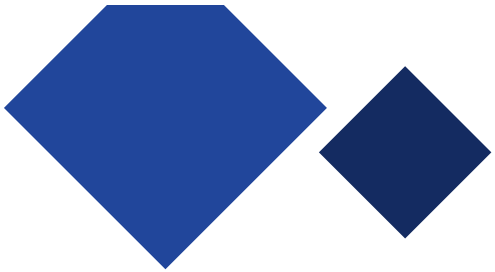

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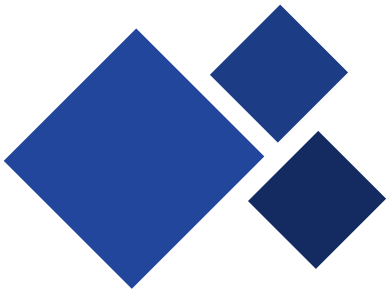
Lecture 18

Fourier transforms in MatLab

Tomaso Erseghe



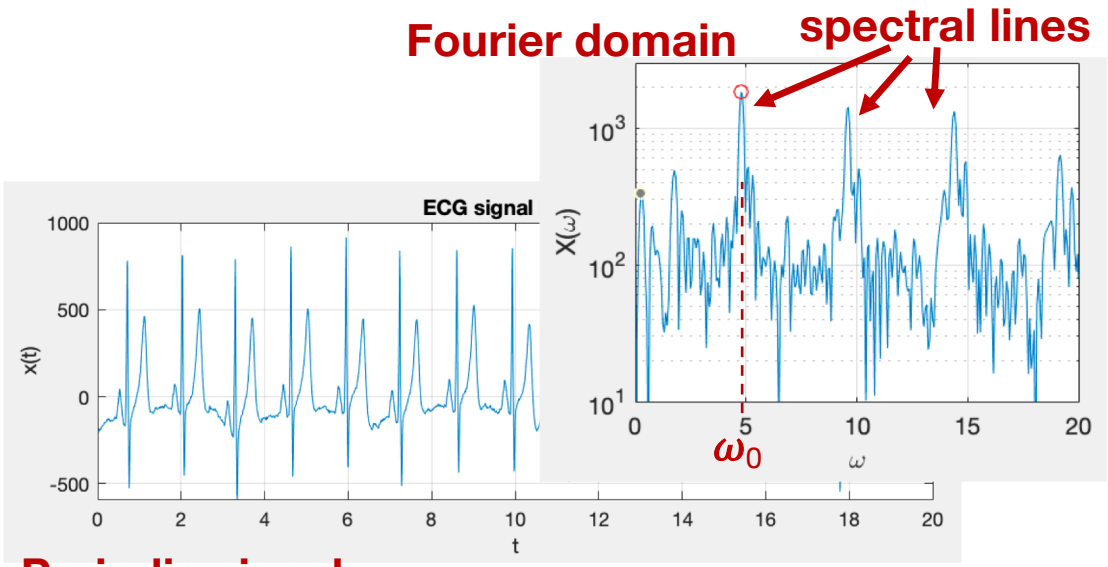
18.4 Periodic signals in MatLab

Some insights on their Fourier transform

- Presence of spectral lines
- Estimating the period from the Fourier domain
- Filtering sinusoidal noises

Periodic signals

A view in the Fourier domain



Periodic signal

$$s(t) \quad \Longrightarrow \quad S(j\omega) = \sum_k 2\pi S_k \delta(\omega - k\omega_0) \ , \quad \omega_0 = \frac{2\pi}{T_p}$$

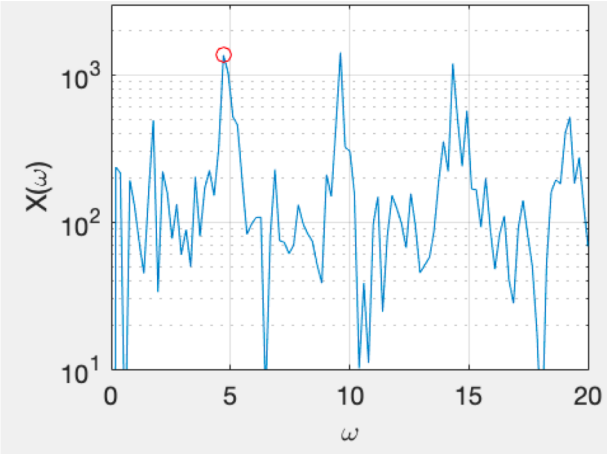
Windowed signal

$$s(t)\,\mathrm{rect}(\tfrac{t}{T_w}) \quad \Longrightarrow \quad S(j\omega) = \sum_k T_w S_k \,\mathrm{sinc}(\tfrac{\omega - k\omega_0}{2\pi/T_w})$$

