

LTI filtering of WSS processes

Let $x(\cdot)$ be a [wide-sense stationary process](#) with:

- Mean μ_x
- Autocorrelation $R_{xx}(\tau)$
- Autocovariance $C_{xx}(\tau)$
- $E[x^2(t)] < \infty$

Let $y(t) = h \ast x(t)$. Then, the following relations are true:

$$E[y(t)] = H(j0) \mu_x$$

$$R_{yx}(\tau) = h \ast R_{xx}(\tau)$$

$$C_{yx}(\tau) = h \ast C_{xx}(\tau)$$

$$R_{xy}(\tau) = \overleftarrow{h} \ast R_{xx}(\tau)$$

$$C_{xy}(\tau) = \overleftarrow{h} \ast C_{xx}(\tau)$$

$$R_{yy}(\tau) = h \ast \overleftarrow{h} \ast R_{xx}(\tau)$$

$$R_{yy}(\tau) = h \ast \overleftarrow{h} \ast C_{xx}(\tau)$$

- $y(t)$ is also wide-sense stationary.
- $y(t)$ is jointly wide-sense stationary with its input.

General form:

Given $y = h \ast x$ and $z = g \ast w$:

$$R_{yz}(\tau) = h \ast \overleftarrow{g} \ast R_{xw}(\tau)$$

Power spectral density

Main article: [Power spectral density](#)

CT case:

$$R_{xx}(\tau) \leftrightarrow S_{xx}(j\omega) \quad C_{xx}(\tau) \leftrightarrow D_{xx}(j\omega)$$

DT case:

$R_{xx}[m] \rightarrow S_{xx}(e^{j\Omega})$ $C_{xx}[m] \rightarrow D_{xx}(e^{j\Omega})$

From:

<https://www.jaeyoung.wiki/> - Jaeyoung Wiki

Permanent link:

https://www.jaeyoung.wiki/kb:wss_processes_lti_systems

Last update: **2024-04-30 04:03**