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A PATH FOR HORIZING YOUR INNOVATIVE WORK

ELIMINATION OF THE OUTPUT DISTURBNCE BY ADDING A SPECIAL FEEDBACK PATH METHOD

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Abstract

The aim of the paper is to focus on the method of adding a special feedback to eliminate the effect of the disturbance added to output of the system. The output expression of the system with and without considering the disturbance was derived. The paper has shown that adding the special feedback loop has removed the effect of the disturbance, and the actual output will be identical to the nominal output which increases the robustness of the system.

1. INTRODUCTION

The main objective of a feedback controller is the *set point tracking*. A controller designed to reject disturbances will take action to force the process variable back toward the desired set point whenever a disturbance or *load* on the process causes a deviation. A set point-tracking controller is appropriate when the set point is expected to change frequently and the controller is required to raise or lower the process variable accordingly. Because of the disturbance *optimal* performance generally requires that a controller be designed or tuned for one role or the other. Almost all feedback loops are designed to achieve as small error signal as possible when comparing the output with the set point or desired output. The disturbance added to the output represents a problem when driving the output expression. Designing a feedback without considering the disturbance will always produce an error. One of the methods used to eliminate this disturbance is by adding a special feedback path.

The method used in this paper introduces the special feedback loop used to eliminate the effect of disturbance that occurs at the output, and evaluate to what extent this method is accurate..

2. UNDISTURBED TRANSFER FUNCTION

Referring to figure (1), two outputs could be derived, one without disturbance, and the other considers the disturbance (d).

2.1 Without disturbance

The transfer function of the system without disturbance i.e d=0 is:

$$\frac{y(s)}{r(s)} = \frac{G(s)}{1+G(s)} \qquad (1)$$

This is the nominal feedback transfer function in which the output disturbance is not considered.

2.2 Disturbed transfer function

The transfer function considers the output disturbance d(s). referring to figure (1) the transfer function could be derived as follows:

$$e(s) = r(s) - y(s) \qquad (2)$$

y(s) = m(s) + d(s) (3)

m(s) =G(s).e(s) (4)

y'(s) = G(s) .e(s) +d(s) (5)

Substituting e(s) from equation (2) yields

y'(s) = G(s).r(s) – G(s).y'(s) + d (6)

Leads to

y'(s) (1+ G(s)) = G(s).r(s) + d (7)

From which

$$y'(s) = \frac{G(s).r(s)+d}{1+G(s)} \quad (8)$$

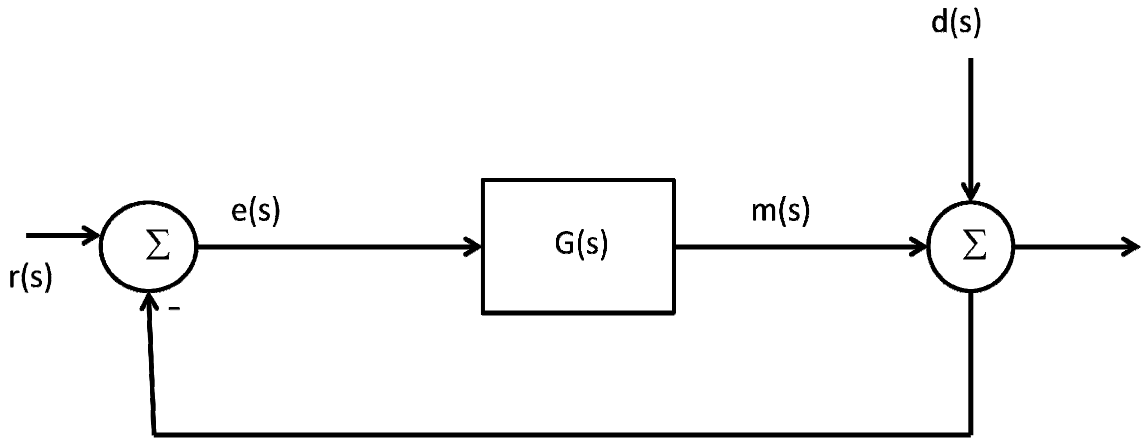

Figure (1) Feedback system with disturbance

The output y(s) in equation (1) is the nominal transfer function since the disturbance is not considered. The output y'(s) in equation (8) considers the disturbance thus called the actual transfer function. The difference between the two outputs represents the error e'(s) in transfer function computation. This difference could be found by computing the norms of y(s) and y'(s).

