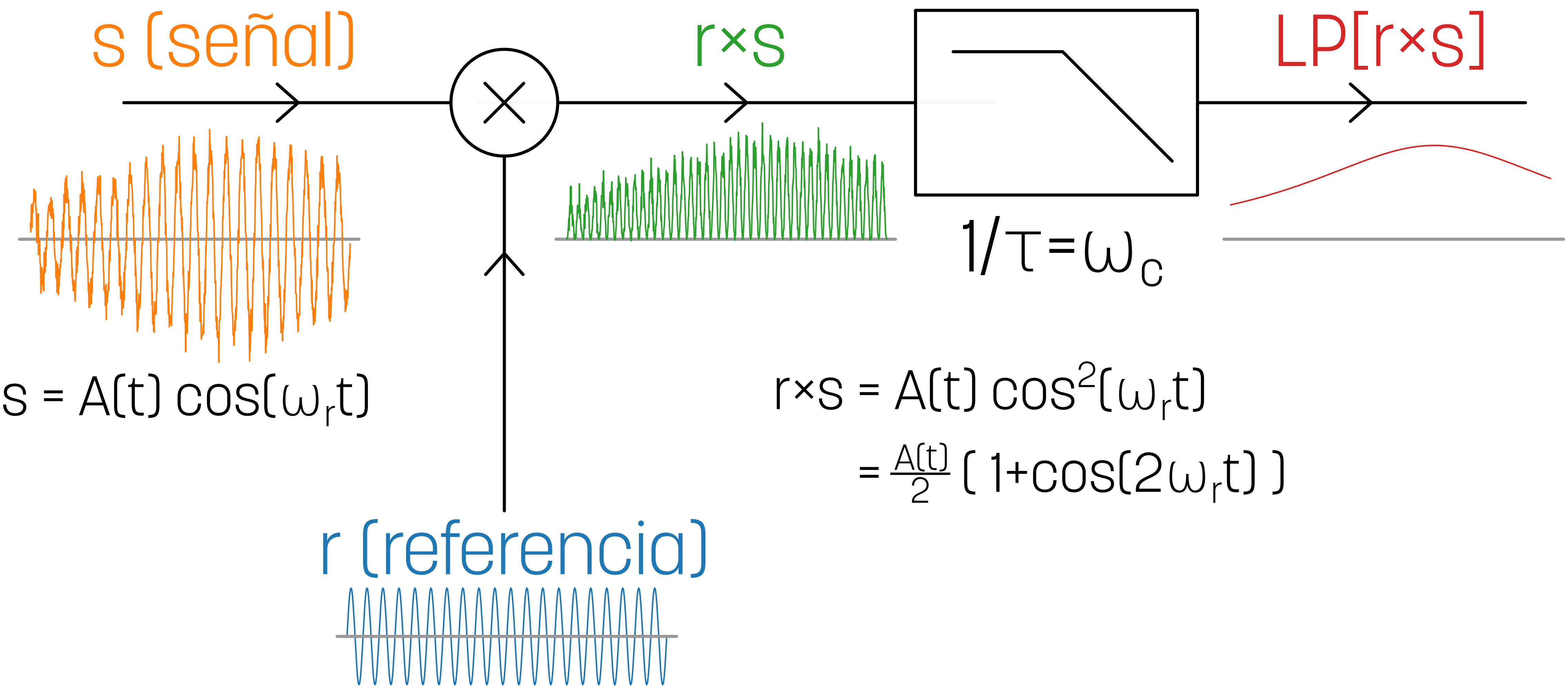
Amplificador Lock-in
y
Mediciones Homodinas

Amplificador Lock-in

Es un INSTRUMENTO



$s = A(t)\cos(\omega_r t)$

$r = \cos(\omega_r t)$

$$r\times s = A(t)\cos^2(\omega_r t) = \frac{A(t)}{2}\left(1+\cos(2\omega_r t)\right)$$

¿Amplificador?

Amplificador Lock-in

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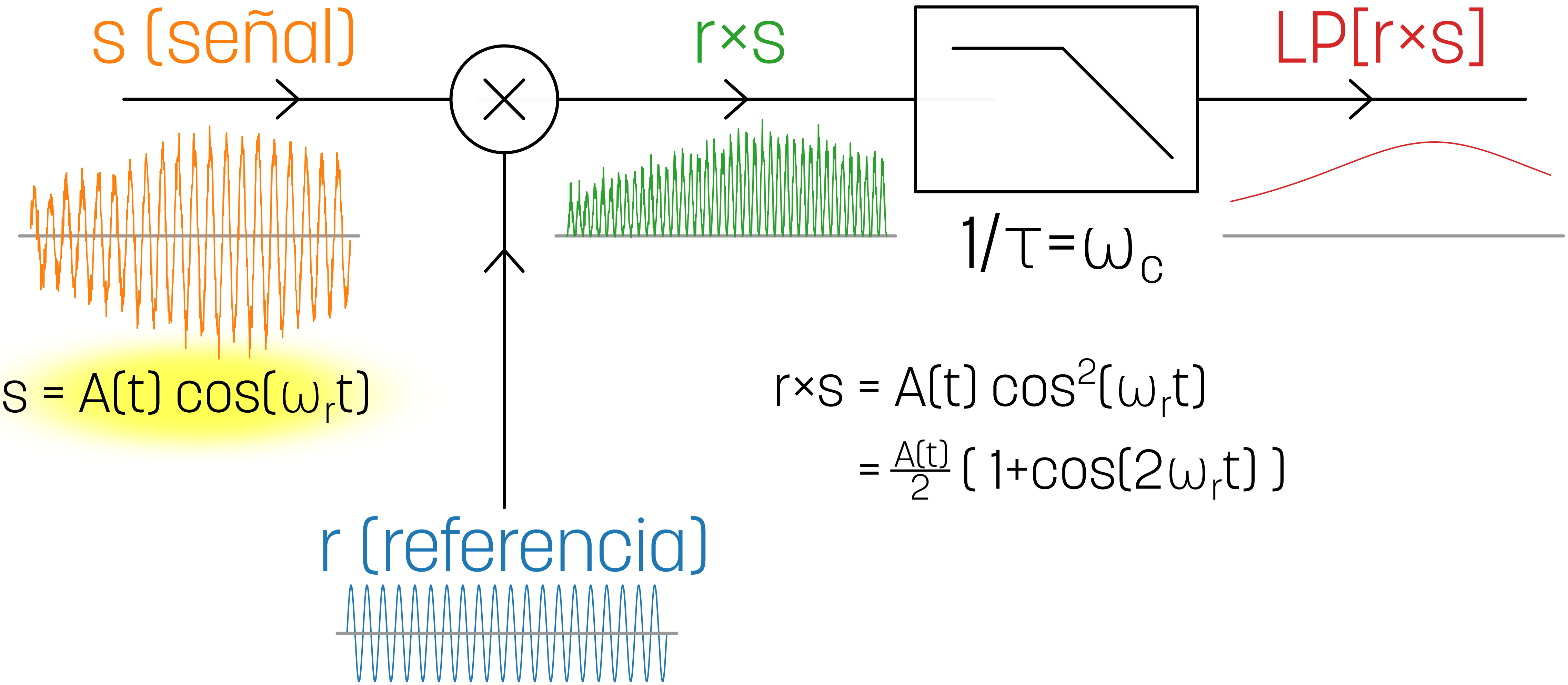

