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CONTROL SYSTEMSPROJECT

FINAL-REPORT

PROJECT TITLE :

PI-PD CONTROLLER DESIGN USING MODIFIED RELAY FEEDBACK

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SLOT : G1+TG1

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Objective :

- PI-PD control methodology is used to achieve the control objectives for the systems which had already been subjected to PID control scheme using previously known methods, the new method incorporates features of the two methods and produces better resultsfor the same set of examples.

Introduction :

- A tuning method based on modified relay feedback experiment hasbeen proposed, which can also be applied to plants that do not possess an ultimate frequency.

- The proposed method is given by carrying out modification to simplePI-PD controller using fractional order integrator in series with Relay in order to identify the given system to its equivalent process model, using parameters obtained from limit cycle output.

- This method can also be applied to both stable and unstable (up tocertain extent) systems in order to obtain desired response with accuracy.

- This method is also applicable to the class of plants for which Ziegler–Nichols (ZN)-like methods can be applied. Thus serves as an optional tuning method for various other classes of plants.

Literature Survey

S.NO.	PUBLICATION YEAR	AUTHOR	TITLE	INFERENCE
	March 2016	Anagha Philip Antony ; Elizabeth Vargh- Ese	Comparison of performance indices of PID controller with different tuning methods	Two design techniques are presented for tuning the parameters of the controller, Zeigler- Nichols and the Åström-Hägglund method based on certain design specifications. In orderto achieve better performances
	March 2011	Jean-Claude Trigeassou ; Alain Oustaloup	Comparison of performance indices of PID controller with different tuning methods	• Fractional integration is defined by the classical Riemman-Liouville integral, derivedfrom repeated integration. • Three approaches commonly usedto define the fractional integration operator (frequency method, frequency distributed

				model, Grünwald derivative) are analysed and compared.

Problem Statement

- Designing and tuning a proportional-integral derivative (PID) and PI- PD controllers appears to be conceptually spontaneous, but it can be hard in practical applications, particularly if multiple (often conflicting)objectives are to be achieved.

Problem Solution

- Using modified relay feedback based identification technique in order to obtain its initial parameters from limit cycle output, after that PI-PDcontrollers are tuned using proposed relay feedback tuning method that produces desired results.

Block Diagrams:

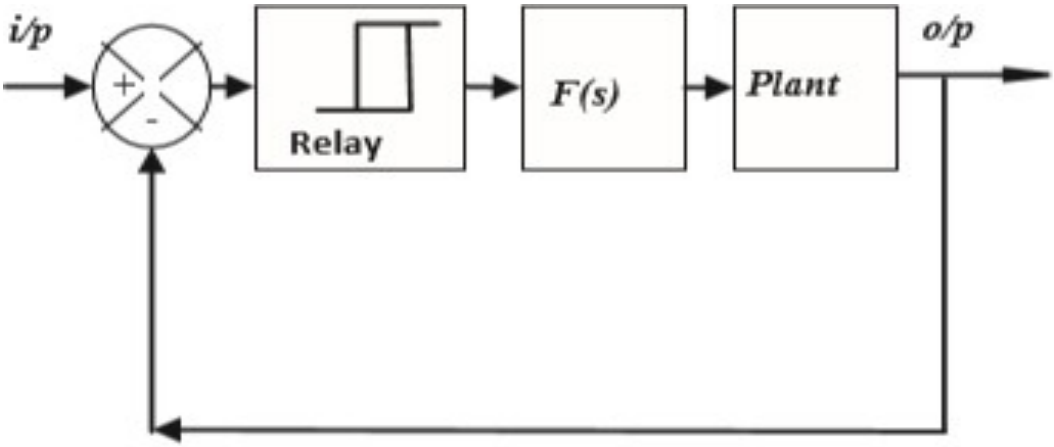


Fig.1Modified relay feedback model for PID controller.

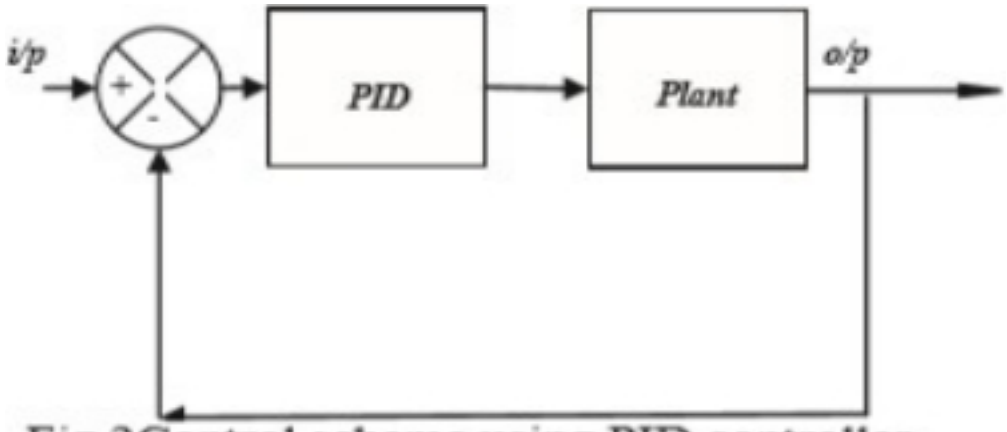


Fig.2Control scheme using PID controller.

