Exercises on H_∞ control with Matlab

1 H_∞ design

Let us consider the second order model of an unstable aerospace vehicle:

$$G(s) = \frac{Y(s)}{U(s)} = \frac{1}{s^2 - 1}$$

The objective is to design an H_∞ feedback controller $K(s)$ to meet the template depicted in Figure 1 on the sensitivity function S. The model G is also subject to an additive uncertainty Δ whose an upper bound in the frequency-domain is plotted in Figure 2.

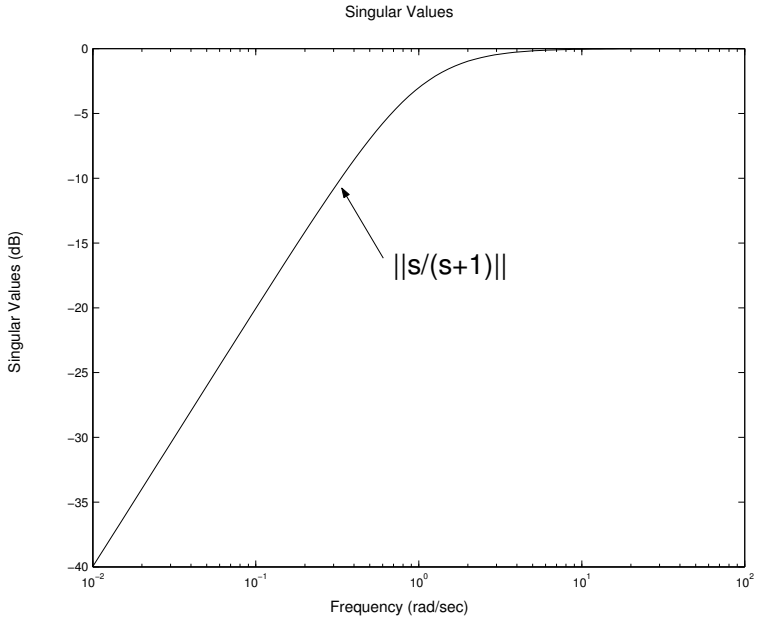

Figure 1: Template on the sensitivity function S.

- Translate this control problem using H_∞ specifications and describe it using a block-diagram representation,
- Propose a set of weighting filters from Figures 2 et 1,
- Compute the state-space representation of the corresponding standard problem $P(s)$,
- Design the controller $K(s)$ using the Matlab Robust Control Toolbox:
  - firstly, using function `hinfsyn` (full order controller design),
  - secondly, using function `systune` (fixed-structure controller design), a multi-objective formulation of the control problem and a judicious controller structure,

– compare and comment the 2 solutions[1].

- Redesign, analyze and comment the controller obtained assuming that the measurement of $\dot{y}$ is also available.

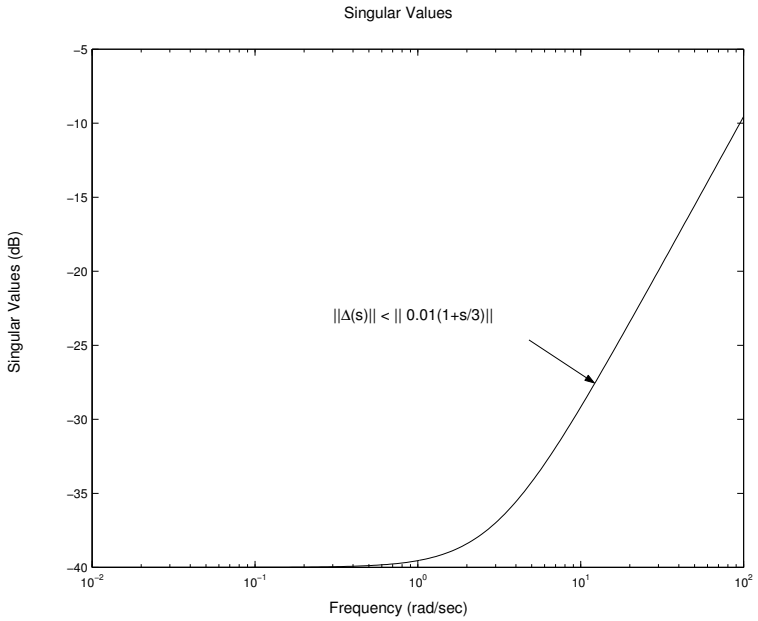

Figure 2: Uncertainty Δ upper bound.

[1]That is, plot the frequency-domain responses (function `sigma`) of the constrained closed-loop transfers and their templates.