Adaptive Position Control of a Levitating Ball

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Abstract – insert abstract here.

Keywords – KeyWord1, KeyWord2, Some KeyWordPhrase Here

I. INTRODUCTION

Introduction here

II. problem description

Problem description here

iII. SySTEM DESCRIPTION

System description here.

|  |  |
| --- | --- |
|  | (1) |
|  | (2) |
|  | (3) |

iv. MRAS CONTROL

A. MIT Rule

A model reference adaptive control was implemented with with a 2nd order model (1) and controller in (2):

|  |  |
| --- | --- |
|  | (1) |
|  | (2) |

When compared with the system transfer function, the model following conditions are as follows:

|  |  |
| --- | --- |
|  | (3) |
|  | (4) |

Equations (1) and (2) are combined with the model following condition and system transfer function to yield derivative of the adaptation laws in (5) and (6):

|  |  |
| --- | --- |
|  | (5) |
|  | (6) |

The adaption rates and were obtained from finite difference equations using the value of and and their derivatives at the previous timestep and the duration of the time step.

|  |  |
| --- | --- |
|  | (7) |
|  | (8) |
|  | (9) |

Initial values of and were set equal to the model following condition. Initial condition of their derivatives were set equal to zero.

|  |  |
| --- | --- |
|  | (10) |
|  | (11) |

B. Normalized MIT rule.

The adaptation laws were normalized using equations (12) to (14). The normalized adaptation law is given by (15), with corresponding to the normalized adaptation rate.

|  |  |
| --- | --- |
| , | (12) |
|  | (13) |
|  | (14) |
|  | (15) |

Where is calculated from (8), (7) as well as (5), (6) for and , respectively. With the normalized MIT rule, and is calculated using (9), but with substituted for . Initial conditions for and were set as per (16) and (17) where and are from (12) and (13)

|  |  |
| --- | --- |
|  | (16) |
|  | (17) |

C. System Simulation

Fig 1 is the simulation with a control input of

A picture containing histogram

Description automatically generated

Fig 1 y and ym for mit rule

Chart

Description automatically generated

Fig 2 error for mit rule

Chart, histogram

Description automatically generated

Fig 3 control signal for mit rule

A picture containing chart

Description automatically generated

Fig 5 y, ym and uc for normalized MIT rule

Chart

Description automatically generated

Fig 6 - error for normalized MIT rule

Chart, histogram

Description automatically generated

Fig 7 - control signal for normalized MIT Rule

D. Experimentation and Results

Both the regular and MIT rule and normalized MIT rule were implemented with python and uploaded onto a raspberry pi. The raspberry pi

D. Discussion

Insert discussion here

V. CONCLUSION

Discussion here

REFERENCES

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