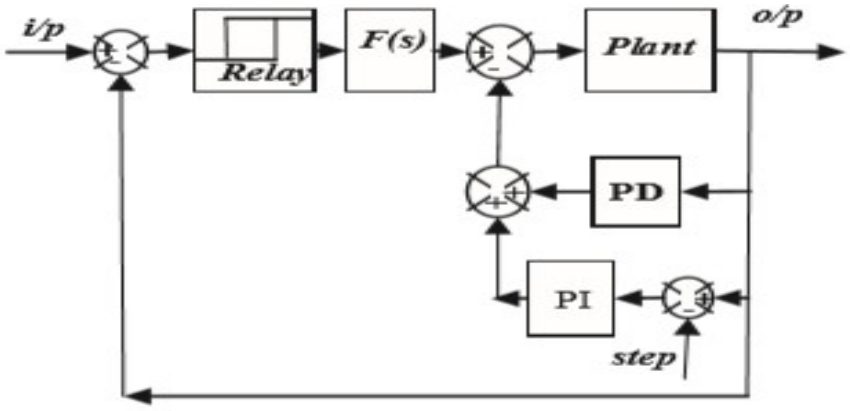


Fig.3 Modified relay based identification model for PI-PD controller.

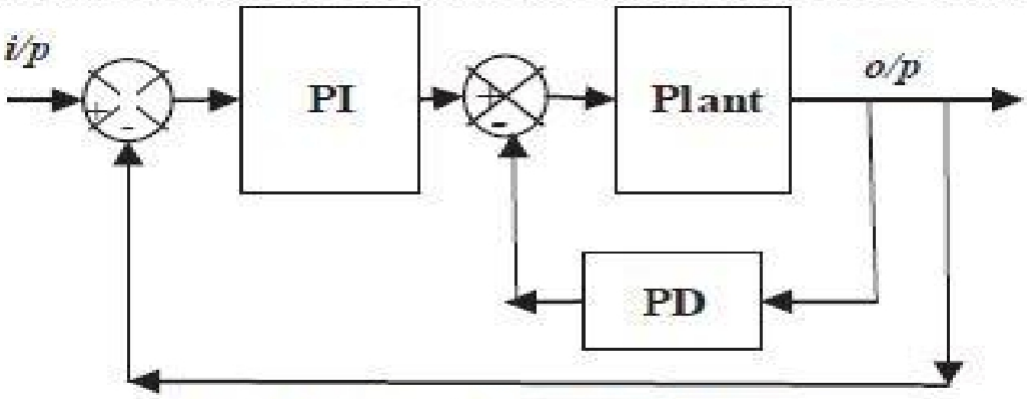


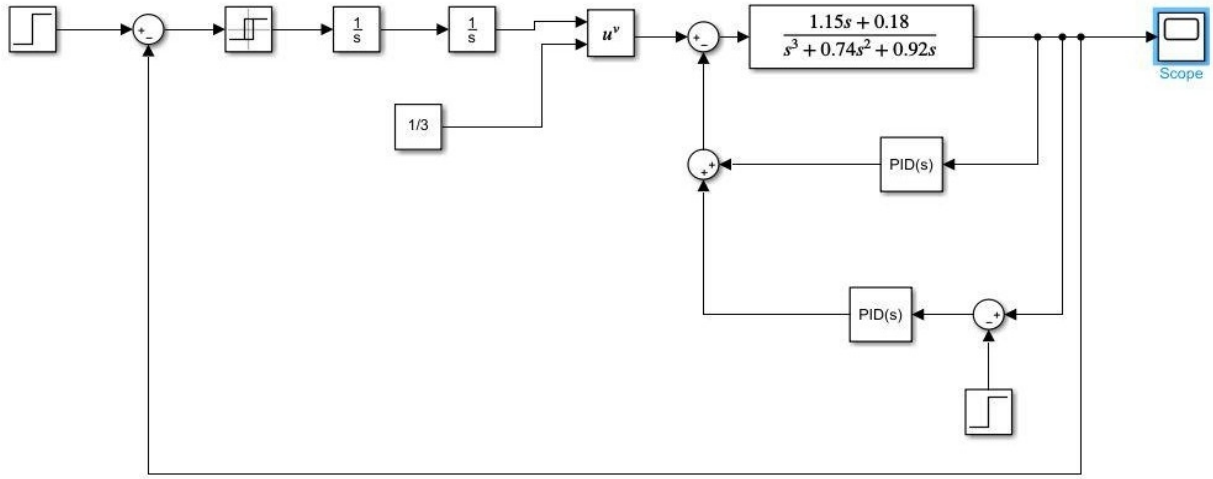
Fig.4 PI-PD control methodology.

