$$y(n) = x(n) + 3.1\,x(n-1) + 5.5\,x(n-2) + 4.2\,x(n-3) + 2.3\,x(n-4)$$

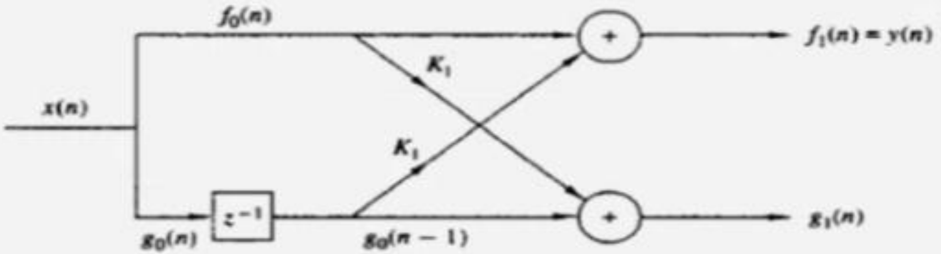
Lattice

$$f_1(n) = f_0(n) + K_1\, g_0(n-1)$$

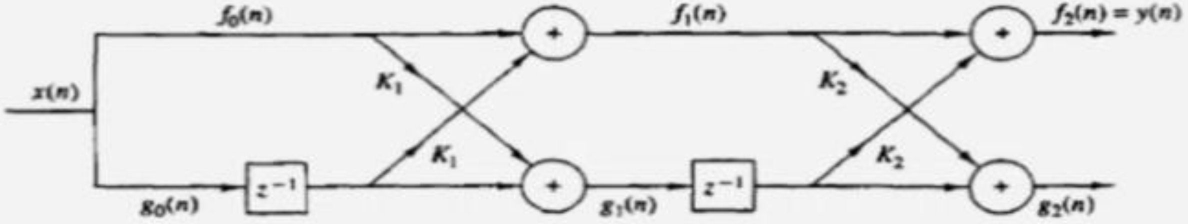
$y(n)$

$$g_1(n) = K_1 f_0(n) + g_0(n-1)$$

Contd…



$$f_0(n) = g_0(n) = x(n)$$
$$f_1(n) = f_0(n) + K_1 g_0(n-1) = x(n) + K_1 x(n-1)$$
$$g_1(n) = K_1 f_0(n) + g_0(n-1) = K_1 x(n) + x(n-1)$$



$$\begin{aligned} f_2(n) &= x(n) + K_1 x(n-1) + K_2[K_1 x(n-1) + x(n-2)] \\ &= x(n) + K_1(1+K_2)x(n-1) + K_2 x(n-2) \end{aligned}$$

The general form of lattice structure for m stage is given by'

$$f_0(n) = g_0(n) = x(n)$$
$$f_m(n) = f_{m-1}(n) + K_m g_{m-1}(n-1) \qquad m = 1, 2, \ldots, M-1$$
$$g_m(n) = K_m f_{m-1}(n) + g_{m-1}(n-1) \qquad m = 1, 2, \ldots, M-1$$

Contd...

Conversion of lattice coefficients to direct-form filter coefficients. The direct-form FIR filter coefficients $\{\alpha_m(k)\}$ can be obtained from the lattice coefficients $\{K_i\}$ by using the following relations:

$$A_0(z) = B_0(z) = 1 \tag{7.2.47}$$

$$A_m(z) = A_{m-1}(z) + K_m z^{-1} B_{m-1}(z) \qquad m = 1, 2, \ldots, M-1 \tag{7.2.48}$$

$$B_m(z) = z^{-m} A_m(z^{-1}) \qquad m = 1, 2, \ldots, M-1 \tag{7.2.49}$$

Conversion of direct-form FIR filter coefficients to lattice coefficients. Suppose that we are given the FIR coefficients for the direct-form realization or, equivalently, the polynomial $A_m(z)$, and we wish to determine the corresponding lattice filter parameters $\{K_i\}$. For the m-stage lattice we immediately obtain the parameter $K_m = \alpha_m(m)$. To obtain K_{m-1} we need the polynomials $A_{m-1}(z)$ since, in general, K_m is obtained from the polynomial $A_m(z)$ for $m = M-1, M-2, \ldots, 1$. Consequently, we need to compute the polynomials $A_m(z)$ starting from $m = M-1$ and "stepping down" successively to $m = 1$.

$$K_m = \alpha_m(m) \qquad \alpha_{m-1}(0) = 1$$

$$\alpha_{m-1}(k) = \frac{\alpha_m(k) - K_m \beta_m(k)}{1 - K_m^2}$$

$$= \frac{\alpha_m(k) - \alpha_m(m)\alpha_m(m-k)}{1 - \alpha_m^2(m)} \qquad 1 \le k \le m-1$$

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$$y(n) = x(n) + 3.1\,x(n-1) + 5.5\,x(n-2) + 4.2\,x(n-3) + 2.3\,x(n-4)$$

Lattice

$$f_1(n) = f_0(n) + K_1 g_0(n-1)$$

$$g_1(n) = K_1 f_0(n) + g_0(n-1)$$

M = 4 order

$$\overbrace{K_1, K_2, K_3, K_4}$$

$\underline{M = 4}$

K_4

$i = 1, 2, 3$

$\underline{m = 4}$

$\underline{i = 1}$	$\underline{i = 2}$	$\underline{i = 3}$
$a_3(1) = 1.529$	$a_3(2) = 1.667$	$a_3(3) = 0.692$

$\underline{M = 3}$, $i = 1, 2$

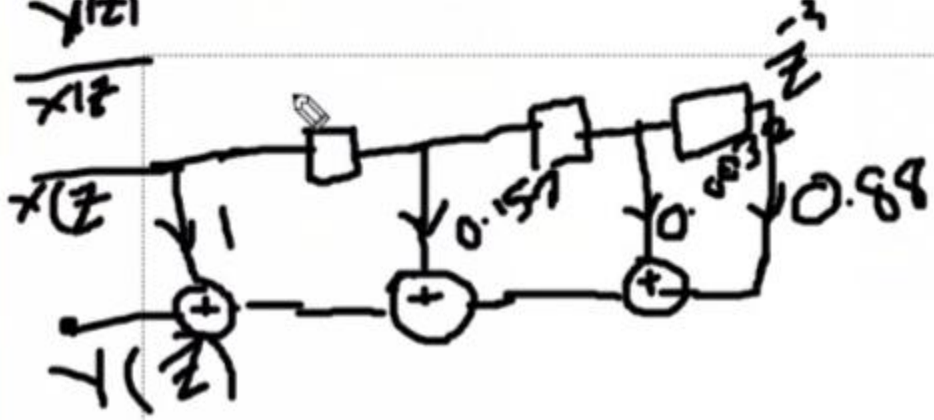
$a_2(1) = 0.733$

$\underline{M = 3,\ i = 2}$

$a_2(2$

$$H(z) = 1 + 0.157z^{-1} + 0.0032z^{-2} + 0.88z^{-3}$$

$$\frac{Y(z)}{X(z)}$$



$f_3(n) = y(n) = h(n$ — $_2(n) + 0.8 Y_2(n-1)$

$$h(n) = \delta(n) + 0.157\,\delta(n-1) + 0.0032\,\delta(n-2) + 0.88\,\delta(n-3)$$