure 8 : Relationship between angular velocity and phase angle

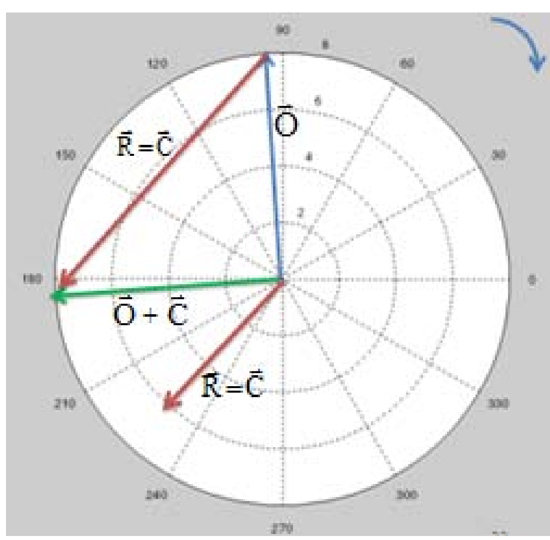

Figure 9 : Denote on polar plot

Performance for the un-threshed grain losses, total grain losses, and threshing efficiency is determined based on experimental performance and dynamic analysis. Table (5) shows experimental performance result. These results based on 17% moisture content. If the machine threshes at 20% (w.b) moisture content, the results of grain losses will be decrease.

Un-threshed weight correction locations are been modally effective. If the unbalance weight is increased, an unexpected result will be produced. When adding calibration weights, check the response vector C. Small vector changes indicate a lack of sensitivity to the weight. Care should be taken when analytically modeling the shaft.

Table 5 : Result of Experimental Performance

No.	Items	Values	units
1	Actual performance rate, P_r	0.5625	acre/h
2	Percentage of damage, P_d	19.231	%
3	Un-threshed grains, U_{th}	2	%
4	Percentage of grain losses, P_{gl}	5.263	%
5	Percentage of total grain losses, T_{gl}	12.263	%
6	Field efficiency, η_t	77.49	%
7	Cutting efficiency, η_c	62.87	%
8	Cleaning efficiency, η_{cl}	90	%
9	Threshing efficiency, η_{cl}	97.77	%
10	Specific consumed energy, S_e	7.8×10^{-3}	kW.h /kg
11	Fuel consumption per hour	3.08	gal/ hr
12	Fuel Cost per Acre	31,197	kyats/acre
13	Labour Cost par Acre	13750	Kyat/acre

The results at 90 degree position are shown in Table (6). These results are determined based on Fig 7, 8 and 9. Table (7) is to compare for the values of stiffness and modal mass from design and unbalance weight condition.

Table 6 : Result of Unbalance Weight at 90° position

Items	Parameters	Symbols	Values
1	Original response (mil p-p)	$\vec{O}$	$2.98 \angle 90.6°$
2	New response (mil p-p)	$\vec{O}+\vec{C}$	$3.8 \angle 180.6°$
3	Response due to calibration weight	$\vec{R}=\vec{C}$	$4.8 \angle 218.71°$
4	Applied force of calibration weight	$\vec{F}$	$0.2902 \angle 90°$
5	Synchronous dynamic stiffness	$\vec{K}_{DS}$	$4730.9 \angle 129°$
6	Modal mass (kg)	M	0.0451
7	Modal stiffness (N/m)	K	903.4586
8	Modal damping (N.s/m)	D	12.539
9	Influence vector (mil p-p)	$\vec{H}$	$26.83 \angle 129°$

Table 7 : Comparison of Modal Mass and Stiffness of Shaft and Unbalance (90° position)

Items	Modal mass	Stiffness
Shaft	34.68 kg	3.9716×10^9 N/m
unbalance	0.1398kg	2799 N/m

For all Fig. 7 to Fig. 10, 90 degree condition result of unbalance weight is only considered for the relationship of dynamic stiffness and losses. This position is applied as the operating speed of the shaft approaches to the critical speed, the center of rotation begins to shift toward the CG. The phase angle between the exciting force (direction of the unbalance) and the actual vibration will be 90 degree. In this particular case, the vibration (response) amplitude lags the unbalance by 90°. So, dynamic stiffness for dynamic analysis is determined at 90° position calibration weight.

At 90 degree position, the values of stiffness decrease slightly in each engine speed (9.425, 10.2102 and 10.996 m/s. So, 903.47 N/m of stiffness can be accepted for this engine speed, 10.996 m/s.