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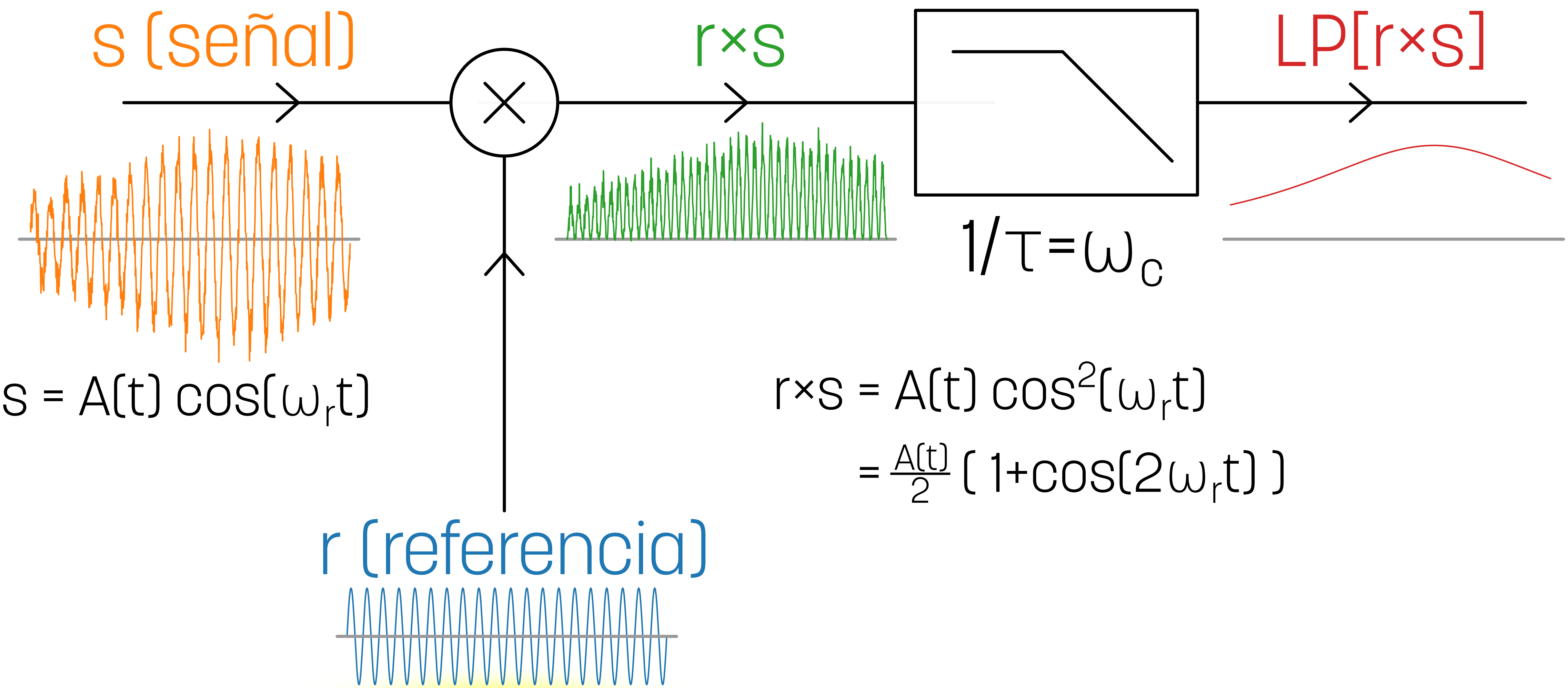

