Assignment 12 Papoulis ex 8.40

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June 14, 2022

Outline

Question

Show that, for complex systems. (9-149) and (9-194) yield

$$S_{yy}(s) = S_{xx}(s)H(s)H^*(-s^*) \quad S_{yy}(z) = S_{yy}(z)H(z)H^*(\frac{1}{z^*})$$

Solution

We have

$$S_{yy}(s) = S_{xx}(s)H(s)H^*(s) \quad S_{yy}(z) = S_{yy}(z)H(z)H^*(z) \tag{2.1}$$

Also for complex systems $s = j\omega$ and $z = e^{-s} = e^{-j\omega}$

$$s^* = -j\omega = -s \qquad z^* = e^{j\omega} = \frac{1}{z} \tag{2.2}$$

$$s = -s^* \qquad z = \frac{1}{z^*} \tag{2.3}$$

Substituting (2.3) in (2.1)

$$S_{yy}(s) = S_{xx}(s)H(s)H^*(-s^*) \quad S_{yy}(z) = S_{yy}(z)H(z)H^*(\frac{1}{z^*}) \tag{2.4}$$