Example-1:Aircraft Pitch Angle Model

Transfer Function=

$$G_p(s) = \frac{1.15s + 0.18}{s^3 + 0.74s^2 + 0.92s}$$

Block Diagram:



Limit Cycle output of this model(Using PI-PD methodology):

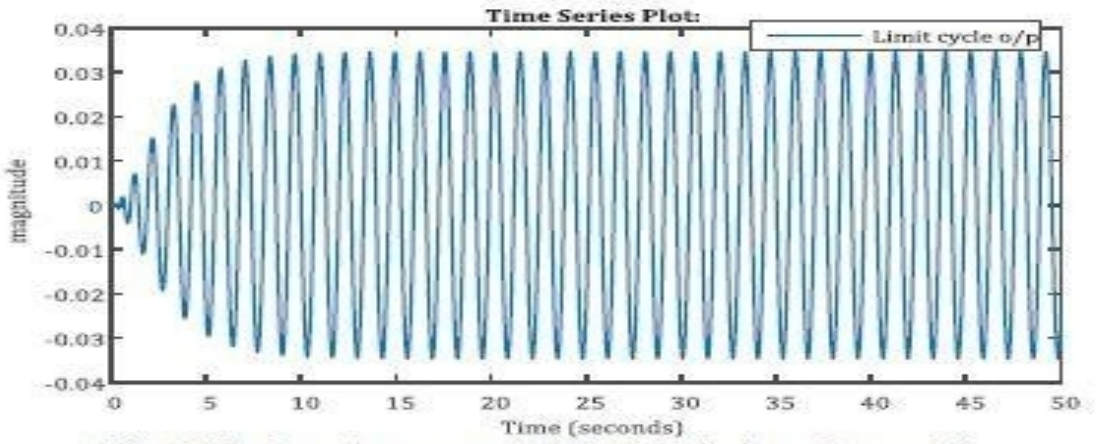
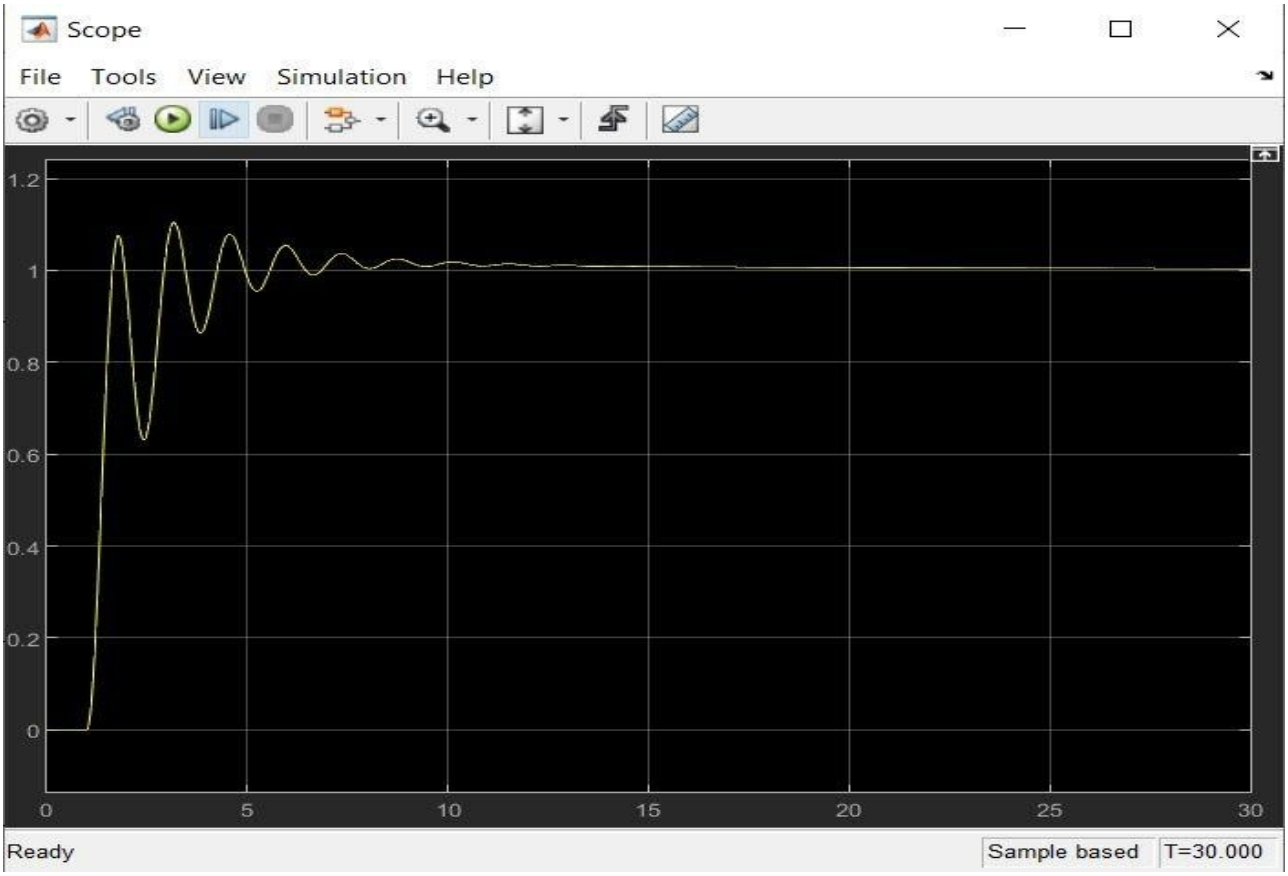