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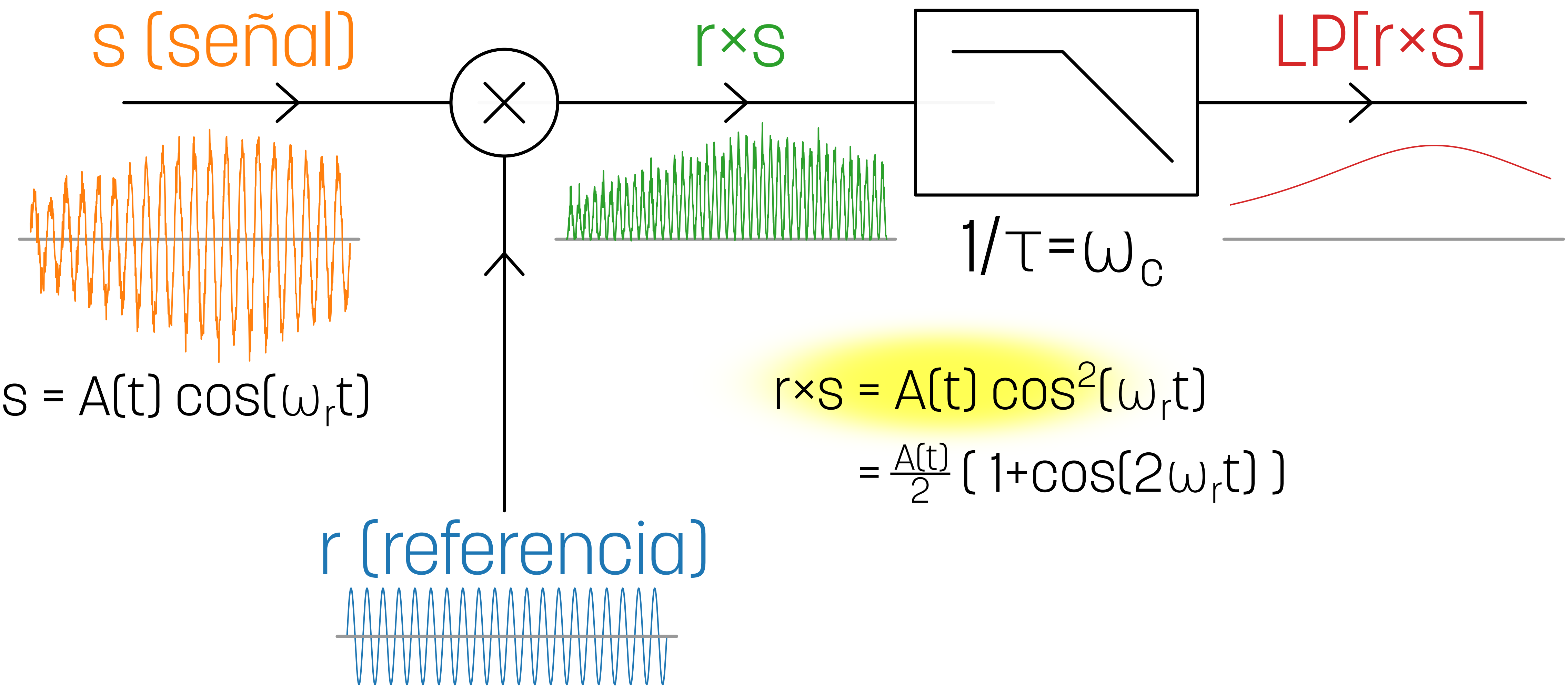

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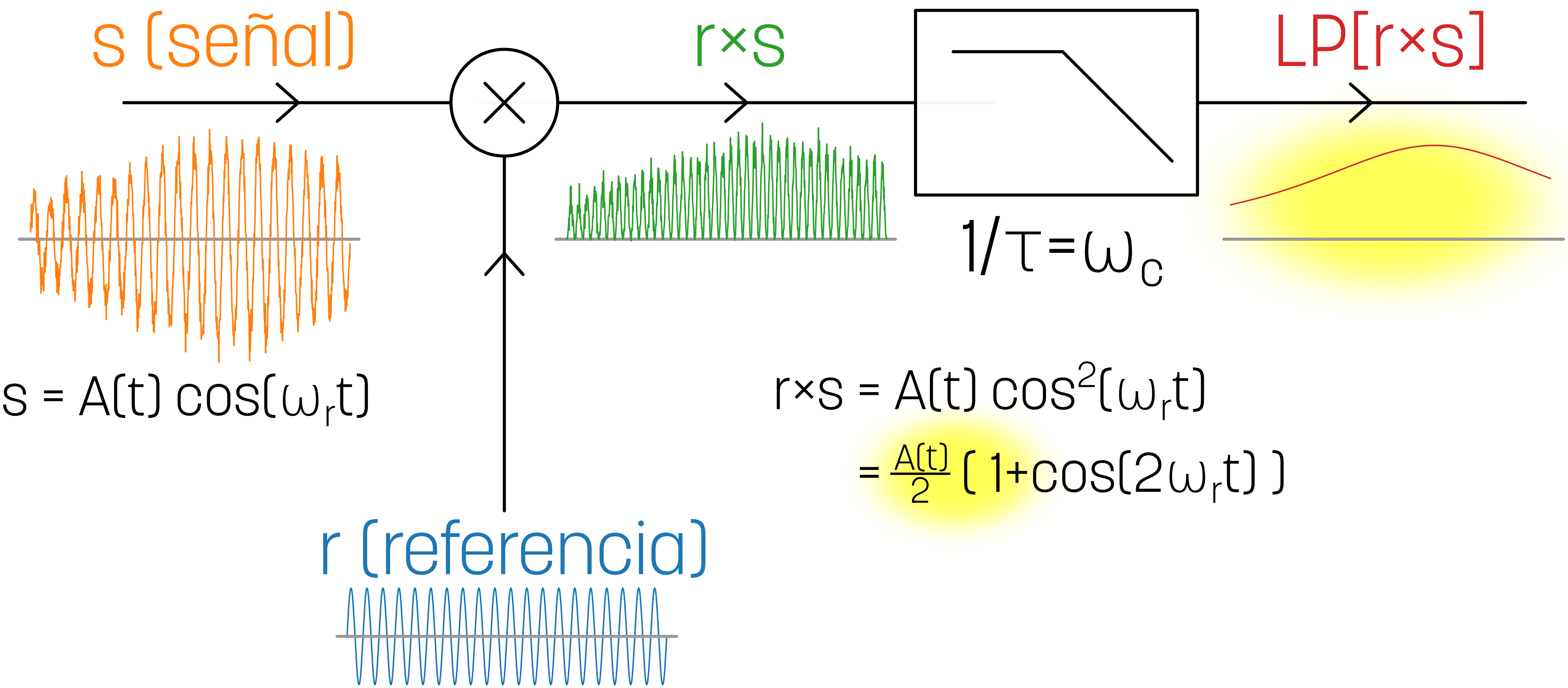

