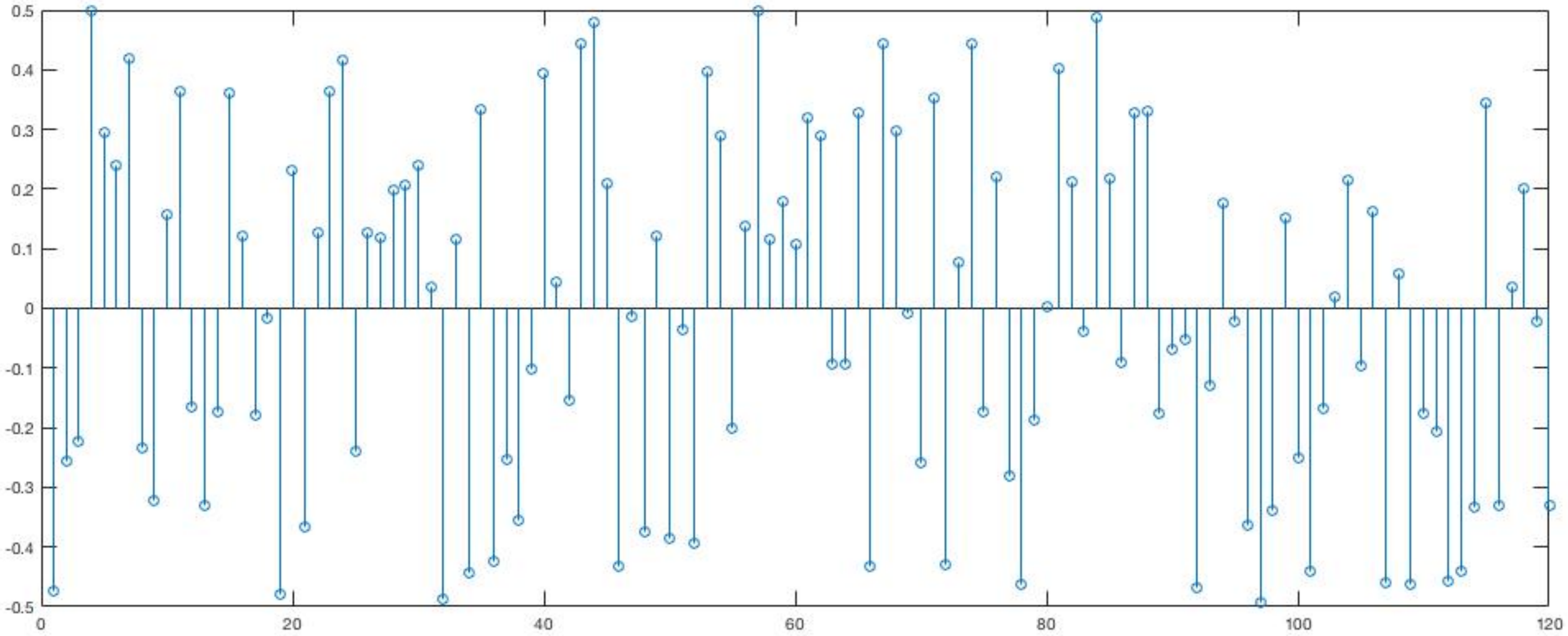
Power Spectral Density (PSD)

