ESISAR AC 514
Département : AUTOMATIQUE
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2018 : Fault Diagnosis

TP 1: ROBUST ACTUATOR FAULT DETECTION AND ISOLATION

1 UNKNOWN INPUT OBSERVER

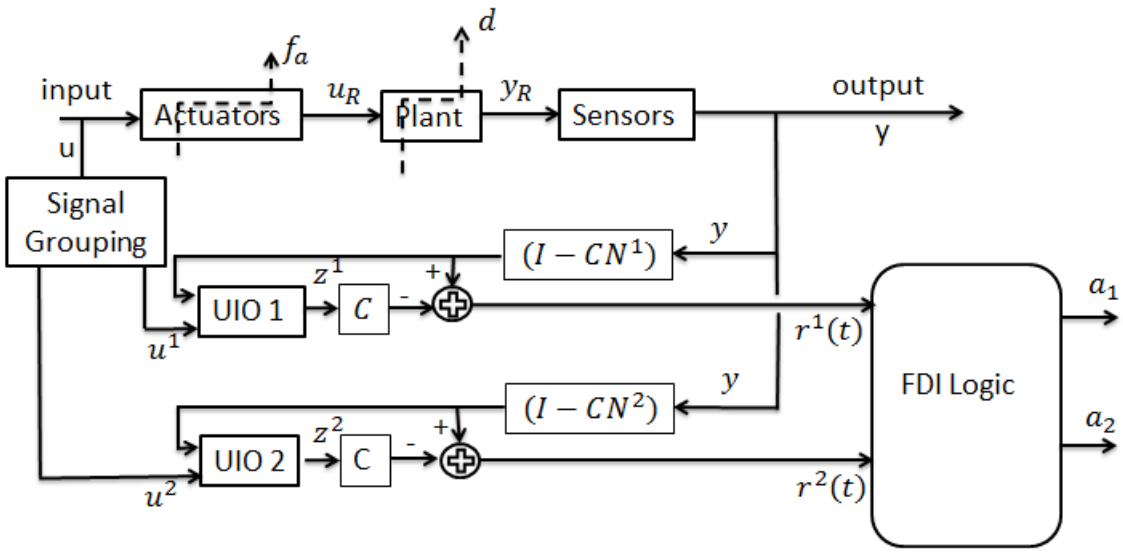
Consider the following linear time invariant system

$$\begin{aligned} \dot{x} &= Ax + B(u + f_a) + Ed \\ y &= Cx \end{aligned} \tag{1}$$

$$A = \begin{bmatrix} -1 & 0 & 0 \\ 1 & -1 & 1 \\ 0 & 1 & -2 \end{bmatrix},\ B = \begin{bmatrix} 1 & 0 \\ 0 & 1 \\ 0 & 0 \end{bmatrix},\ E = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix} \text{ et C=I}$$

where d is an additive disturbance and f_a the potential fault actuator. All matrices are known with appropriate dimensions.

In order to detect and isolate the fault actuator, the following scheme is proposed.



with the sensitive table:

	r^1	r^2	Fault alarm
f_{a1}	0	1	a_1=1 if f_{a1} hold true $\forall$ f_{a2} and d
f_{a2}	1	0	a_2=1 if f_{a2} hold true $\forall$ f_{a1} and d
d	0	0	

Table 1

To generate the 2 robust residuals r^i (i=1 and 2) a bank of 2 UIO is designed:

$$\begin{cases} \dot{z}^i(t) = F^i z^i(t) + T^i B^i u^i(t) + G^i y(t) \\ \hat{x}(t) = z^i(t) + N^i y(t) \\ r^i(t) = y(t) - C^i \hat{x}(t) \end{cases} \quad (2)$$

Where the fault plant model "i" is decomposed as:

$$\begin{cases} \dot{x}(t) = Ax(t) + B^i u^i(t) + B^i f^i{}_a(t) + E^i d^i(t) \\ y(t) = Cx(t) \\ for\ i = 1, 2 \end{cases} \quad (3)$$

1. Give the composition of matrices and vectors in order to build each UIO.
2. Give the logique decision for each alarm
3. Check the existence condition for each UIO
    a. Detectability condition
    b. Unknown input decoupled condition
4. Compute each matrices of the UIO. The eigenvalues will be fixed using the duality LQ problem.
5. Design by Simulink software the scheme solution of this diagnosis problem.
6. For each residual gives the sensitivity fault function
7. Check the sensibility given by the table 1.
8. If the UI decoupled condition is not satisfy, do you have an idea to relax this condition?
9. Conclusion