If $\mathrm{x}(t) \overset{\mathcal{FT}}{\longleftrightarrow} \mathrm{X}(f) = \delta(f-8) + \delta(f+8)$ and $\mathrm{x}(t) \overset{\mathcal{FS}}{\underset{1}{\longleftrightarrow}} \mathrm{c_x}[k]$, find $\mathrm{c_x}[k]$.

Answer: $\mathrm{c_x}[k] = \delta[k-8] + \delta[k+8]$.

A continuous-time system has a transfer function

$$\mathrm{H}(s) = \frac{2\times 10^6}{s^2 + 2000s + 2\times 10^6}$$

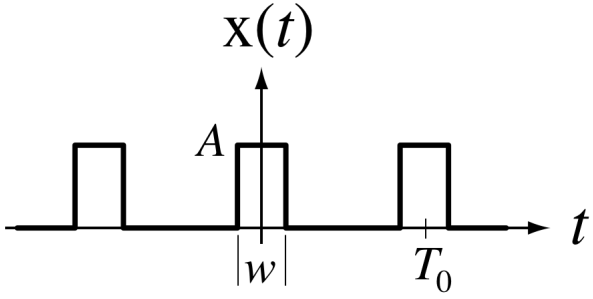
and therefore a frequency response

$$\mathrm{H}(j\omega) = \frac{2\times 10^6}{(j\omega)^2 + j2000\omega + 2\times 10^6} = \frac{2\times 10^6}{(j\omega + 1000)^2 + 10^6}.$$

Find its impulse response.

Answer: $\mathrm{h}(t) = 2000e^{-1000t}\sin(1000t)\mathrm{u}(t)$

This rectangular pulse train excites an amplifier



with transfer function $\mathrm{H}(s)=\dfrac{500{,}000}{s+50{,}000}$ and

therefore frequency response $\mathrm{H}(f)=\dfrac{500{,}000}{j2\pi f+50{,}000}$.

If $T_0=0.5$ ms, $w=0.1$ ms and $A=100$ mV find the average signal power of the amplifier response (using MATLAB where necessary).

Answer: $P_{\mathrm{y}}=0.1873$

The signal from a pressure sensor in an industrial plant is interfered by radiated EMI (electromagnetic interference) from a periodic rectangular pulse train of fundamental frequency 15 kHz. What would be the impulse response of a filter that would reject this EMI, including all its harmonics?

Answer: $\mathrm{h}(t)=B\,\mathrm{rect}(t/T_0)$