**EE3CL4 – Lab 3 Report**

**L04 - Group 06 - Tuesday**

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Contribution:

Ruiyi Deng takes charge of exp2

Yiming Chen takes charge of exp1

**Objective:**

To use the root locus technique to design a phase lead compensator for a marginally stable servomotor.

**Experiment I: Design of Phase-Lead Compensator**

The idea of designing the phase-lead compensator comes from prelab. And the design procedure is similar.

Attached below is the code and the comments show the design procedure completely.

图片包含 日程表

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图形用户界面, 文本, 应用程序

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After this part we can obtain the values parameters of z = 8, p = 18.635 and kc = 1.632 and the result is shown below.

图形用户界面, 文本, 应用程序

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From the three parameters above, we can obtain the phase lead compensator controller Gc(s) as Gc(s) = 1.632\*(s+8)/(s+18.635).

The next part is to calculate kv and the code is shown below,

文本

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With the value of velocity error constant kv = 22.02 and the result is shown below,

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The next step is to calculate the poles of the transfer function and the code is shown below,

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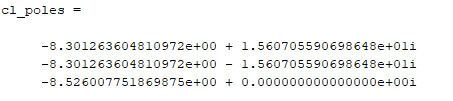
The command series is to connect different part of the control systems together.

And finally we can get the closed-loop transfer function from the given formula

图片包含 图示

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The desired poles are the same as p and z values from previous sections and the calculated result is shown below,



Which are very close to the desired values and the error here is acceptable.

Then for the step response and unit ramp response the code is attached below,

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and the simulation result is shown below

图表

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As can be seen the overshoot is 22% and is closed to the constraint and the 2% settling time is about 0.485 s. Both simulation results met the design requirement.

And below is the simulation result for the unit ramp input.

图表

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As can be seen from the figure, the steady-state error of the linearity analysis is 0.05. This result corresponds to the formula given be ess = 1/kv.

Because the design is done by approximations for a second-order system with no zeros according to the prelab preparation videos, there exists some discrepancies in the results for sure especially when the servomotor is a third-order system with one zero. However, with the simulation results that we can clearly see that our design met the requirements. And we think the little error is under tolerance.

**Experiment II: Experiment with Phase Lead Compensator**