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Control System for Opening and Closing of Canister Hatch Door

D. Sawant[1], H. Khomane[2], K.Ghule[3], A. Bansode[4], D.Salunke[5]

BE Students, Dept. of E&TC, Parvatibai Genba Moze College of Engineering, Savitribai Phule Pune University, Pune, India[123]

Scientist, R&DE (DRDO), Pune, India[4]

PhD[ECE], Professor, Dept. of E&TC, Parvatibai Genba Moze College of Engineering, Savitribai Phule Pune University, Pune, India[5]

ABSTRACT: Control systems have wide range of applications. Here we are controlling an opening and closing of a door of missile storing canister. Basically system is electromechanical system in which we are using PMDC motor and for controlling speed PID controller. In this system speed of motor varies at different instants so that operation will be smooth and vibration or jerk free. Speed controlling refers to speed variation carried out manually. The simulation and experimental investigation is done in MATLAB R2008b.

KEYWORDS:MATLAB Simulink,PID controller, PMDC motor, PWM.

I.INTRODUCTION

Opening and closing of lighter weight door is easy consuming less power and jerk free. Where in the heavier door system, it is difficult to control the speed and it is more power consuming. It introduced more jerks and vibrations. There are different methods for controlling the speed of PMDC motor so here we are using feedback mode system in which PID controller is used. A trapezoidal speed profile is used in many door systems but this kind of field does not have continuous speed movement .In this door movement, smoothness increase the motor heating and energy consumption, Were in the based S speed profile was design to negate such disadvantages.[1] Controller based closed loop operating system for PMDC motor has already become an important drive configuration in many applications because their high reliability, fast response, simplicity of operations and low cost.[2]

The approach of this paper is to design a closed loop system in which control the speed at different instants of time so the motion of door /system will be jerk or vibration free and consumes less power.

II.PROBLEM DEFINATION

Consider a big size of rectangular or square door. One end of canister has to be closed by hatch. Approximate weight of the door is 30kg.Hatch door opening and closing is an electromechanical based mechanism. The PMDC motor driver, a four bar mechanism through planetary and bevel gear box. The servo operation mechanism is control scheme used.
In the old system, the problem is the motor is controlled using the variation of the armature voltage. Due to this, the heat dissipation is more and minimum torque is at low speed. At high speed, the torque is more due to this it converts vibration into the jerks.

To reduce these jerks, we construct this system**.**

III.PROPOSED STRATEGY

There are different methods for controlling like armature current control, applied voltage control and input resistance control. All these methods are used for high power dissipation, low torque at low speed or high torque at high speed. Because of this we move towards the electronic control system technique. One such technique is Pulse Width Modulation. It has high torque at low and high speed of the motor. Therefore we use the PWM and PID technique for controlling the system.

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IV.SIMULINK MODEL

Basically system is dividing into 3 parts:-

A. Main system

B. Load

C. Error correcting system.\feedback system

A. Main system: -

It consists of voltage controlled power supply, PWM, H-bridge, motor. As per the feedback getting from error correcting system PWM change its duty cycle. So according to duty cycle the current and voltage supplied to motor are changed. This will change the speed of motor at different instant of time.

B. Load: -

For knowing the effect of various parameters on weighted door we are taking one bar in simulation model. The one end of bar is fixed and we are applying torque on bar. Our aim is to rotate the bar up to 90 degree. Here some specifications of door and bar are same so it is very help full for analysing the system

C. Error correcting system. / Feedback system:-

PID controller is main block from this subsystem. By tunning PID appropriately we get specified results of torque and we can control the system. The output of this sub system is feedback to main system. The main function of this system is to calculate error in angle and control the position of bar.

The three important functionality term of PID highlighted below.

The proportional term (K_p):- providing an overall control action proportional to the error signal through the all pass gain factor.

The integral term (K_i):- reducing steady state errors through low frequency compensation by an integrator.

The derivative term (K_d):- improving transient response through high frequency compensation by a differentiator.

