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ANS) The two plots of flat earth equations and stability axix models. Both are ideantical indiacting that our stability axix models is correct as shown in **Figure 1&2.**

Graphical user interface, chart

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**Figure 1&2:** The first plot represnets the statevairables for the flat earth and the second plot represnts the state variables for stability axix models

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ANS) Figure 3 shows the entire A matrix, the method I used for decopling is by spliting the A matrix and no accounting for the terms in the other dynamic model (logitudianl or latral). I split the A matrix equally and for most of the part its correct yet some inaccureties are resulted which shows why my eigen values resultied one unsatable value.

A picture containing graphical user interface

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**Figure 3:** The implicit A matrix of the entire model

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**Figure 4:** The implicit B matrix of the entire model

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**Figure 5:** The implicit A matrix of the logitudinal and latral

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**Figure 6:** The implicit B matrix of the logitudinal

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**Figure 7:** The implicit B matrix of the latral

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|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Longitudinal | | | Lateral | | | |
|  | -0.9131 + 1.6599i | short-period mode |  | -1.4020 + 0.0000i | roll subsidence mode |
|  | -0.9131 - 1.6599i | short-period mode |  | -0.0860 + 0.6266i | dutch roll mode |
|  | -0.0654 + 0.0000i | phugoid mode |  | -0.0860 - 0.6266i | dutch roll mode |
|  | 0.0418 + 0.0000i | phugoid mode |  | -0.1632 + 0.0000i | spiral mode |

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For the controller design, I have used two methods to design the controller. The first one uses the implicit A matrix of the longitudinal matrix and is save in *Project 2 step 2> Part2>PitchAxisControlDesign. The second method uses the entire implicit matrix of the model and is saved in Project 2 step 2> Part2>* *controllerdesingbig.*

I have used the root locus of the second method to come up with the following gain values. Figure 8 shows the phugoid poles in a alpha/Ue root locus. K\_alpha is assumed to be 25. K\_q = 2.62.

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**Figure 8:** root locus of alpha/Ue

Chart

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**Figure 9:** root locus of q/Ue

I have created two files for the closed and open loop system and outputted the results. I couldn’t find the appropriate gain value to stabilize the entire model since the K\_alpha is not tacking the phugoid poles in my case. So in the model I had the K\_alpha gain negative to stabilize the model and the results were promising, if K\_alpha is positive then it would be over damped.

Chart

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**Figure 10:** alpha open loop vs closed loop.