Example 9-3: Consider an FIR filter defined by the difference equation

$$y[n] = 6x[n] - 5x[n-1] + x[n-2]$$

The z-transform system function is $H(z) = 6 - 5z^{-1} + z^{-2}$ which factors as

$$H(z) = (3 - z^{-1})(2 - z^{-1}) = 6\,\frac{(z - \frac{1}{3})(z - \frac{1}{2})}{z^2}$$

Thus, the roots of $H(z)$ are $\frac{1}{3}$ and $\frac{1}{2}$. Note that a different filter

$$w[n] = x[n] - \tfrac{5}{6}x[n-1] + \tfrac{1}{6}x[n-2]$$

has a system function with the same roots, but each filter coefficient is 1/6 as big. This simply means that $w[n] = y[n]/6$, and the system function of the second system is $\frac{1}{6}H(z)$.

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