TÉCNICO LISBOA

Electrónica Geral

Problema

Filtros Digitais com Aritmética Distribuída

Determinar a tabela que é necessário dispor em memória para o cálculo, pelo método da aritmética distribuída, da equação:

$$y_n = 0,5x_n - 0,75x_{n-1} + 0,25y_{n-1}$$

Admitir que se utilizam palavras de 4 bits.

PROBLEMA 20

Aritmética distribuída

$$y_n = \underbrace{\frac{1}{2}}_{a_0} x_n - \underbrace{\frac{3}{4}}_{a_1} x_{n-1} + \underbrace{\frac{1}{4}}_{b_1} y_{n-1}$$

4 bits

$x^0 . x^1 x^2 x^3$

$y^0 . y^1 y^2 y^3$

$$x = -x^0 + \sum_{j=1}^{3} x^j z^{-j}$$

$$y_n = a_0 \left(-x_n^0 + x_n^1 z^{-1} + x_n^2 z^{-2} + x_n^3 z^{-3}\right) +$$

$$+ a_1 \left(-x_{n-1}^0 + x_{n-1}^1 z^{-1} + x_{n-1}^2 z^{-2} + x_{n-1}^3 z^{-3}\right) + b_1 \left(-y_{n-1}^0 + y_{n-1}^1 z^{-1} + y_{n-1}^2 z^{-2} + y_{n-1}^3 z^{-3}\right) =>$$

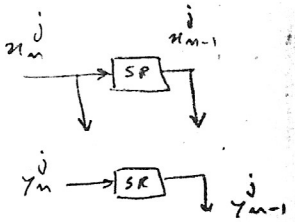
$$=> y_n = -\left[+ a_0 x_n^0 + a_1 x_{n-1}^0 + b_1 y_{n-1}^0\right] + \left[a_0 x_n^1 + a_1 x_{n-1}^1 + b_1 y_{n-1}^1\right] z^{-1} +$$

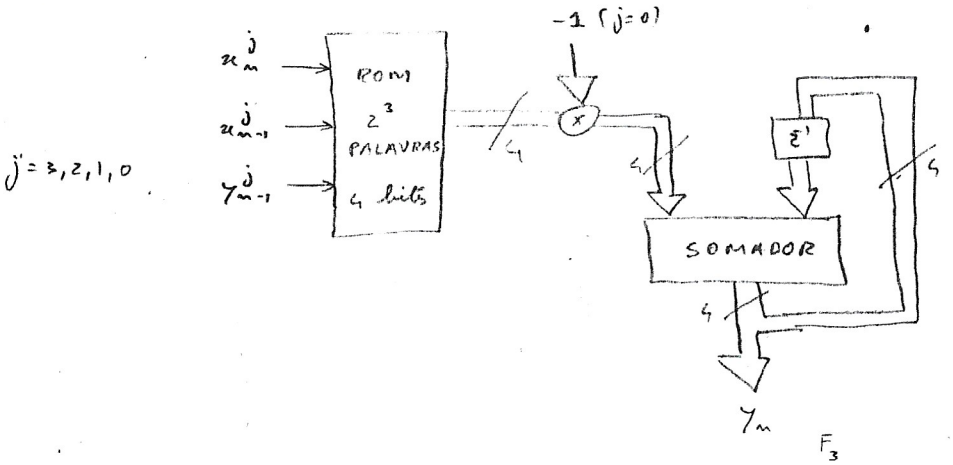
$$+ \left[a_0 x_n^2 + a_1 x_{n-1}^2 + b_1 y_{n-1}^2\right] z^{-2} + \left[a_0 x_n^3 + a_1 x_{n-1}^3 + b_1 y_{n-1}^3\right] z^{-3} =$$

$$= \sum_{j=0}^{3} F(x_n^j, x_{n-1}^j, y_{n-1}^j) \cdot z^{-j}$$

	j=0	j=1	j=2	j=3
$x_n \rightarrow$	x_n^0	x_n^1	x_n^2	x_n^3
$x_{n-1} \rightarrow$	x_{n-1}^0	x_{n-1}^1	x_{n-1}^2	x_{n-1}^3
$y_{n-1} \rightarrow$	y_{n-1}^0	y_{n-1}^1	y_{n-1}^2	y_{n-1}^3
	F_0	F_1	F_2	F_3

$$F(x_n^j, x_{n-1}^j, y_{n-1}^j) = \begin{cases} (a_0 x_n^j + a_1 x_{n-1}^j + b_1 y_{n-1}^j) & j = 1, \\ -(a_0 x_n^0 + a_1 x_{n-1}^0 + b_1 y_{n-1}^0) & j \end{cases}$$





$2^4 = (2^4)$

F_3

$F_2 + z^{-1} F_3$

$F_1 + z^{-1} F_2 + z^{-2} F_3$

$-F_0 + z^{-1} F_1 + z^{-2} F_2 + z^{-3} F_3 = y_n$

$\frac{1}{2}$ x_m^i	$\bar{x}_{m-1}^j$	$\bar{y}_{m-1}^j$	F	
0	0	0	0	0.000
0	0	1	0.25	0.010
0	1	0	-0.75	1.010
0	1	1	-0.5	1.100
1	0	0	0.5	0.100
1	0	1	0.75	0.110
1	1	0	-0.25	1.110
1	1	1	0	0.000

$-0.5 = 1.100$

1.100

$-0.25 = 1.110$