1 Laborversuch Tempomat

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1 Laborarbeit

Die Laborarbeit gibt Ihnen die Gelegenheit, sich individuell und praktisch mit der Regelungstechnik zu beschäftigen. Sie bearbeiten die Aufgaben alleine oder in einer Zweiergruppe. Die Aufgaben sollten sich während der vorgegebenen Vorlesungszeit lösen lassen.

2 Laborbericht

Dokumentieren Sie Ihre Arbeit mit Screenshots und den Antworten auf die gestellten Fragen in einem PDF. Dieser und die folgenden Berichte werden bei Vollständigkeit mit jeweils einem Punkt bewertet, die Sie zusätzlich zu den Punkten in der Klausur gutgeschrieben bekommen. Den Laborbericht laden Sie bitte in den entsprechenden Moodle-Kurs hoch.

3 Vorbereitungen

Geben Sie im Matlab-Fenster sdl_car ein und speichern das Modell lokal ab. Simulieren Sie das Modell mit unterschiedlichen Driver Inputs. Falls alles wie erwartet funktioniert, ändern Sie dann Folgendes:

• sdl_car ▶ Vehicle Body: PS-Simulink Converter duplizieren und Einheit km/hr setzen. Neuen Out-Port vkmh mit dem Converter und den Converter mit dem V-Signal des Vehicle Body Blocks verbinden, , *Road incline* auf 0.01 setzen (*PS Constant*-Block rechts unten).



• sdl_car ▶ Engine: Enable idle speed controller setzen, Idle speed reference: auf 50, Stall speed: auf 0

😣 💷 🛛 Block Parameters: Engine

Generic Engine

(1)

Represents a system-level model of spark-ignition and diesel engines suitable for use at initial stages of modeling when only the basic parameters are available. An optional idle speed controller is included.

The throttle input signal T lies between zero and one and specifies the torque demanded from the engine as a fraction of the maximum possible torque. If the engine speed falls below the Stall speed, the engine torque is blended to zero. If the engine speed exceeds the Maximum speed, the simulation stops and issues an error message.

Connections F and B are mechanical rotational conserving ports associated with the engine crankshaft and engine block, respectively. Connections P and FC are physical signal output ports through which engine power and fuel consumption rate are reported.

Settings

speed control:	Enable idle speed controller			
speed reference:	50		rpm	
ntroller time constant:	1	:	5	
troller threshold speed:	1		rpm	
	<u> </u>	<u>C</u> ancel	<u>H</u> elp	
Generic Engine Represents a system-level model of spi available. An optional idle speed contro	Block Parameters: Engine rk-ignition and diesel engines suitable for use at initial stages of modeling who ller is included.	en only the ba	isic parameters ar	2
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• Verknüpfung des Ausgangs Thr des Blocks Driver Inputs trennen und mit einem neuen In-

Port Thr verbinden, den offenen Ausgang mit einem Terminator verbinden (oder einen manual switch einbauen, so dass man zwischen äußerem Eingang und dem Driver-Inputs-Block umschalten kann), dann alles zu einem Subsystem zusammenfassen.



4 Modellidentifikation

Simulieren Sie einen Step-Input. Das Modell sollte sich erst bei Thr=0 einschwingen (zum Beispiel durch step time 100), so dass der Sprung in einem stationären Zustand auf das Modell wirkt. Nutzen Sie den *To Workspace*-Block, um die resultierende Geschwindigkeit in den Matlab-Workspace zu sichern. Nutzen Sie das Save-Format *Timeseries*. und setzen Sie die *Sample time* auf 0.04.

Starten Sie die Matlab-App *PID-Tuner*. Sie befindet sich in der Zeile *Control System Design and Analysis* Importieren Sie die Sprungantwort:



• Reiter PID TUNER, Plant, Identify new Plant



1

• Reiter PLANT IDENTIFICATIOM Get I/O Data Step Response



Nutzen Sie Auto Estimate und verstellen Sie die Streckenparameter manuel (Button *Edit Parameters*), um die Übertragungsfunktion anzupassen. Probieren Sie alle vier vorgegebenen Übertragungsfunktionen aus (One Pole, Two Real Poles, Underdamped Pair, Underdamped Pair + Real Pole), die am besten zur Sprungantwort passt. Wichtig ist, dass die Überhöhung und der Stationärwert getroffen werden. Beim Anstieg darf die identifizierte Strecke auch daneben liegen. Wenn Sie fertig sind mit identifizieren klicken Sie auf Apply. Das linke Fenster zeigt dann die Sprungantwort des geschlossenen Regelkreises mit dem aktuellen Regler.

5 Reglerentwurf

Im Reiter PID TUNER ist als Regler-Typ *Type: P* und *Form: Standard* voreingestellt. Wählen Sie dieselbe Form wie im PID-Tuner Block, also jeweils *Parallel* oder *Standard*. Sie können den Wert mit dem Schieberegler *Response Time (seconds)* tunen. Exportieren Sie mit dem Button Export für Ihr System den Regler. Im Workspace gibt es dann die Variable C, die die Verstärkung des entworfenen P-Reglers enthält. Erweitern Sie Ihr Simulink-Modell, so dass Sie eine Referenzgeschwindigkeit vorgeben können, die dann vom entsprechenden Regler eingeregelt wird. (1)

Ziel: Entwerfen Sie einen Regler, so dass die Referenzgeschwindigkeit genau eingeregelt wird, ohne dass die Geschwindigkeit schwingt oder überschwingt. Ein Sprung von 0 km/h auf 100 km/h des Referenzwerts sollte in weniger als 150 s eingeregelt werden.