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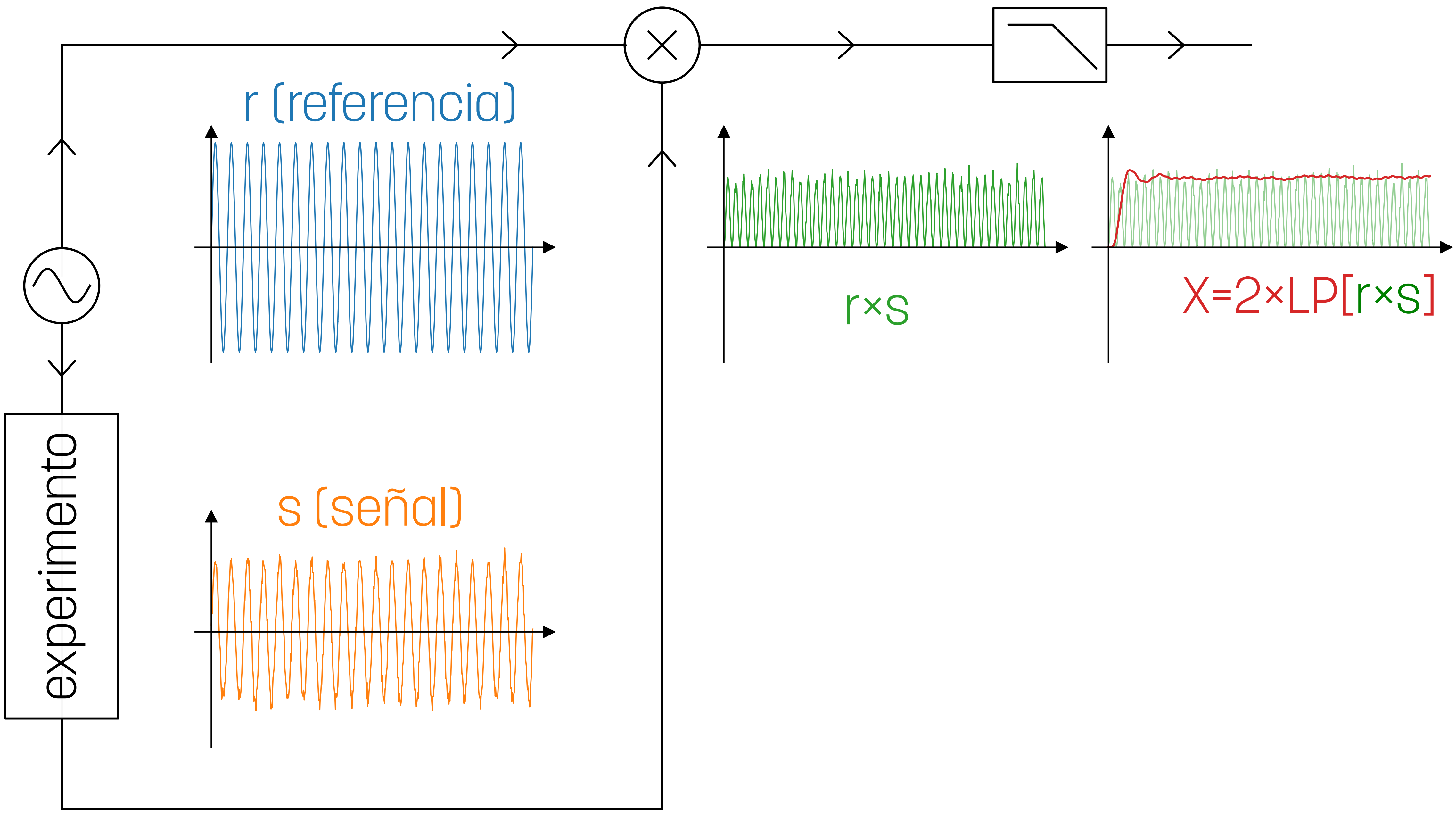
¿Amplificador?

