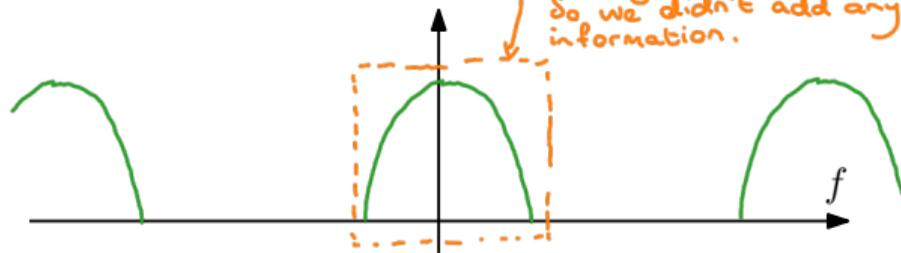
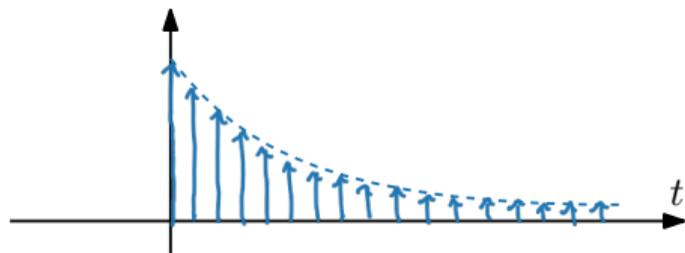
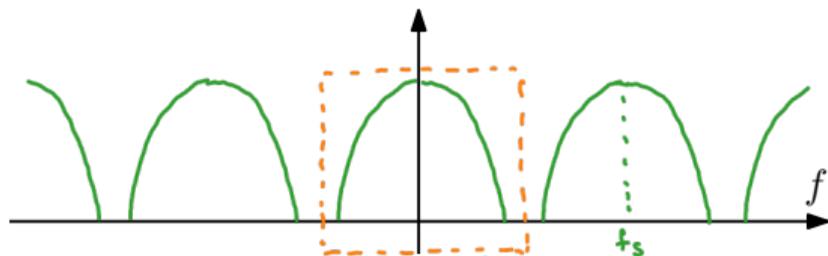
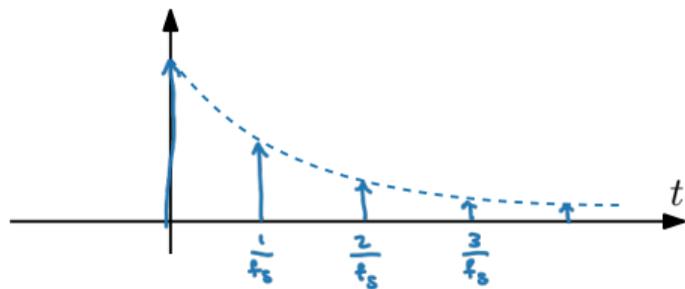
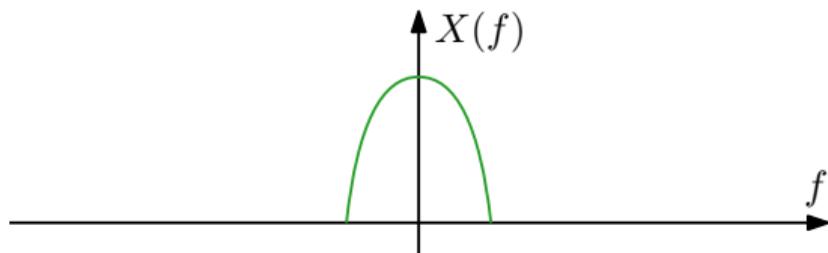
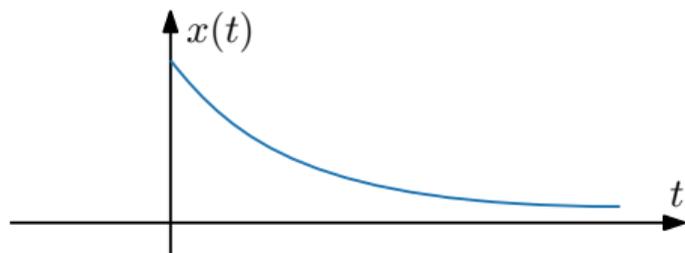