Table 8 : Results of Stiffness for (Unbalance) calibration weight

Engine speeds (m/s)	9.425	10.2102	10.996
Position (degree)	Stiffness (N/m)	Stiffness (N/m)	Stiffness (N/m)
30	3143.427	2941.34	2799
60	1696.7251	1587.6	1511
90	1014.6117	949.33	903.47
120	600.5195	561.934	534.81
150	287.5591	269.0757	256.15
180	20.0446	18.7543	17.851

Table (8) refers to the effect of stiffness at various unbalance weight position by considering for each engine speeds. These relationships are shown by bar chart in Fig. 10. In this bar chart, the values of dynamic stiffness decrease steadily in the forward engine speeds (9.425, 10.2102 and 10.996 m/s). Also, these values become low from 30 degree to 180 degree. The highest dynamic stiffness can be found at the lowest speed.

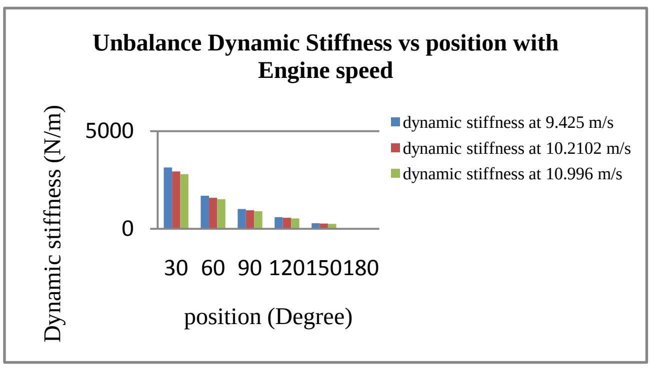

Figure 10 : Independent effect of dynamic stiffness (unbalance) on position

Table 9 : Results of Modal mass for (Unbalance) calibration weight

Engine speeds (m/s)	**9.423**	**10.2102**	**10.996**
Position (degree)	**Modal mass (kg)**	**Modal mass (kg)**	**Modal mass (kg)**
30	0.157	0.1469	0.1398
60	0.0848	0.0793	0.0755
90	0.0507	0.0474	0.0451
120	0.03	0.0281	0.0267
150	0.0144	0.0134	0.0128
180	0.001001	0.000937	0.000892

Table (9) shows the value of modal mass for (unbalance) calibration weight on various attached position. In this condition, Modal mass means trial mass, which is used during balancing to make temporary mass distribution on the shaft.

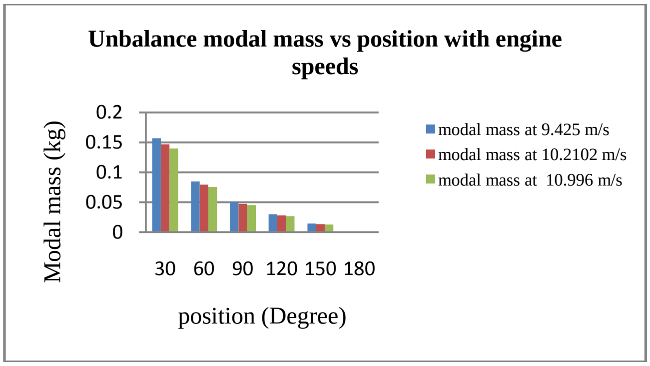

Figure 11 : Independent effect of modal mass (unbalance) on position

Fig. 11 can shows clear the change of modal mass for unbalance at various positions with engine speeds. There are three various modal mass values for each 9.425, 10.2102 and 10.996m/s. The graph is decreasing slightly from the position of 30 to until 180 degree.

Table 10 : Results of Total Stiffness including calibration weight

Engine speeds (m/s)	9.425	10.2102	10.996
Position (degree)	Stiffness×1 0 ^{9} (N/m)	Stiffness×1 0 ^{9} (N/m)	Stiffness×10 ^{9} (N/m)
30	3.971603143	3.971602941	3.971602799
60	3.971601697	3.971601588	3.971601511
90	3.971601015	3.971600949	3.971600903
120	3.971600601	3.971600562	3.971600535
150	3.971600288	3.971600269	3.971600256
180	3.97160002	3.971600019	3.971600018

Table (10) shows total stiffness including the value of calibration weight and shaft from design consideration depends upon engine speeds. The shaft for this thresher withstands strength, resist to unbalance weight so that it is stiffness dynamically. In dynamic analysis, the value of operating speed is determined based on natural frequency and frequency ratios.