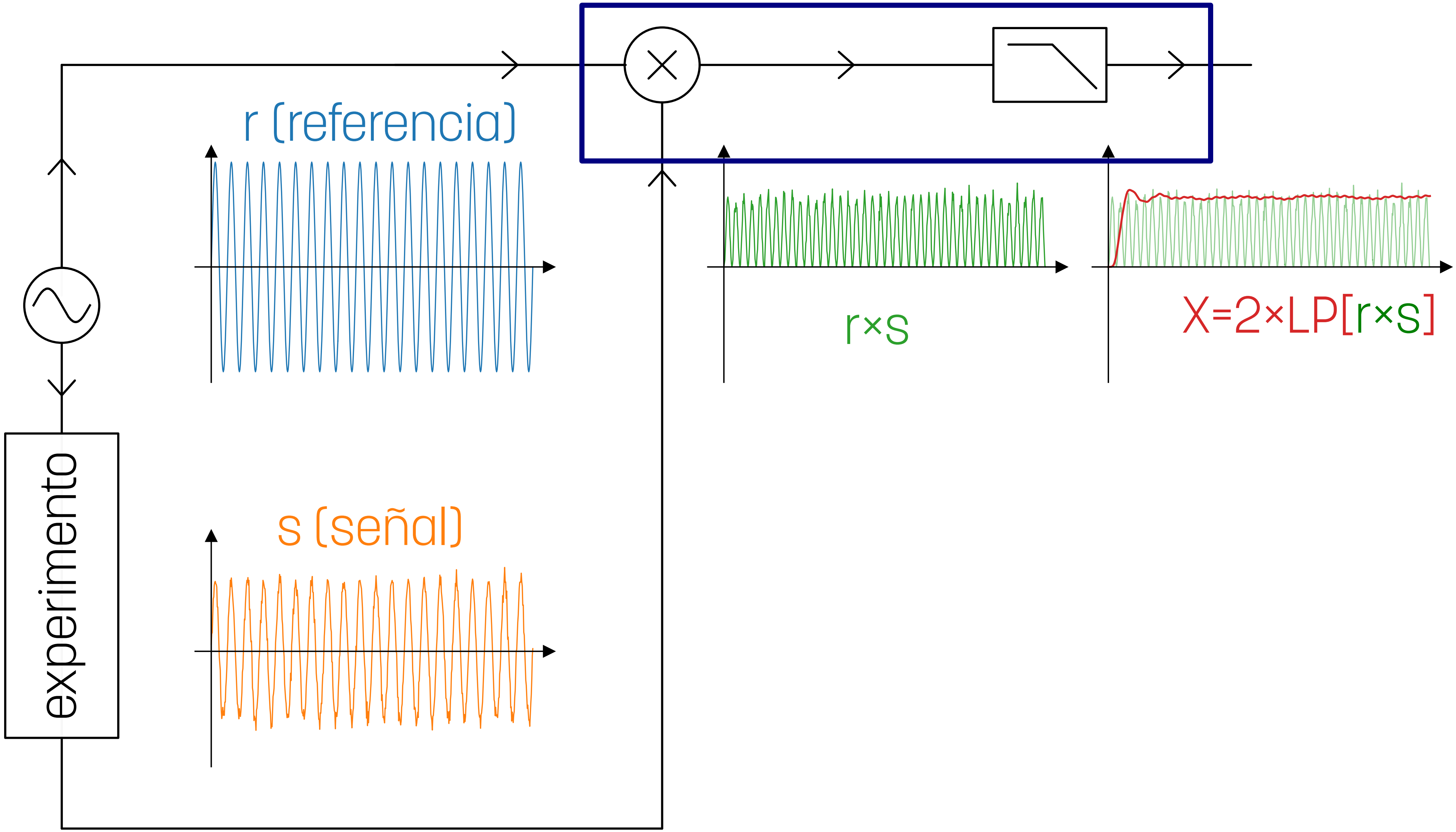
Medición HOMODINA

Es una Técnica



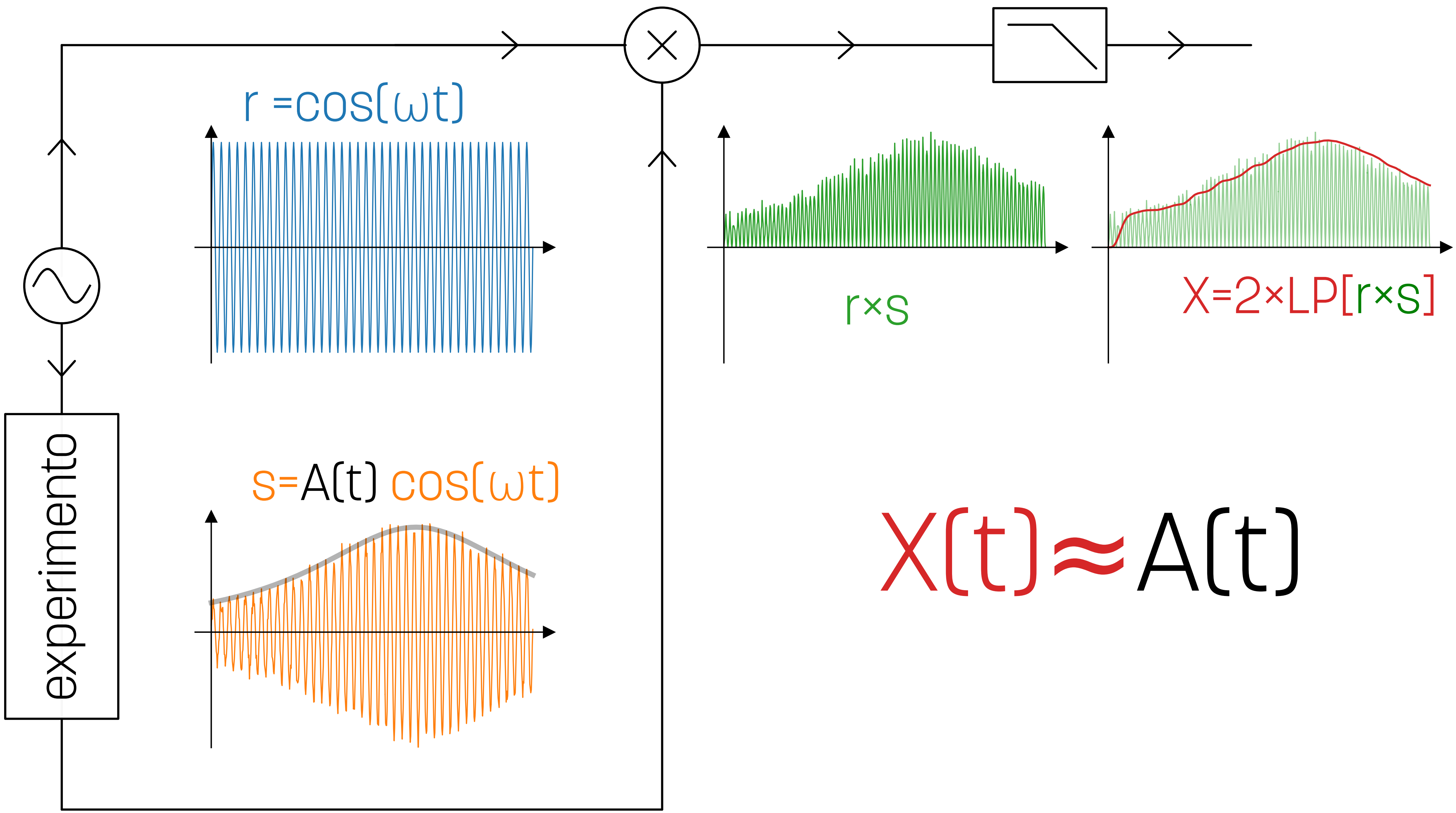
Medición HOMODINA

Es una Técnica **Lock-in**



Medición HOMODINA

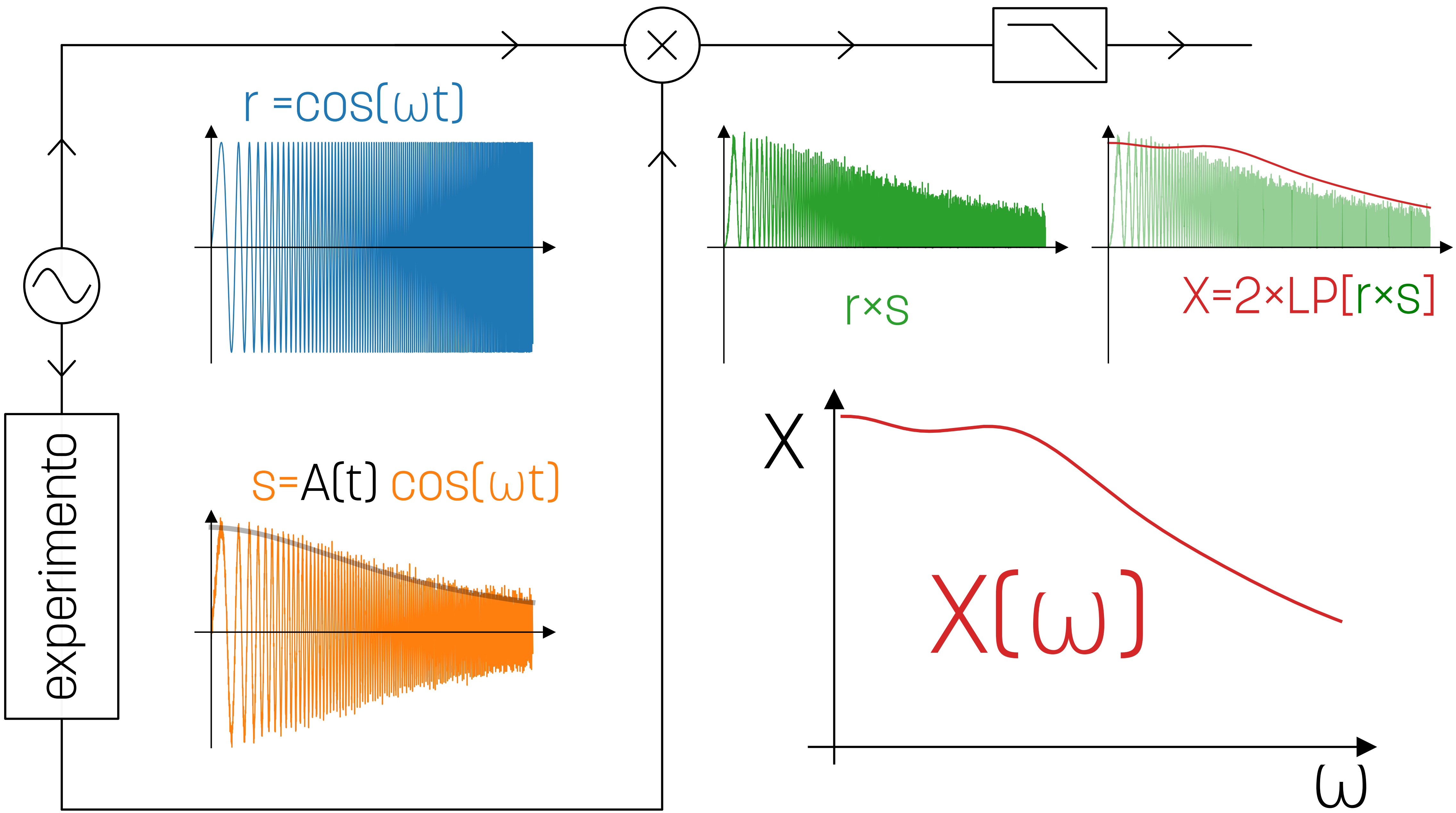