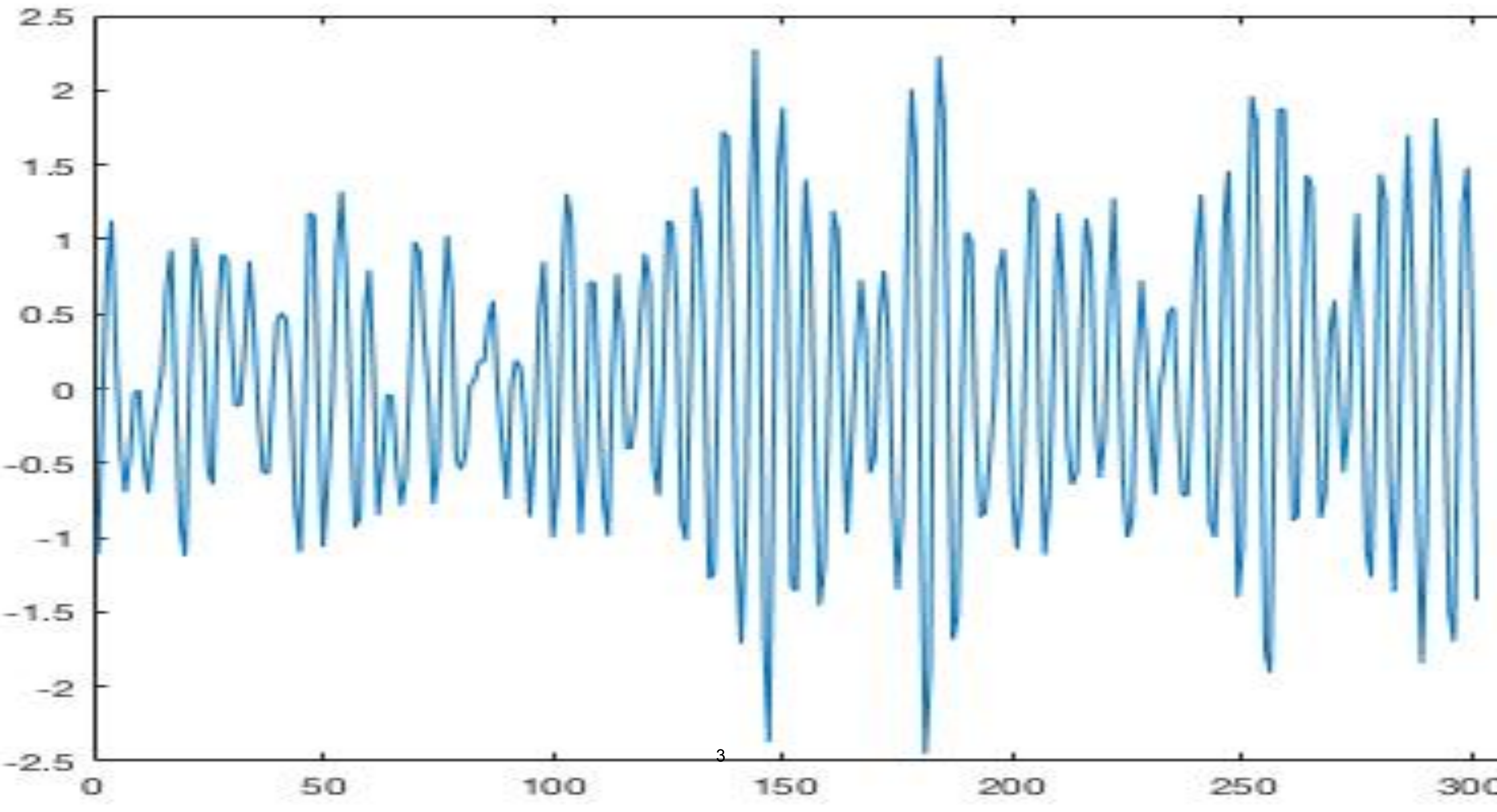
6.011, Spring 2018

Lec 18

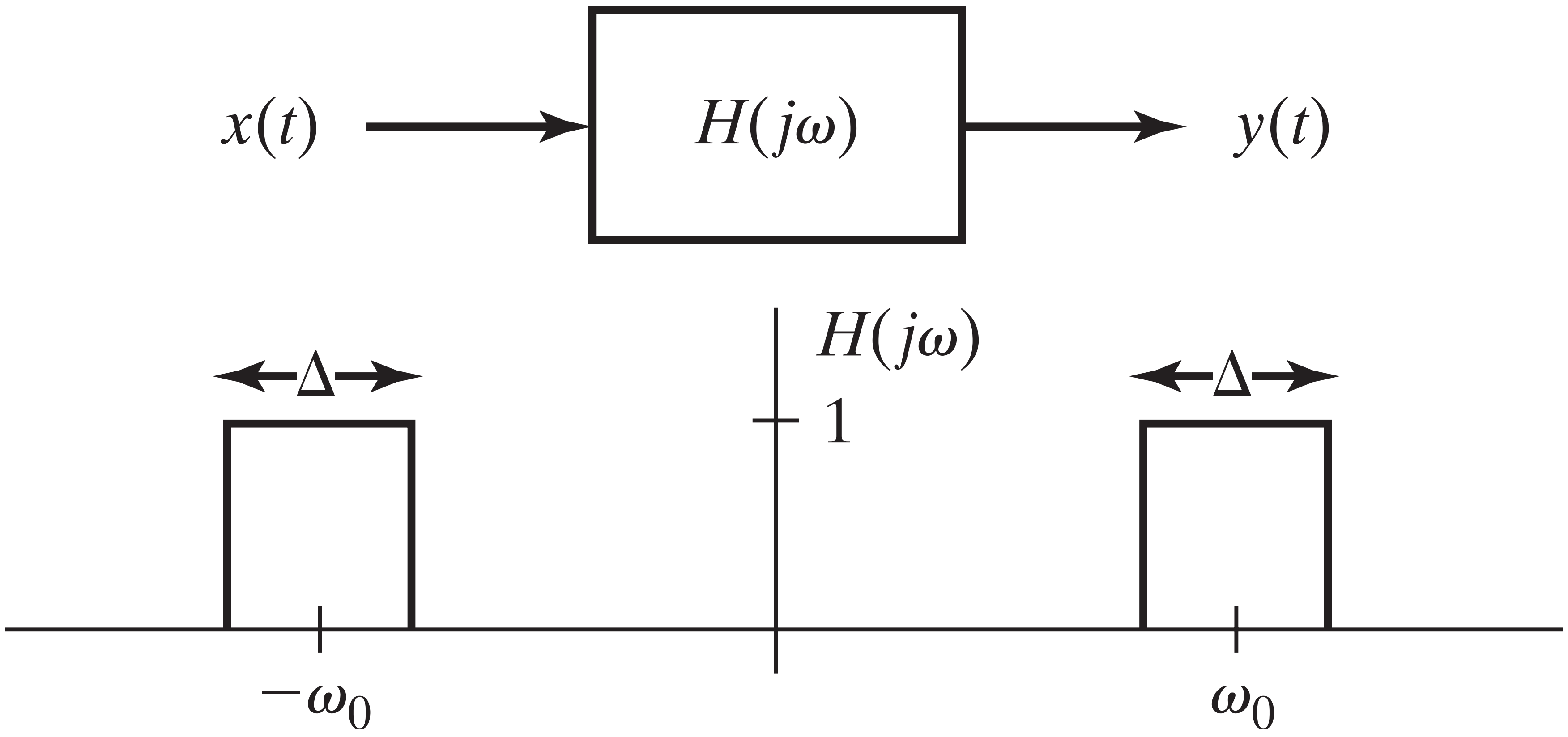
iid signal x[n], uniform in [-0.5,+0.5]



y[.] obtained by passing x[.] through resonant 2^{nd}-order filter H(z), poles at $\pm 0.95e^{j\pi/3}$



Extracting the portion of *x(t)* in a specified frequency band



Questions (warm-up for Quiz 2!)

WSS process $x[\cdot]$ with

