Time Update of min Cost

Let $\xi(N)$ be min. cost associated with

$$\min \|w\|^2_{\Pi} + \|y_N - H_N w\|^2$$

We would like to get a recursion for $\xi(N)$.

$$\xi(N) = \|y_N\|^2 - \|\hat{y}_N\|^2$$
$$= \|\tilde{y}_N\|^2$$

$$= y_N^* \tilde{y}_N$$
$$= y_N^* [y_N - H_N w_N]$$

Would like to relate it to
$$\xi(N-1) = y_{N-1}^* [y_{N-1} - H_{N-1} w_{N-1}]$$
How?

$$y_N = \begin{bmatrix} y_{N-1} \\ d(N) \end{bmatrix}$$

$$H_N = \begin{bmatrix} H_{N-1} \\ u_N \end{bmatrix}$$

$$w_N = w_{N-1} + g_N e(N)$$

$$\Rightarrow \xi(N) = y_N^{*} \left[y_N - H_N w_N \right]$$

$$= \begin{bmatrix} y_{N-1}^{*} & d^{*}(N) \end{bmatrix} \begin{bmatrix} y_{N-1} - H_{N-1} w_N \\ d(N) - u_N w_N \end{bmatrix}$$

$$= \begin{bmatrix} y_{N-1}^{*} & d^{*}(N) \end{bmatrix} \begin{bmatrix} y_{N-1} - H_{N-1} \left[w_{N-1} + g_N e(N) \right] \\ d(N) - u_N \left[w_{N-1} + g_N e(N) \right] \\ \vdots \end{bmatrix}$$

Can show that

$$\xi(N) = \xi(N-1) + \gamma(N)\,|e(N)|^2$$

$$= \xi(N-1) + \frac{|r(N)|^2}{\gamma(N)}$$