EE1205 TA

Sayyam Palrecha* EE22BTECH11047

Mason's Gain Formula

Mason's Gain Formula, also known as Mason's Rule or the Signal Flow Graph Method, is a technique used in control systems. It provides a systematic way to analyze the transfer function of a LTI system, especially those with multiple feedback loops and complex interconnections.

parameters	description
$X(s)$	input signal transfer function
$Y(s)$	output signal transfer function
N	Total number of forward paths
P_i	Gain of the i^{th} forward path
$\triangle$	determinant of the graph
$\triangle_i$	path factor for the i^{th} path

TABLE 0
CURRENT PARAMETERS

$$T(s) = \frac{Y(s)}{X(s)} = \frac{\sum_{i=1}^{N} P_i \triangle_i}{\triangle} \tag{1}$$

From the signal-flow graph, we identify:

1) Number of forward paths possible (N).
2) Forward path gain for each path P_i.
3) Number of individual loops in the system and there corresponding loop gain.
4) Number of non-touching loops (i.e which do not share any common node) and their corresponding loop gain.

parameters	description
L_i	Loop gain of the i^{th} individual loop
$L_i^{'}$	Loop gain of the i^{th} non-touching loop

TABLE 4
NEW PARAMETERS

$$\triangle_i = 1 - \sum L_i \quad (L_i \text{ that doesn't touch the forward path}) \tag{2}$$

$$\triangle = 1 + \sum L_i - \sum_i \Pi_{j=0}^{i} \left(L_j^{'}\right). \tag{3}$$