$$C_{xx}[m] = \rho\delta[m-1] + \delta[m] + \rho\delta[m+1]\,.$$

What is the largest magnitude ρ can have?

WSS process $x(\cdot)$ with mean μ_x and PSD $S_{xx}(j\omega)$. What is its FSD?

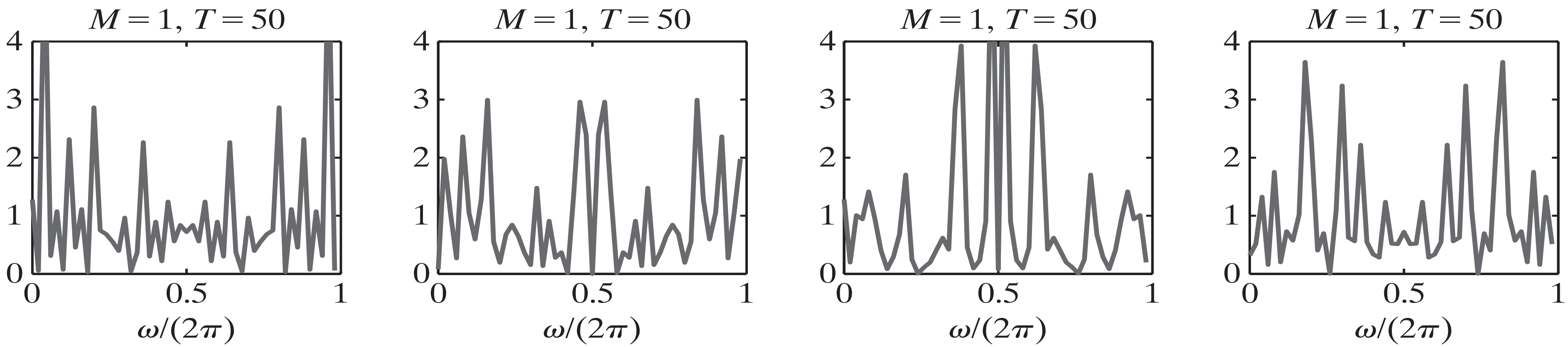
Zero-mean WSS process $x(\cdot)$ with

$$S_{xx}(j\omega) = \frac{1}{1+\omega^2}$$

and let $y(t) = Z + x(t)$, where Z has zero mean, variance σ^2, and is uncorrelated with $x(\cdot)$.

