Examples description [1]

Let $P(s)$ be a LFT plant subjected to both real parametric and dynamic complex uncertainties Δ and in feedback with a controller $K(s)$, whose connections are presented in Fig. 1.

The structure of $P(s)$ is:

$$\begin{bmatrix} z_\delta \\ z \\ y \end{bmatrix} = \begin{bmatrix} P_{\delta\delta} & P_{\delta w} & P_{\delta u} \\ P_{z\delta} & P_{zw} & P_{zu} \\ P_{y\delta} & P_{yw} & P_{yu} \end{bmatrix} \begin{bmatrix} w_\delta \\ w \\ u \end{bmatrix}, \tag{1}$$

with $w \in \mathbb{R}^{m_1}$ a vector of exogenous inputs, $z \in \mathbb{R}^{p_1}$ a vector of regulated outputs, $y \in \mathbb{R}^{p_2}$ the measured output, and $u \in \mathbb{R}^{m_2}$ the control input.
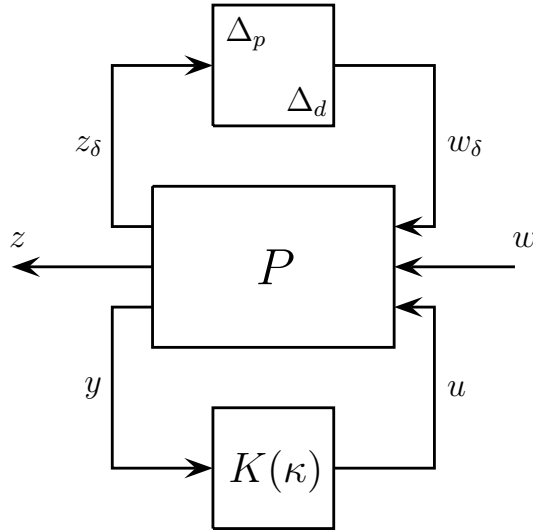

Figure 1: Robust control interconnection

The uncertainty block Δ is structured as

$$\Delta = \begin{bmatrix} \Delta_p & 0 \\ 0 & \Delta_d \end{bmatrix}, \tag{2}$$

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[1]For further details please refer to Aguiar, R.S.S., Apkarian, P. and Noll, D. - "Structured robust control against mixed uncertainty". Submitted to IEEE TCST.

where Δ_p represents the real parametric uncertainty and Δ_d the complex dynamic uncertainty. Δ_p and Δ_d are assumed to have a block-diagonal structure:

$$\Delta_p := \text{diag}\left[\delta_1 I_{r_1}, \ldots, \delta_{N_p} I_{r_{N_p}}\right], \tag{3}$$

for real uncertain parameters $\delta_1, \ldots, \delta_{N_p} \in \mathbb{R}$ and their number of repetitions $r_1, \ldots, r_{N_p}$, while

$$\Delta_d := \text{diag}\left[\Delta_1 \ldots, \Delta_{N_d}\right], \tag{4}$$

with $\Delta_i \in \mathbb{C}^{p_i \times q_i}$, $i = 1, \ldots, N_d$ for complex uncertainties.

For the purpose of testing different techniques for robust synthesis of the controller $K(s)$, a set of 30 examples of generalized plant P was built following the structure presented above. The file for each example contains 4 variables:

- P: generalized plant in state-space form;

- blk: the structure of the Δ block;

- nu: number of control inputs;

- ny: number of control outputs.

The variable blk is a matrix of $N_p + N_c$ rows and 2 colums, where each row accounts for one uncertainty. Positive values of a row represent a dynamic uncertainty with the values of the row being the size of the respective full complex block. Negative values indicate a parametric uncertainty where the values of the row, necessarily equal, account for the repetition of this uncertainty.

Table 1 presents the data for each one of the 30 systems in the directory. The column x shows the number of states of the generalized plant P. The number of exogenous and control inputs are given in columns w and u while the respective outputs are given by columns z and y. Each Identity Matrix shown on column Δ_p accounts for one parametric uncertainty while the size of the matrix gives the number of repetition r_i of this uncertainty. Under the column Δ_d each full matrix $C_{p \times q}$ accounts for one dynamic uncertainty while the dimensions $p \times q$ gives the size of the block uncertainty. The columns w_δ and z_δ gives the total number of inputs and outputs, respectively, of the generalized plant in feedback with the Δ block.

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Example	x	w	z	u	y	w_δ	z_δ	Δ_p	Δ_d
1	9	3	3	1	2	1	1	-	$C_{1\times1}$
2	7	2	1	1	1	3	3	-	$C_{3\times3}$
3	8	4	4	1	3	3	3	-	$C_{3\times3}$
4	12	2	6	2	2	8	8	-	$C_{8\times8}$
5	22	2	2	2	2	2	2	-	$C_{1\times1}\ C_{1\times1}$
6	3	1	1	1	1	1	1	-	$C_{1\times1}$
7	26	5	6	2	5	2	2	-	$C_{2\times2}$
8	3	3	2	1	1	1	1	I_1	-
9	23	2	3	1	3	20	20	$I_2 I_{18}$	-
10	10	1	2	1	1	20	20	I_{20}	-
11	5	2	2	1	1	21	21	I_{21}	-
12	9	1	1	1	1	3	3	$I_1 I_1$	$C_{1\times1}$
13	7	2	4	1	1	5	5	$I_2 I_2$	$C_{1\times1}$
14	8	4	3	1	2	5	5	$I_3 I_1$	$C_{1\times1}$
15	8	4	2	2	2	2	2	I_1	$C_{1\times1}$
16	14	2	6	2	2	8	8	$I_1 I_1 I_1 I_1 I_1 I_1$	$C_{2\times2}$
17	9	1	2	1	1	8	8	$I_1 I_1 I_1 I_3 I_1$	$C_{1\times1}$
18	6	1	2	1	1	6	6	$I_1 I_2 I_2$	$C_{1\times1}$
19	6	2	2	1	1	15	15	$I_1 I_3 I_3 I_3 I_1 I_3$	$C_{1\times1}$
20	11	1	2	1	1	21	21	$I_1 I_3 I_3 I_3 I_3 I_3 I_1 I_1 I_1 I_1$	$C_{1\times1}$
21	8	2	6	2	2	8	8	$I_1 I_1 I_1 I_1$	$C_{4\times4}$
22	19	3	2	1	1	16	16	$I_1 I_1 I_1 I_2 I_2 I_2 I_2 I_1 I_1 I_1 I_1$	$C_{1\times1}$
23	8	4	4	1	3	11	11	$I_1 I_6 I_1$	$C_{3\times3}$
24	7	2	1	1	1	4	4	I_1	$C_{3\times3}$
25	24	2	3	1	3	22	22	$I_1 I_1 I_1 I_6 I_6 I_6$	$C_{1\times1}$
26	8	2	6	2	2	8	8	$I_1 I_1 I_1 I_1$	$C_{1\times1}\ C_{1\times1}\ C_{1\times1}\ C_{1\times1}$
27	7	2	2	1	1	2	2	I_1	$C_{1\times1}$
28	7	3	2	1	2	7	7	$I_1 I_5$	$C_{1\times1}$
29	4	3	2	1	1	2	2	I_1	$C_{1\times1}$
30	8	2	2	1	1	2	2	I_1	$C_{1\times1}$

Table 1: Information data of the 30 examples.