Es una Técnica



$$X(t) \approx A(t)$$

Medición HOMODINA

Es una Técnica



Para que sirve?

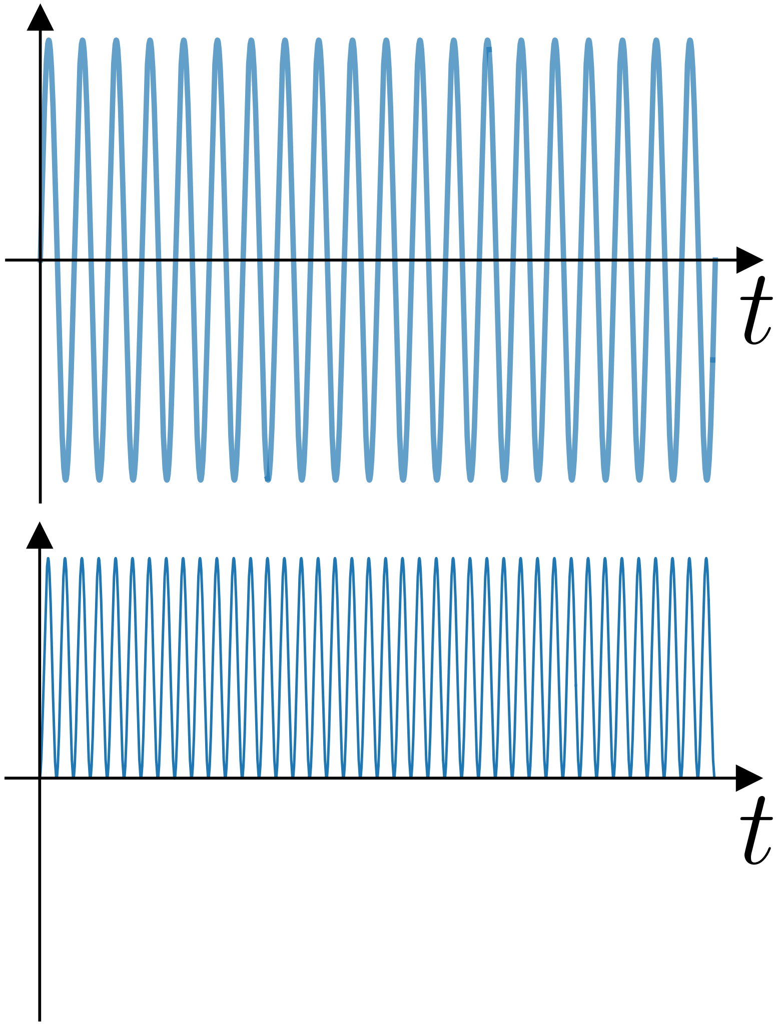
Filtrar señal útil:
Quedarte con la frecuencia que tiene información del fenómeno que estás midiendo