The magnitude of the error (E) could be computed as:

$E = L_2((y') – (y))$ (9)

Assume for simplicity r(s)=4, g(s) =10, d= 0 for nominal output , d=2 for disturbed output.

From equation (1) $y(s) = \frac{(4).(10)}{1+(10)}$

= 40/11

From equation (8)

$$y'(s) = \frac{(4).(10)+2}{1+(10)}$$

$$= 42/11$$

From equation (9), the size of the error (E) could be found as:

E =norm$_2$(y' – y) = (42/11) – (40/11) = 2/11

3. DISTURBANCE ELIMINATION

The method used in eliminating the effect of the disturbance (D)is illustrated in figure (2). Special feedback loop (G2) was added to the system. G2 is derived as follows:

$G_1.e = G_1(R – G_2.D)$ (10)

$y' = G_1(R – G_2.D) + D$

$= G_1.R – G_1.G2.D + D$ (11)

From equation (11) it can be seen that for the output y to be y = G_1.R (without Disturbance)

The term - G_1G_2.D + D must be equal to zero .

$G_1G_2.D + D = 0$ (12)

From equation (12)

$G_2 = \frac{1}{G_1}$ (13)

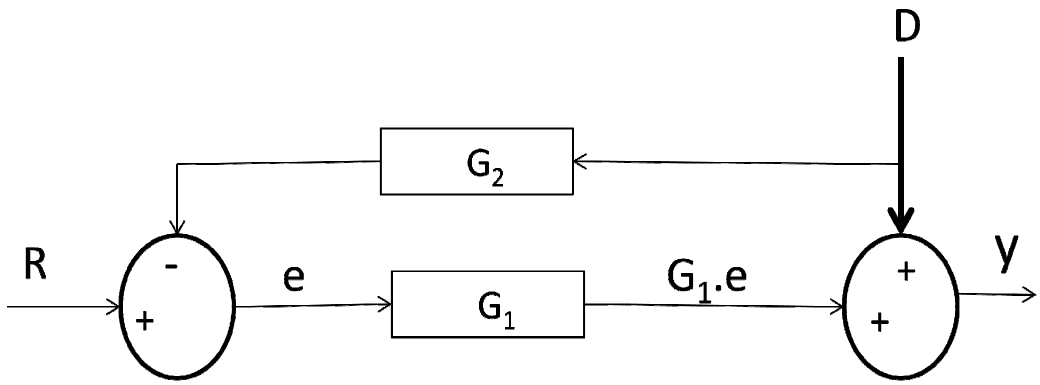

Figure (2) Adding the special feedback loop

Taking $G_1 = \frac{10}{S+1}$ and R as unit step ($\frac{1}{S}$), $G_2 = \frac{S+1}{10}$,the output should be $R.G_1 = \frac{10}{S(S+1)}$

When applying equation (11), G1.G2 will be =1 since G2=1/G1, and the equation will be equal to:

$R.G_1 - D + D = R.G1$ (D is eliminated).

4. CONCLUSION

The disturbance added to the output is considered as one of the serious problems that face control systems. The paper described the method of removing the effect of this disturbance by adding the special feedback loop. As discussed in the paper when this loop is added, the actual output was identical to the nominal output in which the disturbance was not considered. Since adding the special feedback loop needs an additional cost, future research should concentrate on how to lower this cost. Another benefit of adding the special feedback is that it increases the system' robustness.

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