What are μ_y and $S_{yy}(j\omega)$?

Periodograms (e.g., a unit-intensity "white" process)



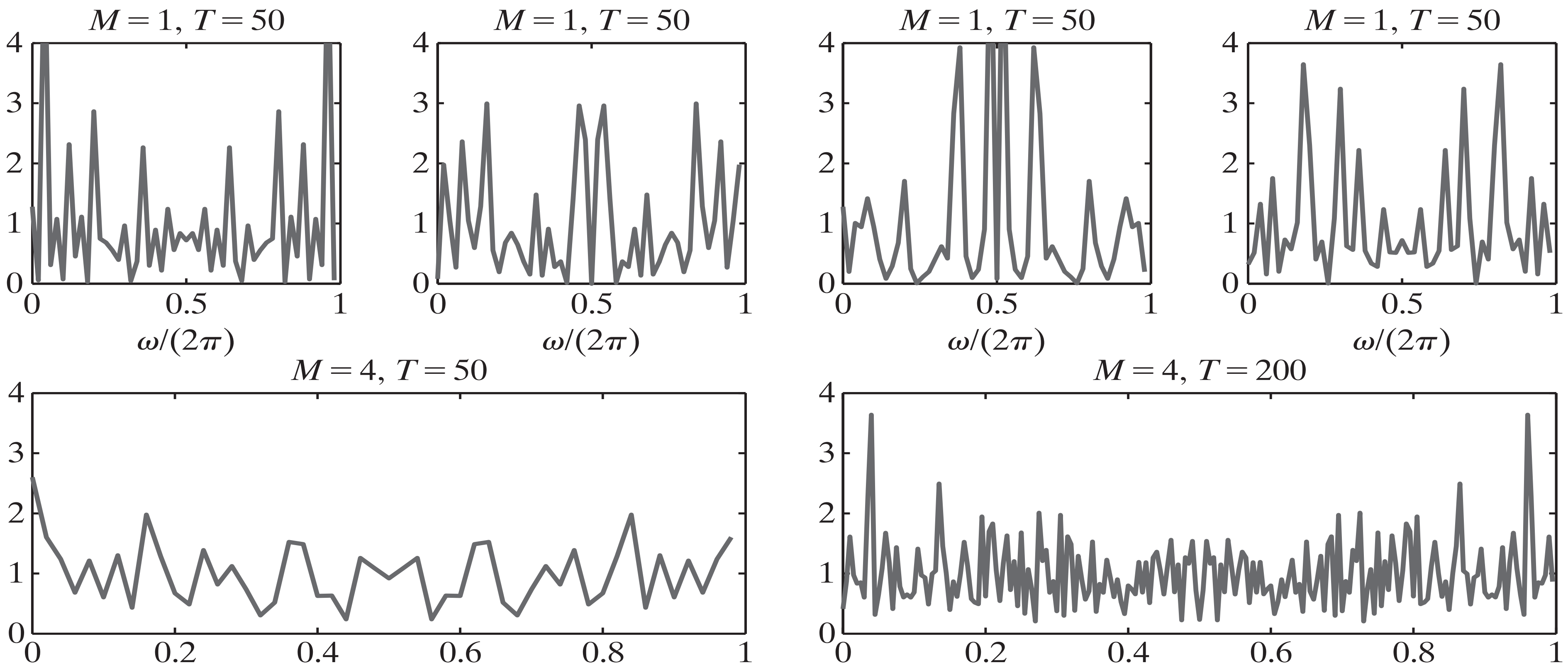
$$\text{CT case:} \quad X_T(j\omega) \leftrightarrow x(t) \ \text{ windowed to } \ [-T, T]$$

$$\text{Periodogram} = \frac{|X_T(j\omega)|^2}{2T}$$

$$\text{DT case:} \quad X_N(e^{j\Omega}) \leftrightarrow x[n] \ \text{ windowed to } \ [-N, N]$$

$$\text{Periodogram} = \frac{|X_N(e^{j\Omega})|^2}{2N+1}$$

Periodogram averaging (illustrating the Einstein-Wiener-Khinchin theorem)



Periodogram averaging (illustrating the Einstein-Wiener-Khinchin theorem)