# Zero padding with the DFT

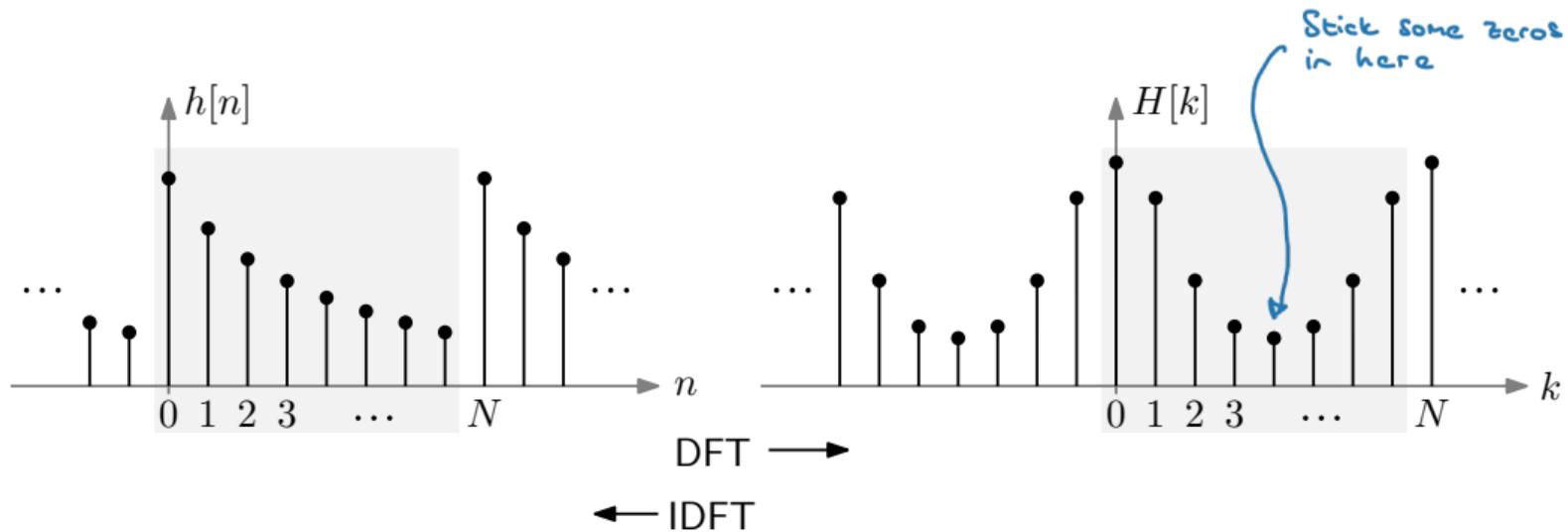
Increasing resolution in time and frequency