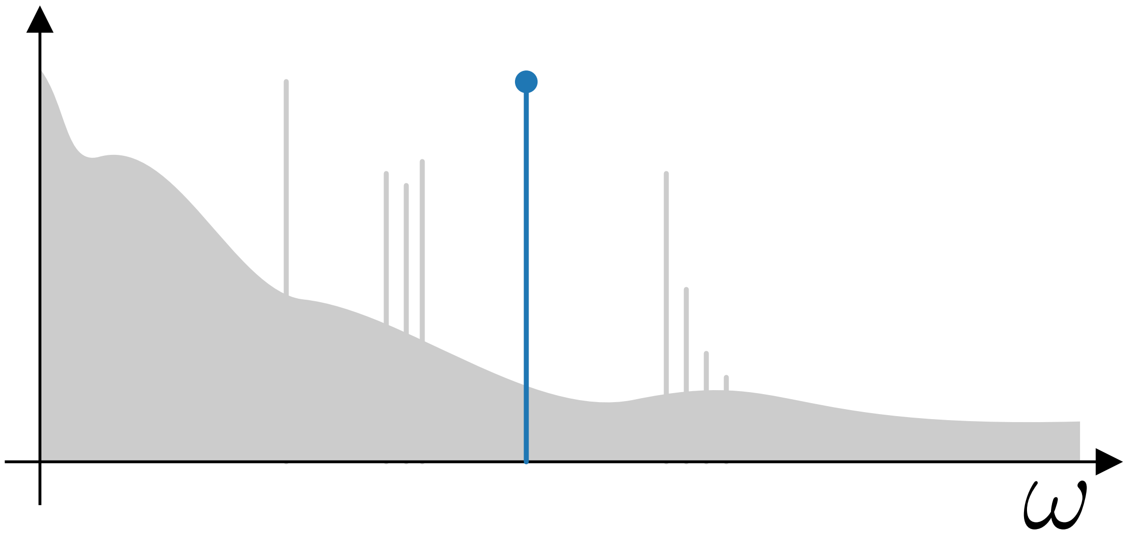
Mejorar relación señal ruido
Medir cosas que normalmente el ruido no te dejaría

Medir Fase
Medir relaciones de fase fácilmente

Filtro de frecuencias

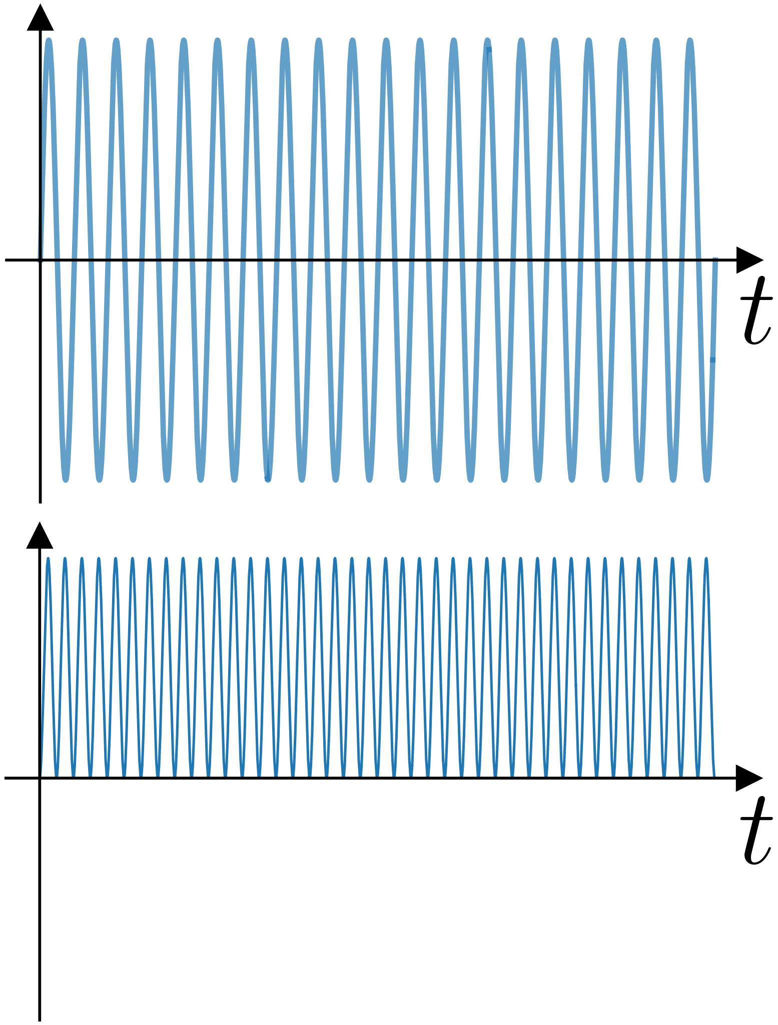
$$\frac{2}{T}\int_0^T \cos(\omega t)\cos(n\omega t)dt = \delta_{0n}$$

