MiniProject, Linear Systems, Fall 2007

- Your report should include WORD document, Matlab codes, 姓名, 學號, 系級, 日期, etc.
- Assigned: 12/25/07, Due on 1/25/08, 5pm, by e-mail to fengli@ntu.edu.tw

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- (Controller and Estimator Design for Bicycle-Rider System)

  Submitting a report for this miniproject is OPTIONAL. That is, the grade for the report is a bonus to the regular grading. If you want to submit your report, please e-mail me your report by 5pm, Fri., Jan 25, 2008. Late report will NOT be graded.

  - In HW2, you simulated the dynamical behavior of the bicycle-rider system, and in HW3, you analyzed the stability condition of the bicycle-rider system. Also, in HW4, you also checked the controllability and observability of the system under certain conditions. So, in the first part of the miniproject, please try to design (some) state beedback controller(s) to stablize the system as well as to improve the system performance. Also, in the second part of the miniproject, if some of the states are not directly measured by the sensors, please design some faster stable state estimators for the un-measureable states. You should at least answer the following questions and show related data or plots to justify your answer.

    - You can use the state-space model in HW1 for the following analysis, design, and simulation.
    - Show the result in HW2 (the analysis without control).
    - Identify the stability condition again (as in HW3).
    - Analyze the controllability and observability (as in HW4).
    - Desgin a state feedback controller to stabilize the system. What is the closed-loop poles or eigenevalues after the feedback? Plot the trajectory of all the states for about a reasonable time interval.
    - If only y_f, θ can be measured by the sensors, design state estimators for the other states. What are the closed-up poles or eigenvalues of the estimators. Plot the trajectory of the actual states and the estimated states together and plot the difference between these two types of states.
    - Use the estimated states to design the state feedback controller. Plot the trajectory of (1) the states controlled by full state feedback, (2) the states controlled by the feedback of estimated states.
    - Use the measureable states (i.e., the output) to design the state feedback controller. Plot the trajectory of (1) the states controlled by full state feedback, (2) the states controlled by the feedback of measureable states.
    - Compare all the possible cases discussed above in terms of tables of data, plots of state trajectories, etc.