Herman Kamper

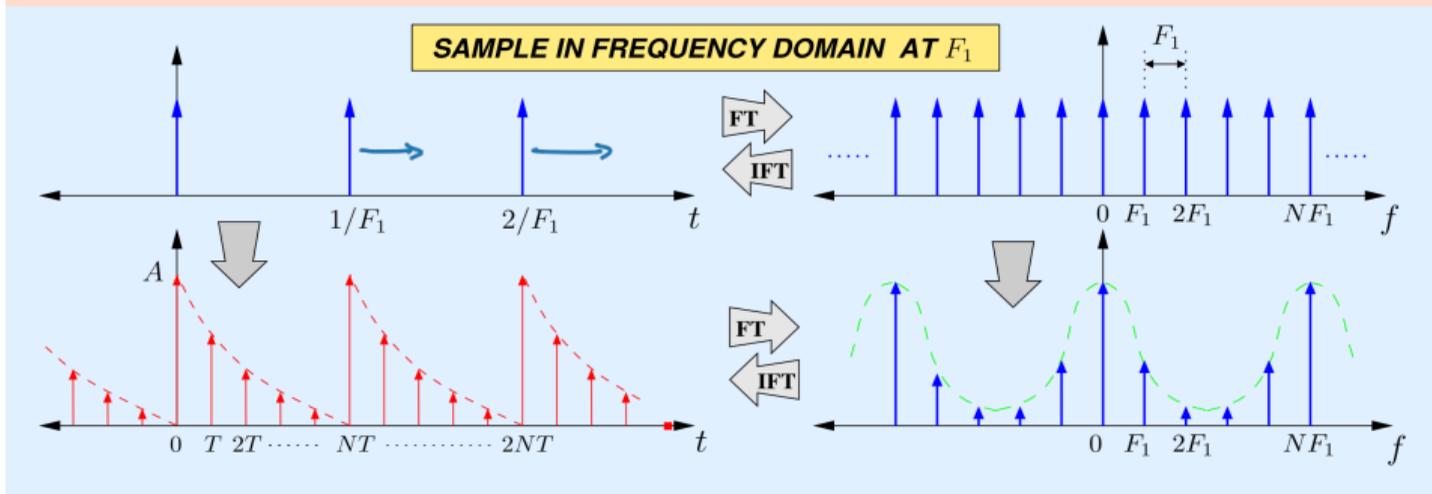
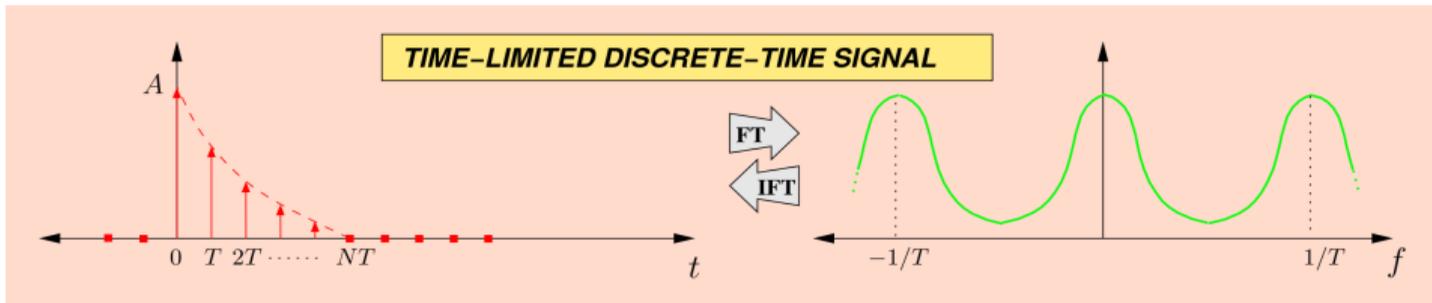
# Increased time-domain resolution