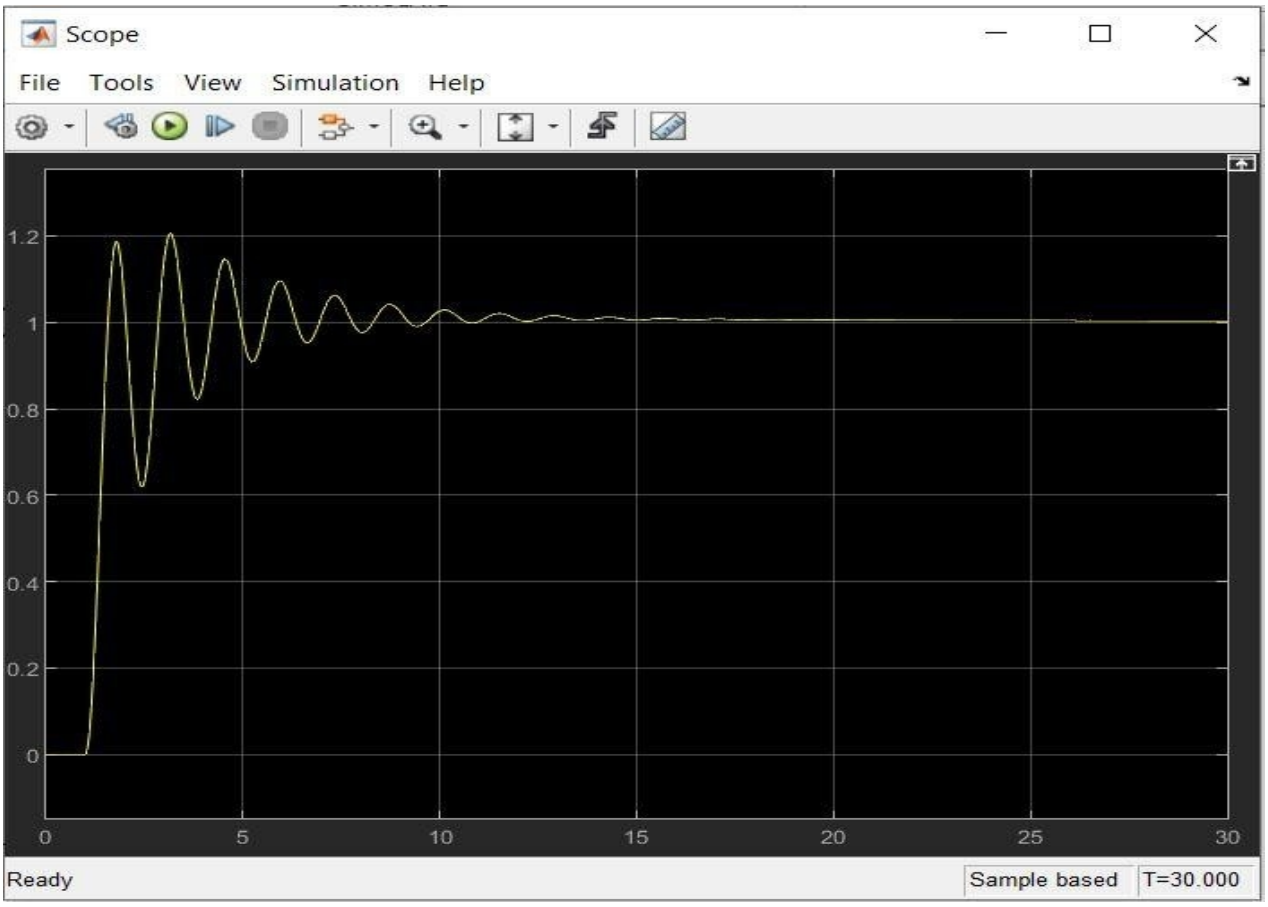
Fig.5 Limit cycle output of aircraft pitch angle model.