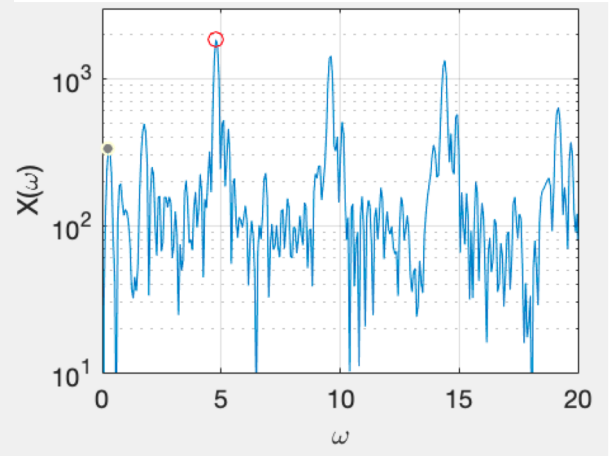
Increasing precision

In the Fourier domain

Natural Fourier sampling



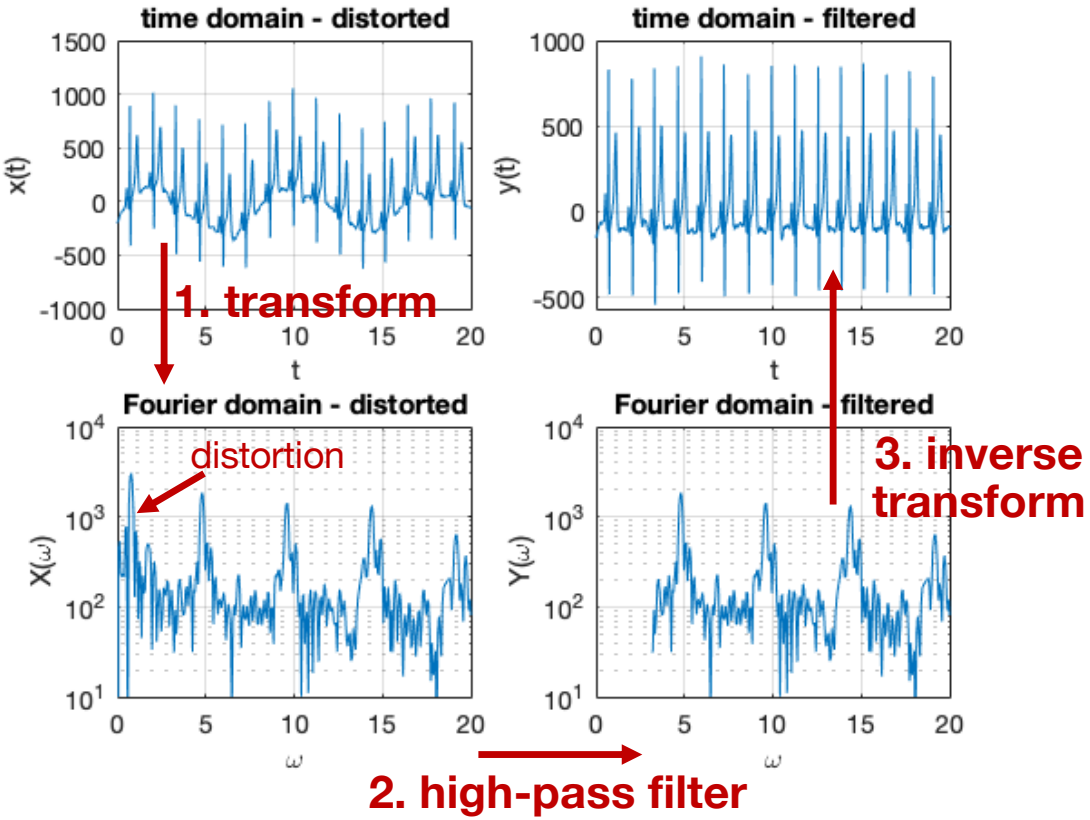
Increased precision by zero padding




```
x = [x, zeros(1,2*length(x))]
```

Filtering

In the Fourier domain



Exercises

On ECG signal processing

Observe the outcome of **quasi-periodic signals** like the ECG signal displaying spectral lines! Try estimating its period from the Fourier domain.

Practice yourself with **filters in the Fourier domain** by removing a sinusoidal distortion applied to an ECG signal

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