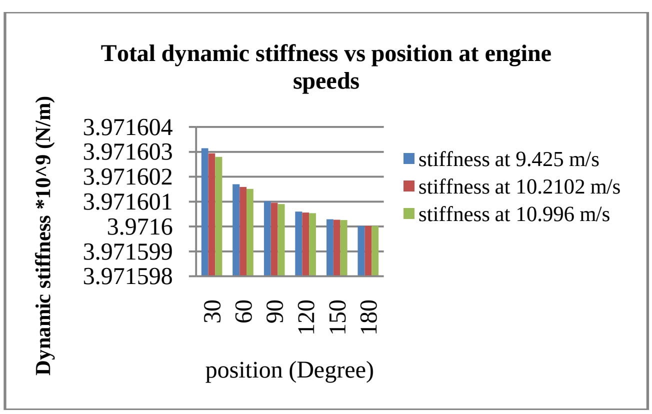

Figure 12 : Desired output of stiffness versus position

In Fig. 12, the total dynamic stiffness increased with decreasing engine speeds (9.425 m/s) for the reason that less feed rate into the threshing drum resulted in less impact force on the material. The forward engine speed of machine had significant effect on decreasing quality dynamic stiffness as speed increased.

Table 11 : Results of Total Mass including calibration weight

Engine speeds (rpm)	9.425	10.2102	10.996
Position (degree)	Modal mass (kg)	Modal mass (kg)	Modal mass (kg)
30	34.84	34.8269	34.82
60	34.7648	34.7593	34.76
90	34.7307	34.7275	34.7251
120	34.71	34.7081	34.7067
150	34.6944	34.6934	34.6928
180	34.681	34.68094	34.681

Table (11) shows the result of total mass (kg) with against to engine speed (rpm) and unbalanced weight position attachment (degree) on the shaft. The design requirement must be nearly the same with the critical speed for the operating speed to approach the C.G point of the shaft.

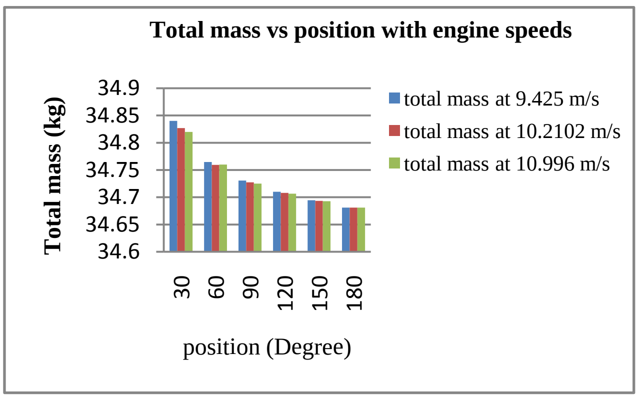

Figure 13 : Desired output of mass versus position

In this Fig. 13, it can see clear the change of total mass at various position with engine speeds. There are three various total mass values for each 9.425, 10.2102 and 10.996m/s. The graph is decreasing slightly from the position of 30 to until 180 degree.

During forward engine speeds (9.425, 10.2102 and 10.996 m/s), the values of un-threshed and total grain losses by changing operating speeds are shown in Fig. 14. According to this result chart, grain losses become increased steadily in each speed by dynamic stiffness consideration. These values also depend upon frequencies ratio. As the frequency ratio increases, the grain losses will follow. So, the grain losses need to adjust balance condition for frequency ratio.

At various speeds, losses are not different, nearly equal and the least in percentage in losses. So, it is satisfied to apply as a shaft of thresher in this combine harvester. Operating speeds, un-threshed and total losses are same each various positions attaching unbalance weight in three forward engine speeds.

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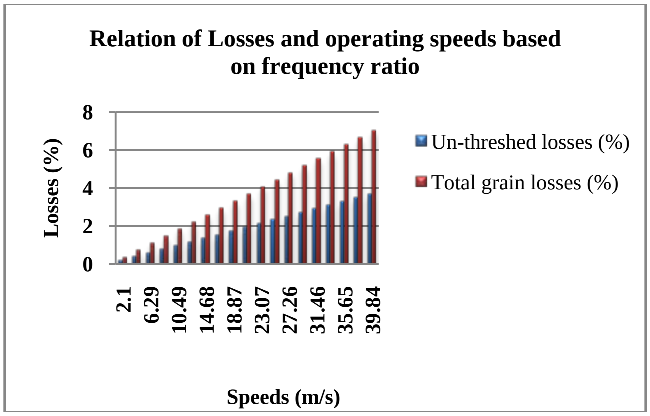

Figure 14 : Desired output of losses on frequency ratio

Fig. 14 refers to the information of whatever the speed changes, all the operating speed and losses are still nearly equal at any attachment of unbalanced weight position. It is only for 90 degree position unbalanced weight at each operating speed.

