Automotive Control HW 2

Luc Rulinda

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**Question 1**

Diagram

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Fig. 1: Open loop model

Diagram

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Fig 2: Closed loop model

By tuning the PI controller while targeting a 0.5 sec rise time and a max overshoot of 10% ( using the Add on: Control systems design) we obtained a P gain of 0.5 sec and I gain of 3.19.

**Question 2:**

Diagram

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Fig. 3: SMC model

Chart

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Fig.4 : Equation

A screenshot of a computer

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Fig. 5: Rise time and overshoot targeted for our SMC model

We modeled the SMC model in Fig. 3 by following the transfer function given in the equation in Fig. 4. It was assumed that in our model λref(t)=1 and the dead time was ignored. We were given phi (1/.08 =12.5), the 33.333 gain corresponds to 1/T(l,e), and the .0285 gain corresponds to T(l,e)/ K(l,e). We targeted the rise time and max. overshoot in question 1 through trial and error to obtain a gain Eta of 3.70.

**Question 3:**

Diagram

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Fig.6: Open loop model with PADE approximation

Diagram

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Fig. 7: Closed loop model with PADE approximation

Text

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Fig. 8: PADE approximation TF obtained from matlab

Diagram

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Fig. 9: Root-locus diagram obtained from Matlab.

For our model to be within the required stability values our gain needs to be less than 2.38 (Where the loci hit the imaginary axis).

**Question 4:**

Text

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Fig.10: MATLAB code used to generate our transfer function

Diagram

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Fig. 11: Open loop model

Diagram

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Fig. 12: Closed loop model

**Question 5:**

Chart, scatter chart

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Fig. 13: State space model matrix values obtained from Matlab code (fig.10)

Chart

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Fig. 14: Open loop model

Diagram

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Fig.15 : Closed loop model

Chart, line chart

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Fig. 16: Obtained ode plots

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Fig.17: Gain margin, phase margin, gain crossover frequency and Phase crossover freq. respectively