The $(\ )^2$ further suppresses the side copies (the ~~freq~~ with zero gain), which thus gives better approximation of the original signal.

We now know that when $\omega_s > 2\omega_m$, reconstruction can be perfect.

However, in practice, we can only directly sample $x(t)$. What will happen when the original bandwidth is too large $\omega_m > \frac{\omega_s}{2}$?

(sampling is too slow)

or when . In this case, our reconstruction will not lead to $\hat{x}(t) = x(t)$. We say the system is

Q: Can we predict $\hat{x}(t)$ even when the system is under-sampled?

Ans: Yes, the undersampling effect is termed

A special example:

$$x(t) = \cos(w_0 t + \phi)$$

Q1: Find $\mathcal{F}T$ of $x(t)$.

Ans: By noting that

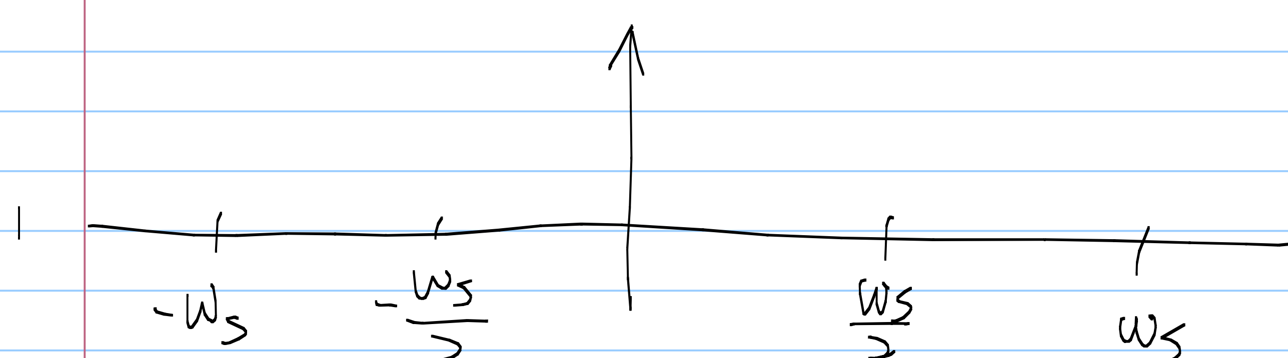
Sampling with $\omega_s > 2\omega_0$

After sampling, the spectrum of $X_p(j\omega)$ becomes

The LPF will isolate the freq in this range.

However, if we keep increasing ω_0 while let ω_s be constant, eventually the system will be <u>under-sampled</u>.

We will have when $\omega_s < 2\omega_0$



Therefore, after the LPF and $\times T$, we have

$\hat{X}(j\omega) =$

$\Rightarrow \hat{x}(t) =$

Summary

	$\omega_s > 2\omega_0$	$\omega_s < 2\omega_0$
$x(t) = \cos(\omega_0 t + \phi)$	$\hat{x}(t) =$	$\hat{x}(t) =$

Therefore, as ω_0 increases (speeds up), the freq of $\hat{x}(t)$ speeds up first but once $\omega_0 > \frac{\omega_s}{2}$ $\hat{x}(t)$ slows down $(\omega_s - \omega_0)$ & we have phase reversal $\phi \rightarrow (-\phi)$

This explains the stroboscope effect: Why in movies, wheels seem to turn slowly and backward.