

**Problem 2.15**

Derive the relationship of Eq. (2.142) between the two cross-correlation factors  $R_{xy}(\tau)$  and  $R_{yx}(\tau)$ .

**Solution**

By definition

$$R_{yx}(\tau) = \int_{-\infty}^{\infty} y(t)x^*(t - \tau)dt$$

Complex conjugate both sides of the equation:

$$R_{yx}^*(\tau) = \int_{-\infty}^{\infty} x(t - \tau)y^*(t)dt$$

Next, replace  $\tau$  with  $-\tau$ :

$$R_{yx}^*(-\tau) = \int_{-\infty}^{\infty} x(t + \tau)y^*(t)dt$$

Finally, replace  $t + \tau$  with  $t$ , which is equivalent to replacing  $t$  with  $t - \tau$ ; we therefore (since  $dt$  remains unchanged)

$$R_{yx}^*(-\tau) = \int_{-\infty}^{\infty} x(t)y^*(t - \tau)dt = R_{xy}(\tau)$$