EE 653- Robust Control - Semester 182
Project

Guidelines

1 At most, two students can share the same results.

2 The project report should be typed by any available text processing software. Use the IEEE format for typesetting. Hand-writing will not be accepted. The report should be well commented and presented.

3 The figures should be clear and labeled to clarify your results. All the figures should be done by Matlab. Use the plot and the print commands to save your figures. For more information, type in the Matlab command window: ?plot and ?print. Do not use print screen command.

4 See your syllabus for the submission deadline. Late submission will be taken into account. Please be guided accordingly.

All the student should consider the problem of strong stabilization of linear uncertain systems with static-output feedback. No other technique should be studied. The students can chose any type of model uncertainty. You can either chose continuous-time systems or discrete-time systems to illustrate the designs. Please note that copying existing results without any significant modification is strictly prohibited. Show a clear methodology with numerical simulations. After submission of the final research project, the students are required to do a presentation to clarify their results.

The project.

Consider the continuous-time Linear-Time-Invariant system described by the state-space equations:

$$\begin{aligned} \dot{x} &= A\,x + B\,u + \Gamma\,\xi, \\ y &= C_1\,x + D\,\eta, \\ z &= C_2\,x \end{aligned} \tag{1}$$

where $x = x(t) \in \mathbb{R}^n$ *is the state vector,* $A \in \mathbb{R}^{n\times n}$ *is the state matrix,* $B \in \mathbb{R}^{n\times m}$ *is the input matrix,* $C_1 \in \mathbb{R}^{p\times n}$ *and* $C_2 \in \mathbb{R}^{p\times n}$ *are the output matrices. The vectors* $\xi = \xi(t) \in \mathbb{R}^q$ *and* $\eta = \eta(t) \in \mathbb{R}^r$ *describe the system norm-bounded uncertainties. The matrices* A, B, C_1, C_2, $\Gamma \in \mathbb{R}^{n\times q}$ *and* $D \in \mathbb{R}^{p\times r}$ *are assumed to be well known.*

- *Write the necessary and sufficient conditions for the existence of a static-output feedback* $u = K\,y$ *that stabilizes the system for the null perturbations* ξ *and* η *and minimizes the* H_∞ *norm of the transfer function defined from the input* $\begin{pmatrix} \xi \\ \eta \end{pmatrix}$ *to the output* z.
- *Write the necessary and sufficient conditions for the existence of a static-output feedback* $u = K\,y$ *that stabilizes the system for the null perturbations* ξ *and* η *and minimizes the* H_2 *norm of the transfer function defined from the input* $\begin{pmatrix} \xi \\ \eta \end{pmatrix}$ *to the output* z.
- *Find numerical schemes to solve the above* H_2 *and* H_∞ *control problems. Justify your procedures.*
- *Find a suitable practical example and apply your obtained results.*
- *Explain how can we solve the robust static-output feedback problem using nonlinear optimization techniques? Provide numerical results for any practical system that is stabilizable by a static output feedback.*