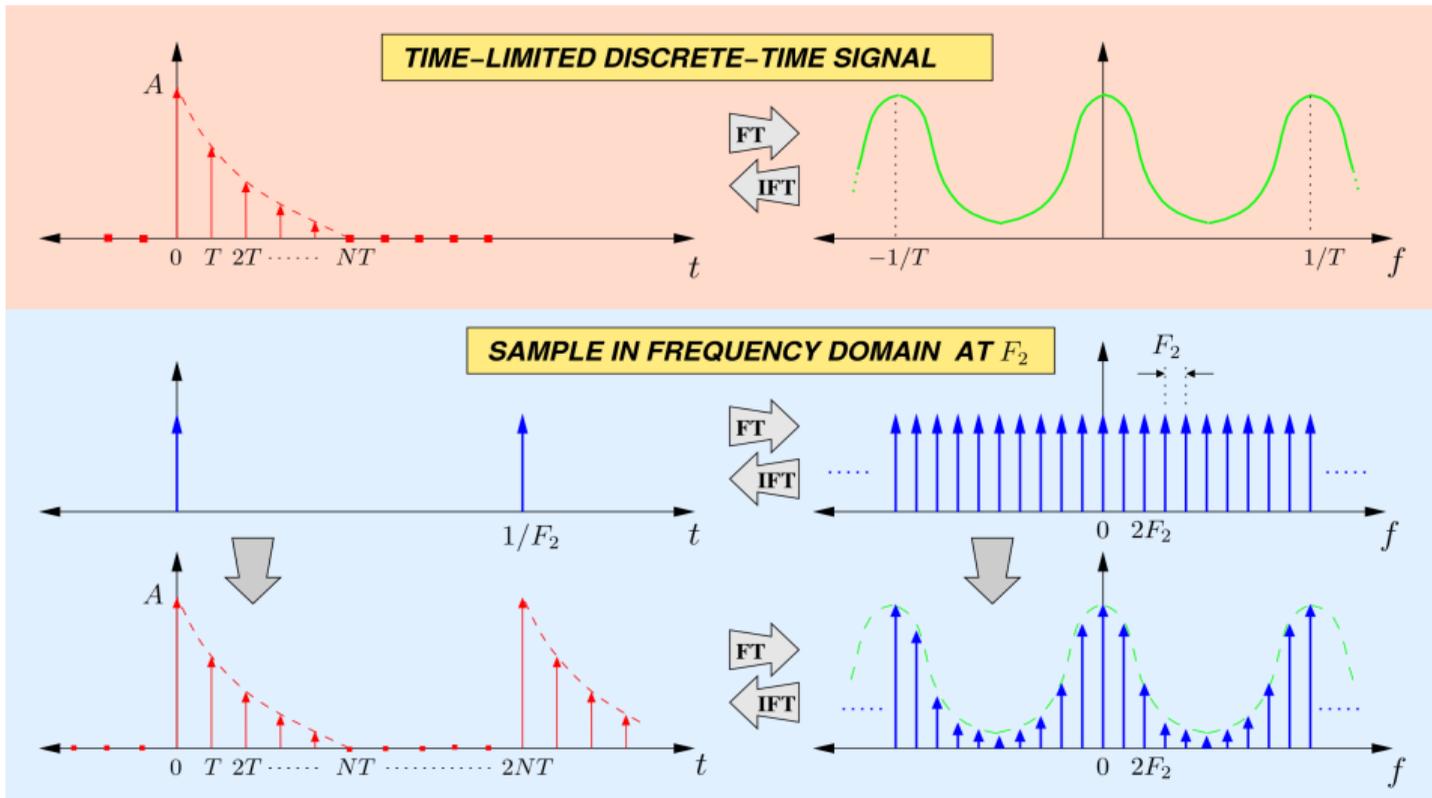
Where do the zeros go?