It can be seen that at each level of drum speed tested, the un-threshed and total grain losses increased significantly as the drum speed increased from 2.1 m/s to 39.84 m/s. However, higher value of grain losses was obtained at higher drum speed. The most un-threshed and total grain losses are 3.7 % and 7.05 % at 39.84 m/s, and then the least value of 0.19 % and 0.37 % by dynamic stiffness consideration were observed at drum speed of 2.1 m/s.

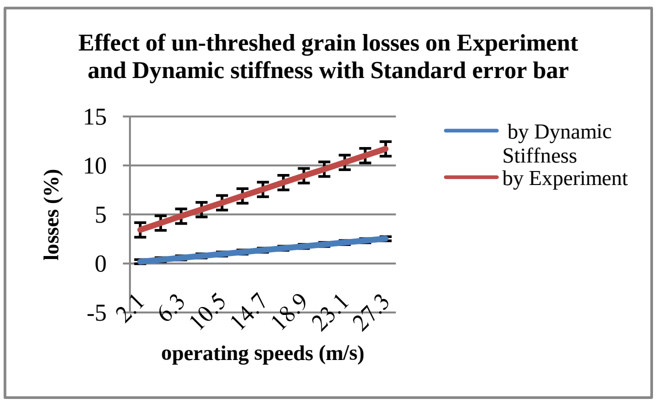

Figure 15 : Effect of Standard error bar for un-threshed grain losses by Experiment and Dynamic Stiffness condition

All the value of un-threshed and total grain losses at each operating speeds with standard error bars are expressed in Fig. 15 and 16. These values are equal for various unbalance weight positions with experiment and dynamic analysis. The effect of drum speed on the value of un-threshed grain losses for both experiment and dynamic stiffness are shown in Fig. 15 and the value of total grain losses for both experiment and dynamic stiffness are shown in Fig. 16.

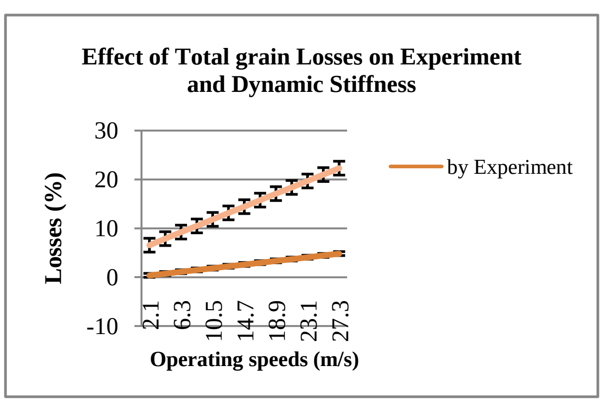

Figure 16 : Effect of Standard error bar for Total grain losses by Experiment and Dynamic Stiffness condition

The results revealed that un-threshed grain losses increased steadily in the dynamic stiffness. By testing dynamic stiffness, the result of un-threshed grain losses increased significantly in experiment as the paddy moisture content decreased at 21.5, 20% and 17 % (w.b). It was observed that at each level of drum speed tested. But, the lower un-threshed grain losses observed at higher paddy moisture content with given drum speeds.

IV. Conclusion

The paddy moisture content and the drum (or shaft) speeds significantly affected the total losses during paddy threshing by placed the shaft in the axial-flow thresher tested. The maximum total grain losses were obtained at shaft speed 39.84 m/s, frequency ratio 0.95 and moisture content 17 % in Fig (14). The values of total grain losses are 12.263 % and 7.05% for each theory with experiment in the paddy field and dynamic stiffness at 90 degree unbalance weight position.

The grain losses decrease in the suitable moisture content 20% (w.b). So, threshing losses was more increase than determining by dynamic stiffness. Comparing these two results, the total grain losses due to the dynamic stiffness is more satisfied than experimental field condition.

In order to minimize the effect of shaft or drum speed on total grain losses in the axial-flow thresher, it is recommended that the threshing operation should be performed immediately after crop harvesting. Performances due to dynamic analysis of the shaft for thresher have been reviewed in this paper. The two main topics include: experimental measurement techniques and dynamic stiffness of the shaft with various operating speeds.

