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ANTENNA DRIVE MECHANISM FOR AN SATELLITE TRACKING SYSTEM

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Abstract: Control systems are an integral part of modern society, and a major part. They consist of subsystems and processes which are assembled in modern industry for the purposes of controlling many processes. Motion control is required for domestic or industrial works. Systems used for such controls are called drives. By measuring output response and feeding it through feedback system and comparing them at summing junctions, the closed loop systems overcome the disturbance problem. An analysis is made of the performance of a dc motor controlled by a proportional-integral derivative (PID) controller. Overshoot appears with large settling time thus confirming a PID control behavior. In this paper Ziegler Nichols (ZN) tuning algorithm is the tuning method used for the proposed dc servo motor position control model. A computer based model is furnished here (using MATLAB SIMULINK).

Index Terms - **PID(proportional-integral derivative),Closed loop, overshoot, Ziegler Nichols (ZN) tuning algorithm.**

I. INTRODUCTION

The motive of this project is to render background information on the factors to be considered and also to check if there is any resemblance in the work carried out by other authors in past years. Over the last decades, control system and its design have been advancing rapidly to respond to the competition and demand of the industrial world, which are the key element in defining new successes. This work is directed towards the design, development and implementation of an auto-tuning Proportional Integral Derivative (PID) Controller for satellite tracking system. Auto-tuning PID controller was designed using MATLAB, Simulink as well as the optimization of PID controller without excessive mathematic calculations.

II LITERATUR SURVEY

Review of Literature is a significant part of the project. It allows assimilation of the knowledge required for the project right from the description of the problem, finding a solution and its implementation. The following report summarizes the review of literature conducted for the project.

Yagimli et al[1] discussed the trajectory of a communicated satellite missile, which is thrown from the combat aircraft to the combat aircraft, was investigated separately using Fuzzy and PID control.

Hazza et al[2] explained that the control system consists of subsystems and connected process for achieving a specified output and performance when a quantified input is given. Two measures are needed to measure its performance, namely the transient response and the steady-state response.

Gao et al[3] explained the Application of adaptive control scheme for altitude tracking system. In the practical satellite systems, the uncertainty of the satellite inertia matrix is inevitable under real circumstances due to fuel consumption, payload motion, and the rotation of solar arrays on the satellite.[3]

Parsai et al[4] introduced a novel technique where a PID Controller is widely used in spacecraft tracking mechanisms. The popularity of the PID controller is attributed to its simplicity but optimum PID parameter tuning is a complicated process.

Vinod et al[5] explained the system that uses dc motor control speed and direction via Bluetooth HC-05 with Arduino. The blueprint is represented on the board of AT Mega 328 and the engine is connected to the ports of input / output. Arduino can generate the pulse width modulation by giving this pulse to L298 enabling pin to control motor speed.

Asha et al[6] discussed varying temperatures to control the speed of the DC motor. LabVIEW platform is employed to develop the code. The temperature sensor used here is an LM35.Through LabVIEW the temperature measuring circuit is interfaced. The sensor to temperature used here is LM35. Both DC motor and temperature measurement code is loaded into Arduino board via LABVIEW software. In LabVIEW the coding or programming is based on the virtual instrumentation platform. The Data Acquisition System (DAS) plays the role of Arduino Uno board.

Harini et al[7] analyses the effect of the load and initial position of the Permanent Magnet Synchronous Motor Control System (PMSM) when the PMSM is used as a vehicle on a flat road and uphill. The analysed control system uses Proportional Integral (PI) as a current controller and incremental encoder as a sensor. The results show that the initial position of the rotor has an effect on the current of the motor.

Zhang et al[8] demonstrated the orbit determination for satellite constellation based on satellite-to-satellite and earth-to-satellite tracking, the tracking would have broad prospects of application in future constellation and manned space vehicle rendezvous and docking. The programming of the orbit determination software is simplified and clears the process of determination of multi-satellite and multi-arc orbits, then applies to YaoGan-9 satellite constellations. Based on earth-to-satellite and satellite-to-satellite tracking, results show that the method can fulfill the multi-satellite orbit determination application requirement in full.

