Outline

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Shannon-Nyquist sampling theorem

If all content above the half-sampling frequency is removed, no aliasing is introduced by sampling. Also the signal spectrum is not distorted, even though it is repeated endlessly, centered at $n2\pi/T$.

This critical frequency, π/T, is called the **Nyquist frequency**. Band-limited signals that have no components above the Nyquist frequency are represented unambiguously by their samples.

This is the **sampling theorem**: One can recover a signal from its samples if the sampling frequency ($\omega_s = 2\pi/T$) is at least twice the highest frequency (π/T) in the signal. This maximum frequency is also called the **bandwidth** B.

Shannon-Nyquist sampling theorem

The signal can be fully reconstructed if there are no overlaps in the frequency domain.
If the sampling frequency is at least twice the bandwidth B, then the signal can be reconstructed without a problem (no overlap). (fig. a)
If the sampling frequency is too low then information will be lost (overlap). (fig. b)

Sampling frequency $f_s \geq 2B$