Output of the system(Using PI-PD Methododlogy)

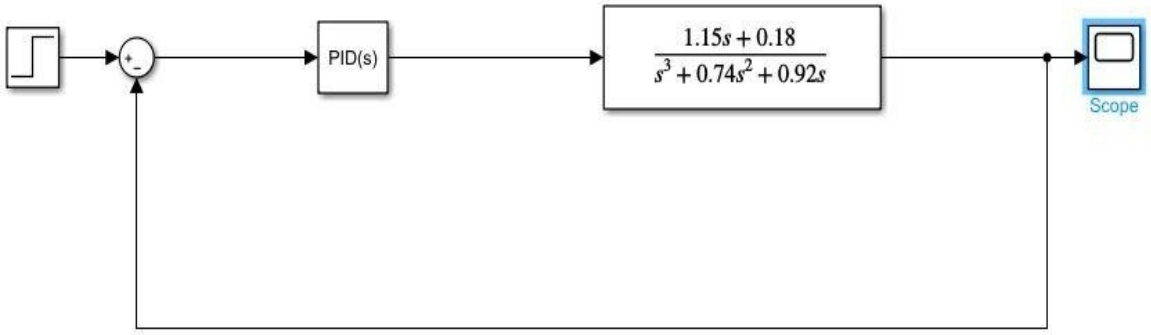
1st solution:



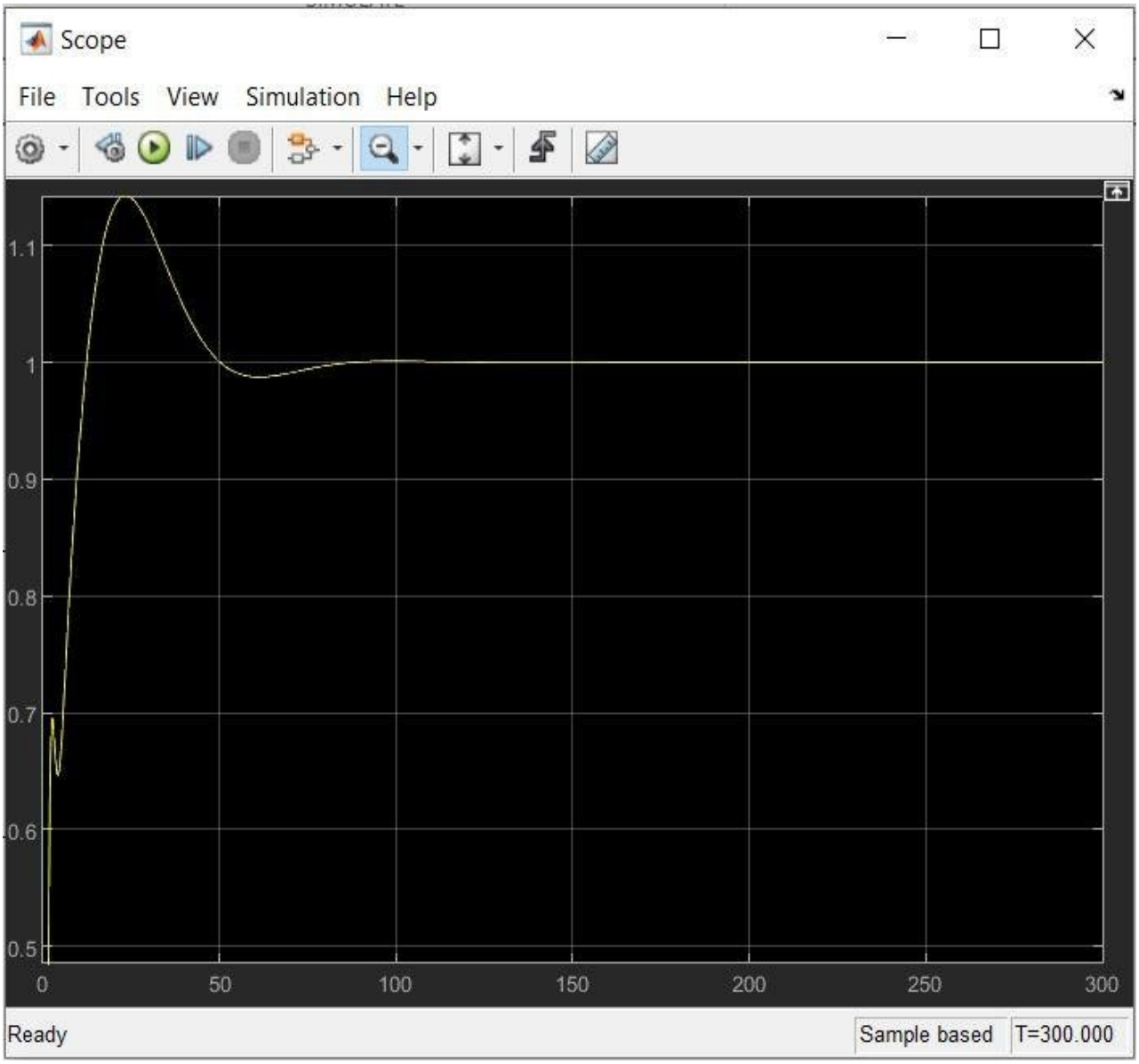
2nd solution:



Block Diagram(Zeigler-Nicholas Method):



Output of the System(With Zeigler-Nicholas Method):

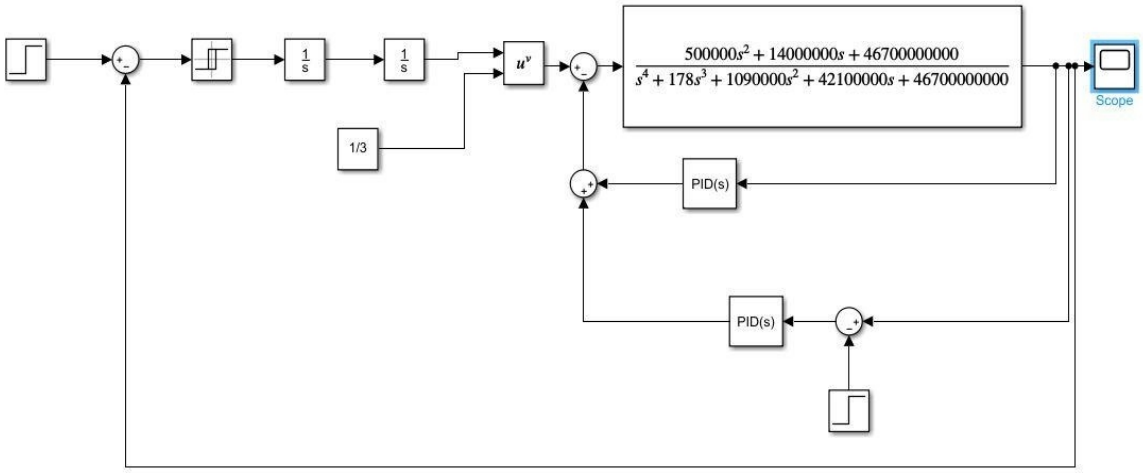


Example-2: Disc Position Control Model

Transfer Function:

$$G_p(s) = \frac{(500000\,s^2 + 14000000\,s + 46700000000)}{(s^4 + 178\,s^3 + 1090000\,s^2 + 42100000\,s + 46700000000)}$$

Block Diagram



Limit cycle Output Of this Model(Using PI-PD methodology)