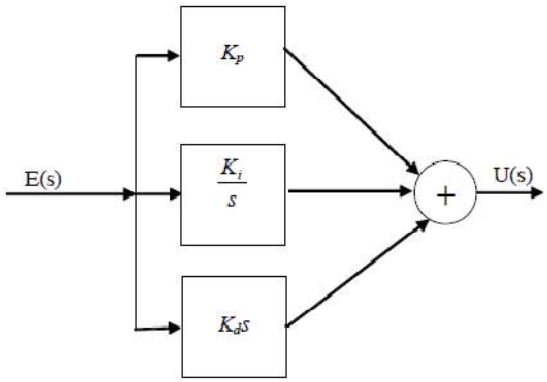

Fig 1: Parallel Form of the PID Compensator

The transfer function of the PID controller is

$$G(s) = \frac{U(s)}{E(s)} \quad \ldots [1]$$

$$G(S) = K_p + K_i/S + K_d.S \quad \ldots [2]$$

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For opening of system just apply revers current to motor.

In the fig 2, it shows the Simulink model consists of three sub systems and scops for getting results.

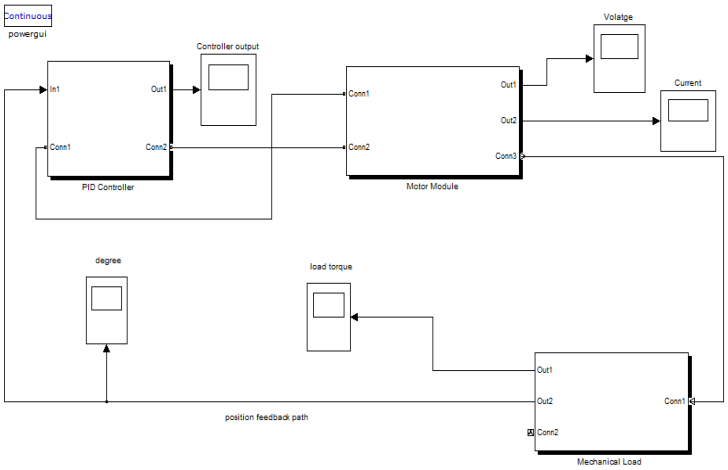

Fig 2: Simulink model.

V.SIMULATIONRESULT AND DISCUSSION

Basically we done current and voltage analysis of control system.

Current is directly proportional to torque so the pattern of graph is same .The angle increases continuously with respect to time. In contrast, we get voltage response in which error voltage is continuously decreases with respect to time.

In the fig 3, it shows the graph of current vs. time.it showshow much current required for handling a weighted system.

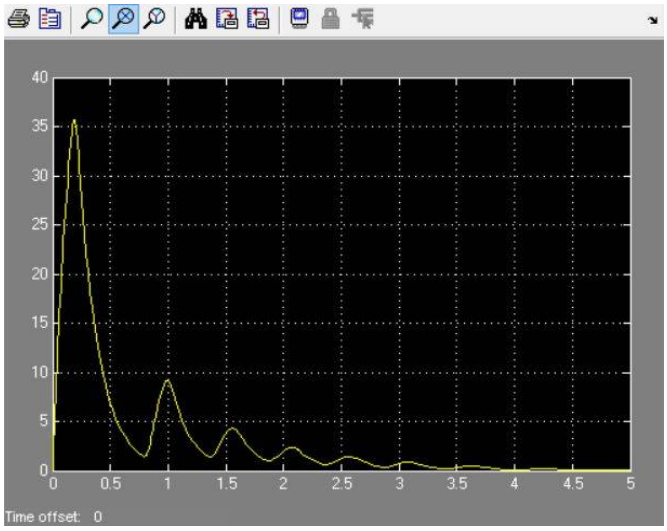

Fig 3: current verses time plot

In the fig 4, it shows the graph of angle vs. time .it shows how the angle of canister hatch door will change with respect to time and it controlled to 90 degree.