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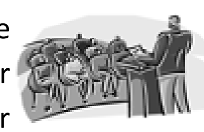
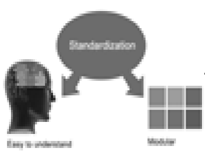


You may join as member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. In addition, it is also desirable that you should organize seminar/symposium/conference at least once.

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

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

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



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

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

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

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

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

MEMBER OF ASSOCIATION OF RESEARCH SOCIETY IN ENGINEERING (MARSE)

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

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

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

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

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

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

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

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

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

It is mandatory to read all terms and conditions carefully.

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

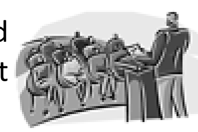
Global Journals Incorporation (USA) is accredited by Open Association of Research Society, U.S.A (OARS) and in turn, affiliates research institutions as “Institutional Fellow of Open Association of Research Society” (IFOARS).

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

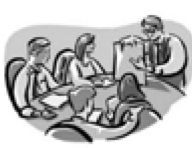
The IFOARS institution is entitled to form a Board comprised of one Chairperson and three to five board members preferably from different streams. The Board will be recognized as “Institutional Board of Open Association of Research Society”-(IBOARS).

The Institute will be entitled to following benefits:

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



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

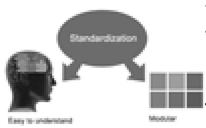


The IBOARS can organize symposium/seminar/conference in their country on behalf of Global Journals Incorporation (USA)-OARS (USA). The terms and conditions can be discussed separately.

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

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

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



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

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

The following entitlements are applicable to individual Fellows:

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

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

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

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

Other:

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

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

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

Note :

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

"

Process of submission of Research Paper

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

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

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

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

(II) Choose corresponding Journal.

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

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

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

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

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Page Size: 8.27" X 11'"

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- Font type of all text should be Swis 721 Lt BT.
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- Author Name in Font Size of 11 with one column as of Title.
- Abstract Font size of 9 Bold, “Abstract” word in Italic Bold.
- Main Text: Font size 10 with justified two columns section
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- First Character must be three lines Drop capped.
- Paragraph before Spacing of 1 pt and After of 0 pt.
- Line Spacing of 1 pt
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- Numbering of First Main Headings (Heading 1) must be in Roman Letters, Capital Letter, and Font Size of 10.
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You can use your own standard format also.
Author Guidelines:

1. General,

2. Ethical Guidelines,

3. Submission of Manuscripts,

4. Manuscript’s Category,

5. Structure and Format of Manuscript,

6. After Acceptance.

1. GENERAL

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

Scope

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

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

2. ETHICAL GUIDELINES

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

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

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

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

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

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

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

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

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Please mention proper reference and appropriate acknowledgements wherever expected.

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

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

3. SUBMISSION OF MANUSCRIPTS

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

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

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

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

4. MANUSCRIPT'S CATEGORY

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

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

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

Research articles: These are handled with small investigation and applications

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

5.STRUCTURE AND FORMAT OF MANUSCRIPT

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

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

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

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

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

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

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

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

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

(h) Brief Acknowledgements.

(i) References in the proper form.

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

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

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

Format

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

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

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

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

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

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

Abstract, used in Original Papers and Reviews:

Optimizing Abstract for Search Engines

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

Key Words

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

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

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

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

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

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

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

Acknowledgements: Please make these as concise as possible.

References

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

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

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

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

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

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

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

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

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

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

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

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

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

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

TECHNIQUES FOR WRITING A GOOD QUALITY RESEARCH PAPER:

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Informal Guidelines of Research Paper Writing

Key points to remember:

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

Final Points:

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

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

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

General style:

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

To make a paper clear

· Adhere to recommended page limits

Mistakes to evade

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

In every sections of your document

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

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

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

· Align the primary line of each section

· Present your points in sound order

· Use present tense to report well accepted

· Use past tense to describe specific results

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

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

Title Page:

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

Abstract:

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

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

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

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

Approach:

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

Introduction:

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

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

Approach:

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

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

Procedures (Methods and Materials):

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

Materials:

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

Methods:

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

Approach:

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

What to keep away from

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

Results:

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

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

Content

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

What to stay away from

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

Approach

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

Figures and tables

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

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

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

Approach:

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

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

Index

H

Heuristic · 4, 8

L

Lemmais · 11

M

Manoeuvering · 17
Meiktila · 37
Myittar · 39

O

Obsolescence · 29

S

Shortis · 20, 25

T

Tachometer · 39
Trajectory · 4, 8, 11, 13

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