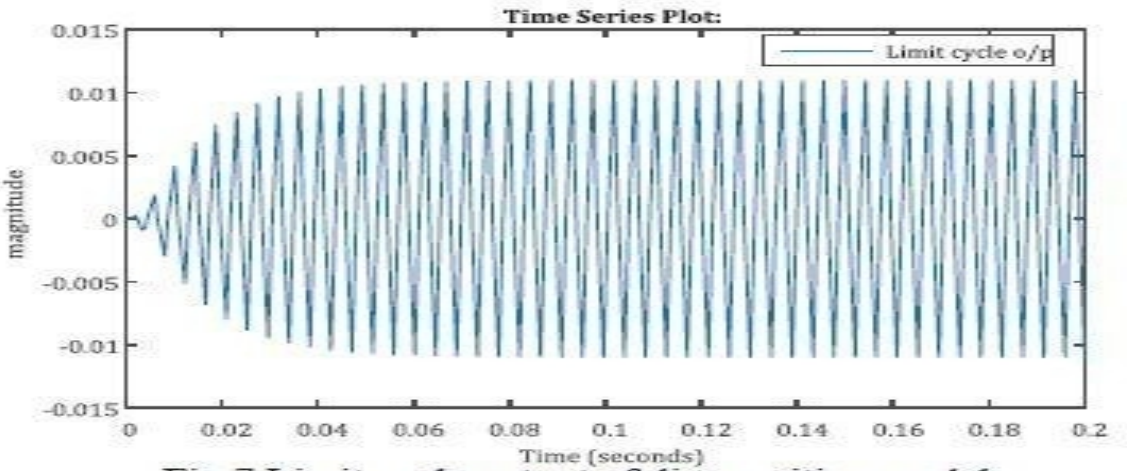
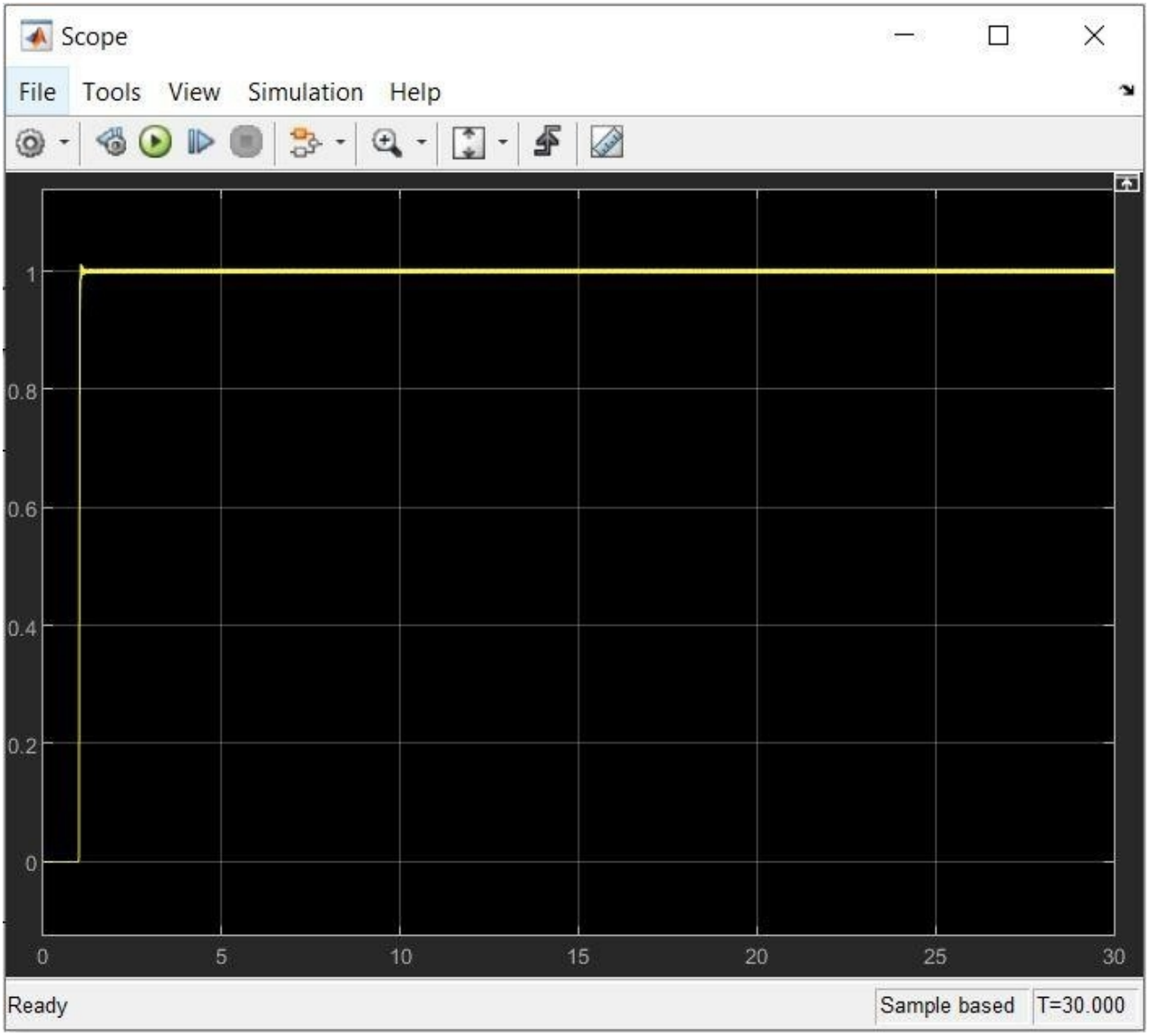
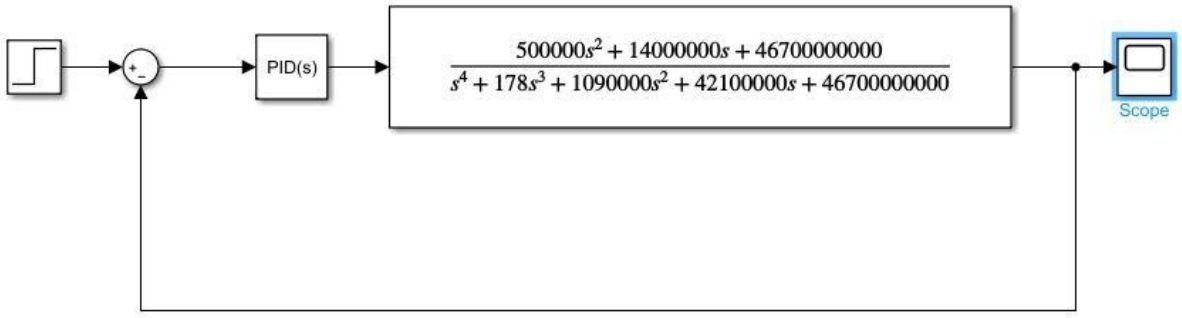


Fig. 7 Limit cycle output of disc position model.