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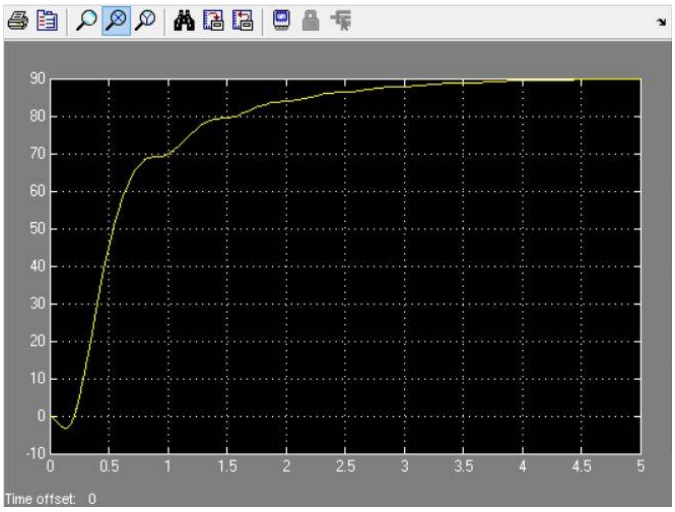

Fig 4: angle verses time plot.

In the fig 5, it shows the graph of torque vs. time .It shows how much torque required for system. When angle reach to 90 degree, torque will be zero.

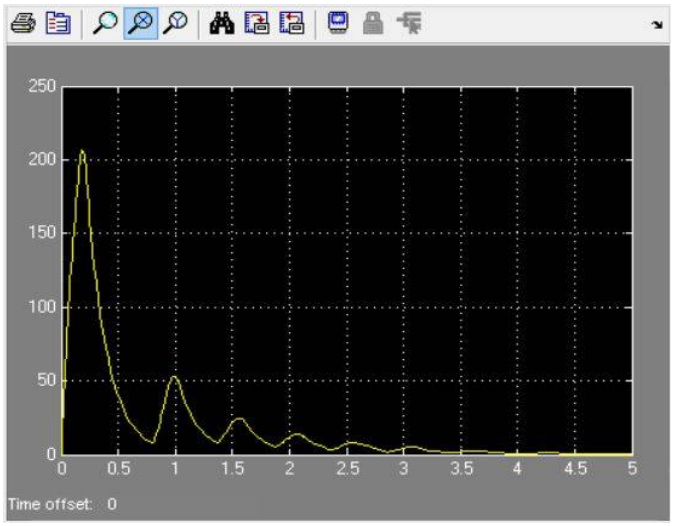

Fig 5: torque verses time plot.

In the fig 6, it shows the graph oferror angle vs. time. The angle of load system (door) compare with reference angle and the difference between them given to PID controller.

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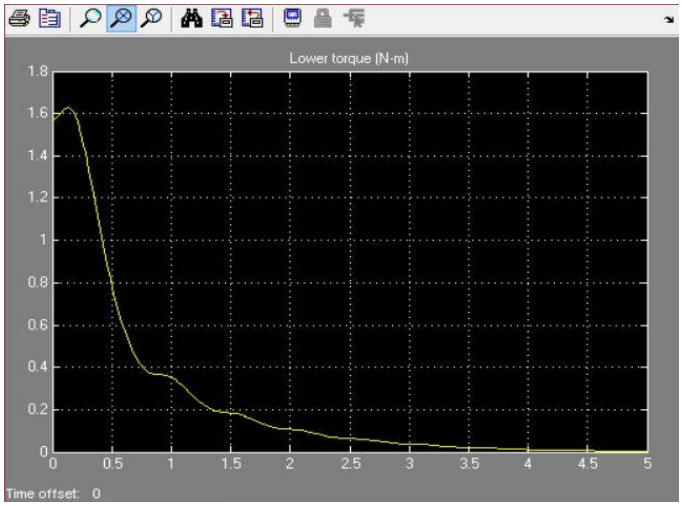

Fig 6: Error angle (radian) verses Time

VI.CONCLUSION

The main aim of our project is to make vibration free that is jerk free. Jerk free system can be achieved by implementing a closed loop system. The closed loop system is developed using PID controller. The speed is controlled by varying duty cycle of PWM so that the applied current supplied to motor is controlled.

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