Advanced Topics in Control 2014: Robust Control and Convex Optimization

Exercise 10: Project system definition

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Please submit your solutions as a **single PDF** with filename *ATICXX-Surname-StudentNumber.pdf* (XX is the exercise number) to *ifaatic@ee.ethz.ch* until May 16th, 09.59 (next Friday). The subject of the email should be *[ATICXX] Surname-StudentNumber*.

This straightforward task gets the ball rolling with the ATIC project. Material from this exercise may (but doesn't have to) appear in your final report.

a) Design a nominal $\mathcal{H}_\infty$ controller for your project system, by following the steps below.

   i) Take the linear time-invariant representation of your system from the previous exercise and remove uncertainties to give a nominal plant with which you can work.

   ii) Determine the correct partitioning/duplication of matrices (A, B, C, D), as in Slide 8:11, that can be used to pose an output feedback $\mathcal{H}_\infty$ design problem (i.e. one that minimizes $||\mathcal{F}_l(P(s), K(s))||_\infty$).

   iii) Solve and give the resulting controller and closed-loop system. You don't have to use the full LMI formulation given in the slides - the function `hinfsyn` from the MATLAB Robust Control Toolbox is sufficient.

   iv) Draw a block diagram showing how the controller, plant, inputs and outputs (measured and controlled) fit together.

b) Give a `sigma` plot of the closed-loop transfer function singular values (check `help sigma`), to demonstrate that the bound η reported is in fact respected.

c) Verify that the closed-loop system is stable from the pole positions.

d) Show and comment on appropriate time-domain response(s) of the system, for example disturbance rejection or the response to a reference step.