Susmita et al[9] discussed the PID tuning approach with the aid of simulation aspects using traditional ZN tuning method. Due to its simple control structure and satisfactory results, the most important reason behind this PID tuning approach is The first method used in this tuning approach is Z-N which is efficient in the tuning of stable systems. The coding is done entirely using MATLAB, and the minimum requirement version is MATLAB R2010a for its execution. The coding in MATLAB consists of two parts i.e. Routh-Hurwitz coding to determine if the system is stable or unstable and the Z-N tuning rule code that performs user-supplied tuning of the systems.

Yulia et al[10] analyses the precise estimation of speed, and for high-performance electrical drives, short measurement time delay is mandatory. Together with speed estimation techniques such as period-based, frequency-based, constant elapse time, and synchronous measurement methods, rotary incremental position encoders are widely used.This paper deals with the technique of speed estimation, which helps to obtain higher precision by filtering the results of the period-based method using Sinc-filter in the third order. Given that the sequence of estimates of the period-based method has the properties of modulated delta-sigma signal, extra information can be extracted.

Haiming et al[11] deals with a new methodology by processing the pulses from an optical incremental encoder to deduce the velocity and position information. The proposed velocity assessment method adopts the hysteresis switch technique to remove the switching fluctuation as compared to the conventional adaptive method. In addition, a time-to - digital converter performed with phase-locked loop is used for accurate time interval measurement, thus improving the velocity assessment resolution. In addition, the calculated velocity and subdividing position are used to calculate the position being discussed in order to achieve higher precision of position detection.

Liang et al[12] interpolated the position control algorithm for permanent magnet synchronous machines (PMSMs) equipped with low resolution encoders which could significantly improve the control performance at low speed. It is based on a sliding-mode observer (SMO) hybrid and a low-resolution incremental encoder, which can improve the accuracy of rotor position through the interpolation control algorithm, and thus overcomes the encoder's low-resolution problem in low-speed operation.

Johnson et al[13] illustrates that one of the commonly used transducer is an incremental optical encoder, used for angular velocity and position estimation. Unfortunately the quantization errors affect both period and frequency counting methods that are frequently used to estimate angular velocity using incremental optical encoder signals.

III METHODOLOGY

The flow chart explain the steps involved in the process of implementation as illustrated in fig 1.1.

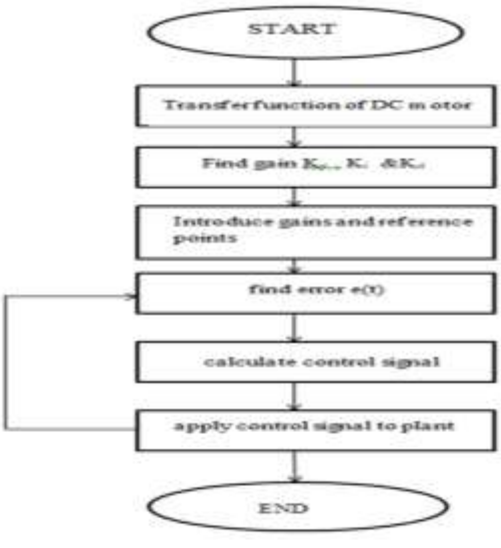

fig 1.1: Flow Chart of PID Implementation

- The first step to implement PID for speed control of a DC motor is to attain the transfer function of DC motor.
- Then find the PID gains using kp,ki &kd.
- After that introduce the reference point, introduce gains and find the difference between the desired value and the actual value in the form of error .
- calculate the control signal that is applied to DC motor.
  $u(t) = MV(t) = K_p e(t) + K_i \int 0 t e(\tau) d\tau + K_d de(t) dt$
- Finally a feedback is taken from output to find the error and this procedure continues until the DC motor is regulated at desired speed.The implementation flow chart is shown in fig 1.1.

III CONCLUSION

The complete introduction to the PID controller and the drive mechanism of satellite tracking system have been explained. To meet this objective of designing, developing and demonstrating the antenna drive mechanism for satellite tracking system is proposed. The literature survey tells about the major contributions of the significant studies and a survey of existing works in the field of antenna drive mechanism. The present work focuses on automatic tuning to control the satellite and no manual errors delay while controlling of satellite. At present the performance of brushed DC motor is controlled by a PID controller. The transient performance of P, P-D, P-I and P-I-D controllers are controlled by the method called Ziegler-Nichols method or trial and error method. The Arduino supplies a software library from the writing project. The version Arduino 1.8.2 open source makes it easy to write code and upload it to the teensy 3.2 board. The aim of the project is to control antenna for real time tracking system.

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