YTÜ Makine Mühendisliği Bölümü

Makina Teorisi, Sistem Dinamiği ve Kontrol Anabilim Dalı Özel Laboratuvar Dersi

MATLAB-Simulink ile 2 Serbestlik Dereceli Taşıt İçin PID Kontrolör Tasarımı

Deney Raporu

Lab Date:

Lab Director:

Number: Name Surname: Group/Sub-group: /

Lab Location: A Blok 3 ve 4. Kat arası-Makine Teorisi Sis. Din. ve Kontrol Laboratuvarı Lab Name: Makine Teorisi - 2 Subject: PID controller design of a 2 DOFs vehicle using MATLAB-Simulink

Apparatus and tools:

- Computer
- MATLAB-Simulink software

Aim of the experiment:

- Obtain the differantial equations of the system.
- Establish a MATLAB-Simulink model for the system. Explain the steps of it in detail.
- Plot the displacement-time graph of the vehicle body for the uncontrolled system.
- Reduce the vehicle body vibration (x_1) by determining the optimum PID parameters.

Text template:

Introduction:

Explain the method of the obtaining the differential equation of the system.

Procedure:

Explain the steps of the establishing the MATLAB-Simulink model in detail.

Experiment Results:

Show each step of the experiment with plots and explain them in your own words.

Conclusion and Remarks:

Discuss the experiment results and explain the effects of the PID parameters on the response of the system.

References:

[1] Metin M. Guclu R., 2010. "Active vibration control with comparative algorithms of half rail vehicle model under various track irregularities", Journal of Vibration and Control, 17: 1525-1539

Conducting the experiment:

- **1.** Obtain the differential equations of the system.
- **2.** Establish a MATLAB-Simulink model for the system. Create simulink block diagram using equations of motion.
- **3.** Create .m file to run the Simulink model.
- **4.** In a simulink model window, click the Model Configuration Parameters in the Simulation tab and set max step size and min step size as 0.02 and 0.019, respectively for variable step solver, as shown in Figure 1.

0		Configuration Parameters: iki_s	d_tasit/Configuration (Active)		×
Select:	Simulation time				
Solver Data Import/Export	Start time: 0.0	Start time: 0.0 Stop time: 10.0			
 Optimization Diagnostics 	Solver options	Solver options			
Hardware Implementation Model Referencing	Type: Varial	ble-step	 Solver: 	ode45 (Dormand-Prince)	
 Simulation Target Code Generation 	Max step size: 0.02		Relative tolerance:	1e-3	
 HDL Code Generation 	Min step size: 0.019		Absolute tolerance:	auto	
	Initial step size: 0.02		Shape preservation:	Disable All	•
	Number of consecutive	min steps:	1		
2	Tasking and sample tim	Tasking and sample time options			
	Tasking mode for perior		Auto		
		Automatically handle rate transition for data transfer			
C		indicates higher task priority			
	Zero-crossing options	Zero-crossing options			
10	Zero-crossing control:	Use local settings	 Algorithm: 	Nonadaptive	•
	Time tolerance:	10*128*eps	Signal threshold	d: auto	
	Number of consecutive	zero crossings:		1000	
					V
0				OK Cancel Help	Apply
				100 million (1990)	
		D .	4		
		Figu	rel		

5. Assign I=0, D=0 and for each 100 increment of the parameter P up to 13000, plot the displacement-time graph of the vehicle body in terms of the parameter P in 3D graph as shown in Figure 2.

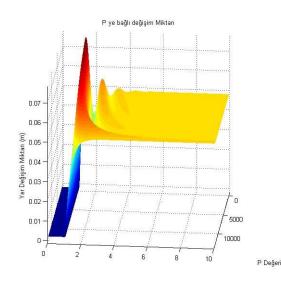


Figure 2

- **6.** Assign P=5000, D=0 and for each 100 increment of the parameter I up to 5000, plot the steady state error of the vehicle body vs the parameter I.
- 7. Assign P=5000, I=0 and for each 10 increment of the parameter D up to 1000, plot the displacement-time graphs of the vehicle body in terms of the parameter D in 3D graph.
- 8. Assigning the values of the PID paremeters as P=13000, I=0.1, D=0.001, plot the displacement-time graphs of the vehicle body and compare this case with the uncontrolled case.
- **9.** Discuss the experiment results and explain the effects of the PID parameters on the response of the system.