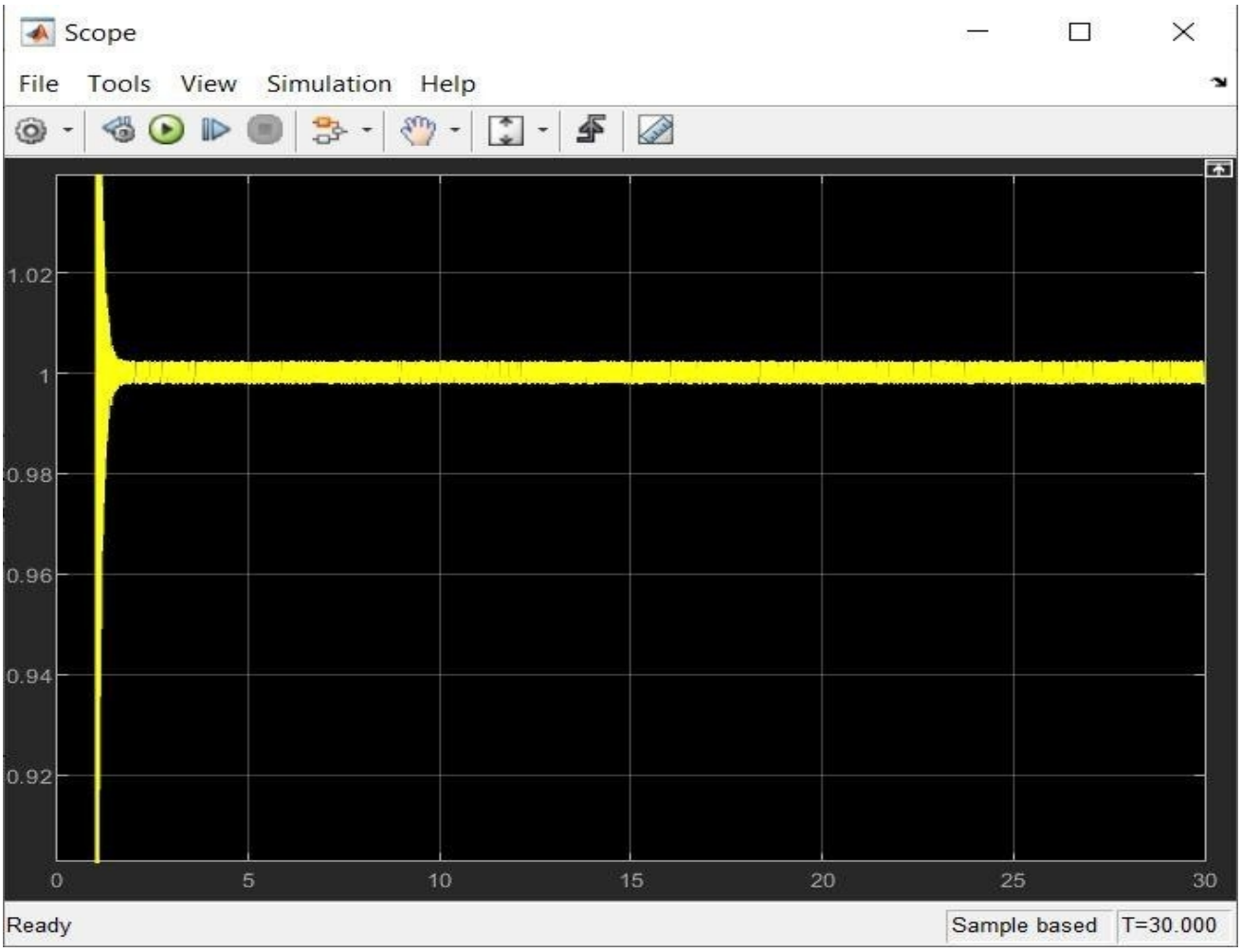
Output of the system(Using PI-PD Methododlogy)



Block Diagram(Zeigler-Nicholas Method)



Output of the System(With Zeigler-Nicholas Method)



CONCLUSION:

In this project, method for relay based identification is proposed using a fractional order transfer function $F_c(s)$ that produces symmetric limit cyclewhich gives accurate values of period and amplitude that helps in proper identification of process model. With the help of this method both stable and unstable systems can be made stable first using PD-PI controller in parallel to the plant as shown above. For identification purpose with someinitial gains, Inner proportional controller enables to estimate the transferfunction model. Based on parameters obtained from limit cycle simple PI- PD controller is tuned using given control scheme. Relay based identification has certain limitations in terms of choosing initial values of gains (K_c,K_f). Future research work can include providing solutions to above discussed problems especially for unstable systems.

THANK YOU