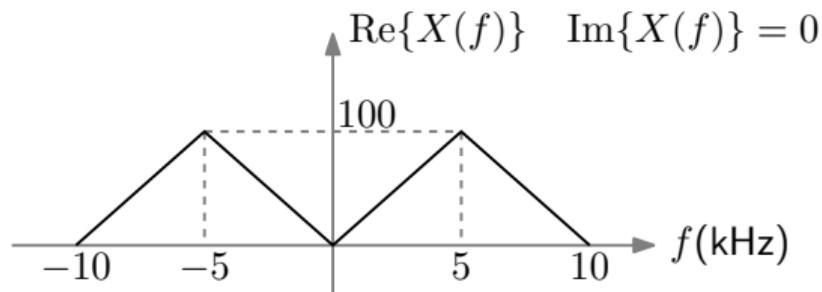
# Increased frequency-domain resolution



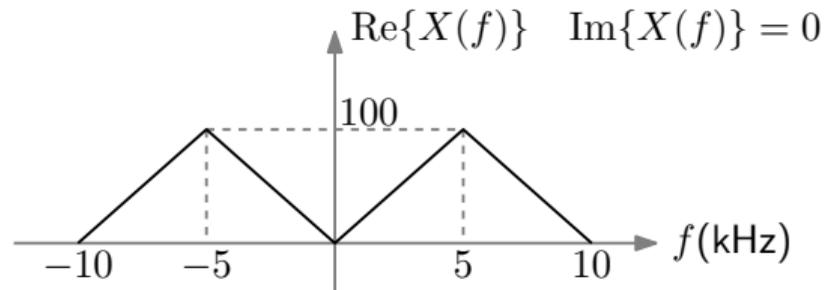
# Increased frequency-domain resolution



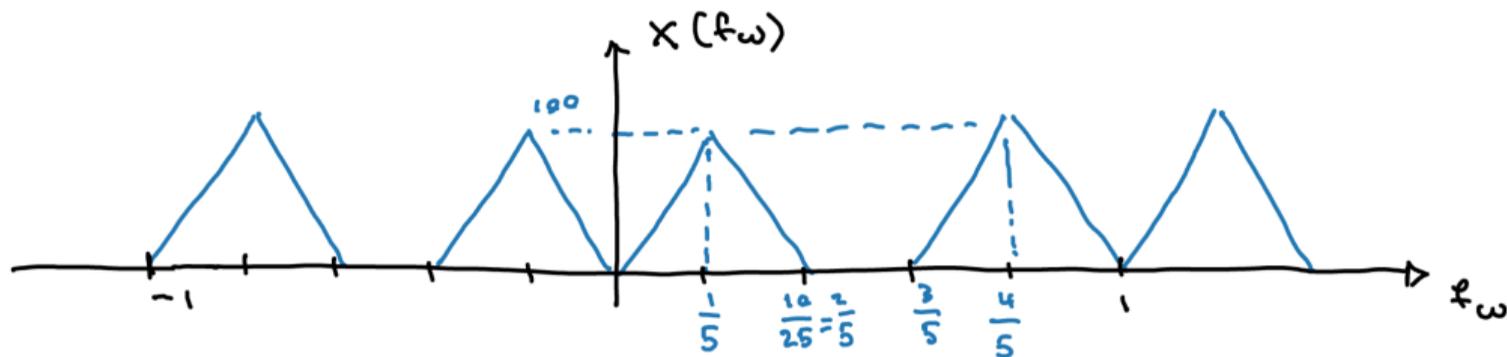
## Example

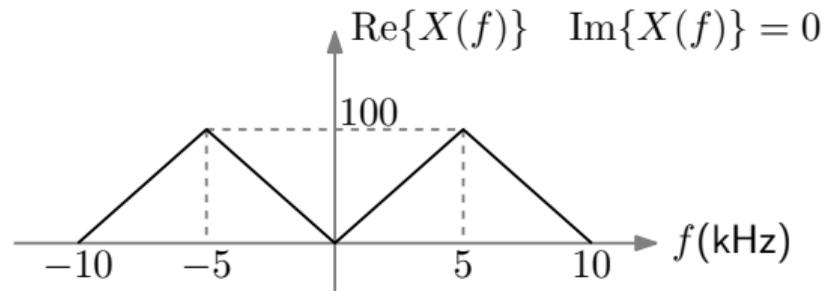


- Is  $x(t)$  periodic or aperiodic? Answer: Aperiodic
- Is  $x(t)$  even, odd, or neither? Answer: Real and even
- What is the minimum sampling frequency required to avoid aliasing when sampling this signal? Answer: 20 kHz



A discrete-time signal  $x[n]$  is obtained by sampling  $x(t)$  at a sampling frequency of  $f_s = 25$  kHz. Sketch the spectrum  $X(f_\omega)$  of the sampled signal  $x[n]$ .





The signal  $x(t)$  is now sampled at  $f_s = 15$  kHz. Sketch the spectrum  $X(f_\omega)$  of the sampled signal  $x[n]$ .