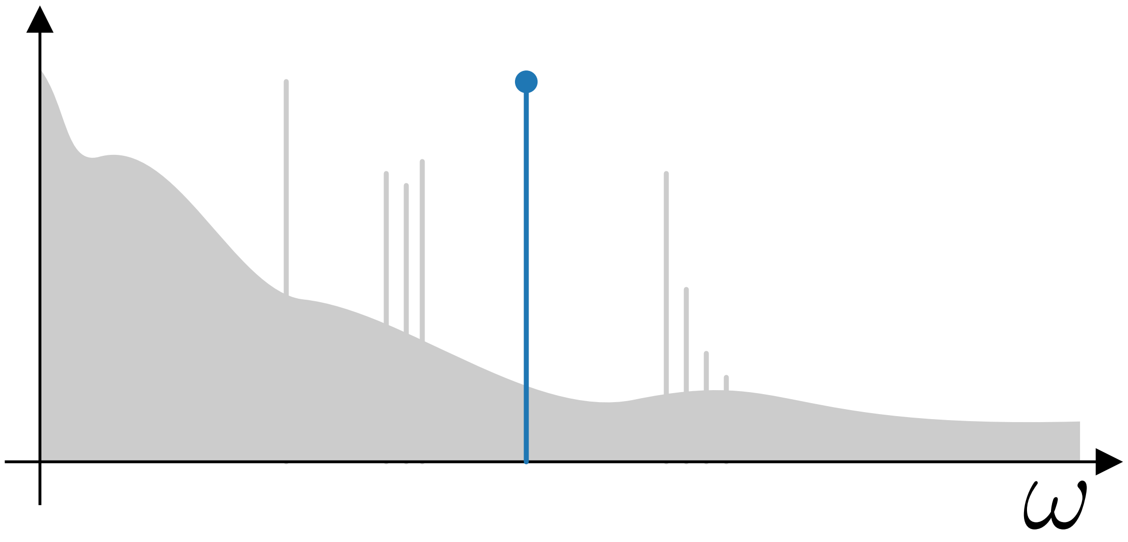




Filtro de frecuencias

$$\lim_{\tau\to\infty}\frac{2}{\tau}\int_{-\frac{\tau}{2}}^{\frac{\tau}{2}}\cos(\omega t)\cos(\omega' t)dt = \begin{cases}1 & \text{si } \omega=\omega' \\ 0 & \text{si } \omega\neq\omega'\end{cases}$$



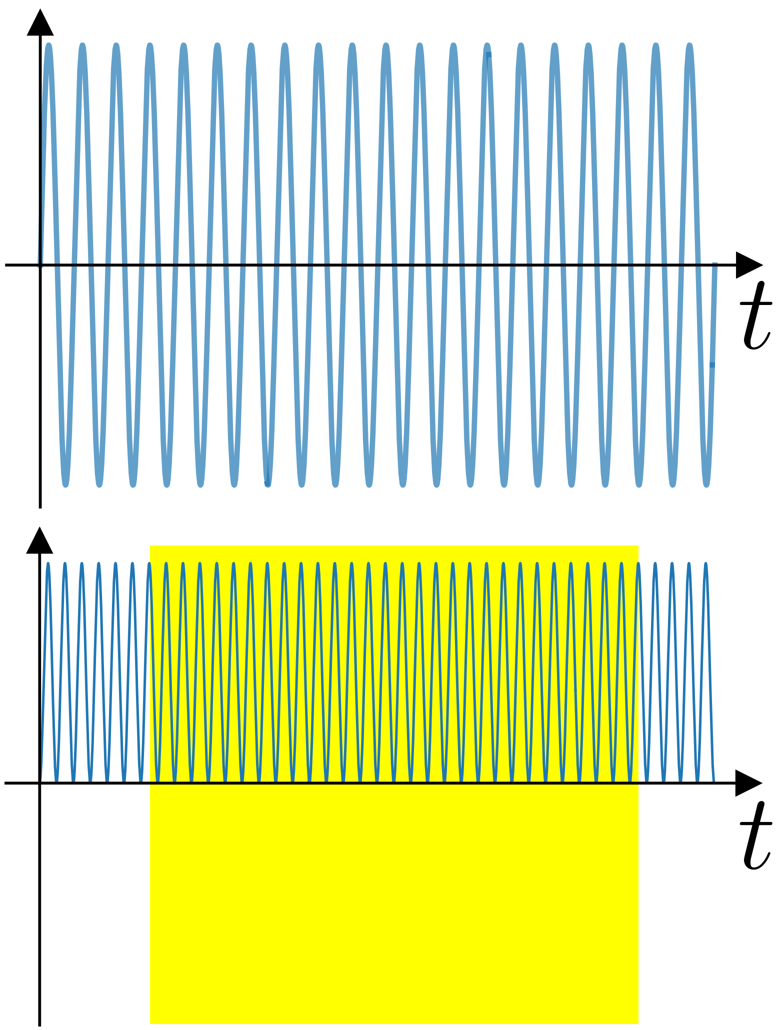


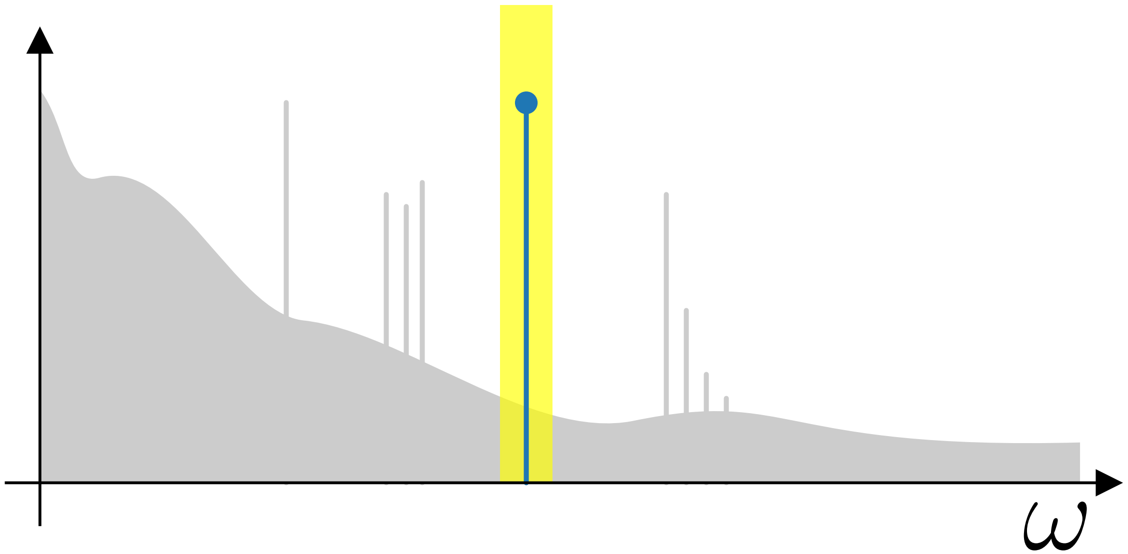
Filtro de frecuencias

$$\frac{2}{\tau}\int_{-\frac{\tau}{2}}^{\frac{\tau}{2}} \cos(\omega t)\cos(\omega' t)dt \approx \begin{cases} 1 & \text{si } \omega = \omega' \\ 0 & \text{si } \omega \neq \omega' \end{cases}$$

$$\omega_c = \frac{1}{\tau} \qquad \tau > T$$

$$\omega_r = \frac{1}{T} \qquad \omega_c < \omega_r$$





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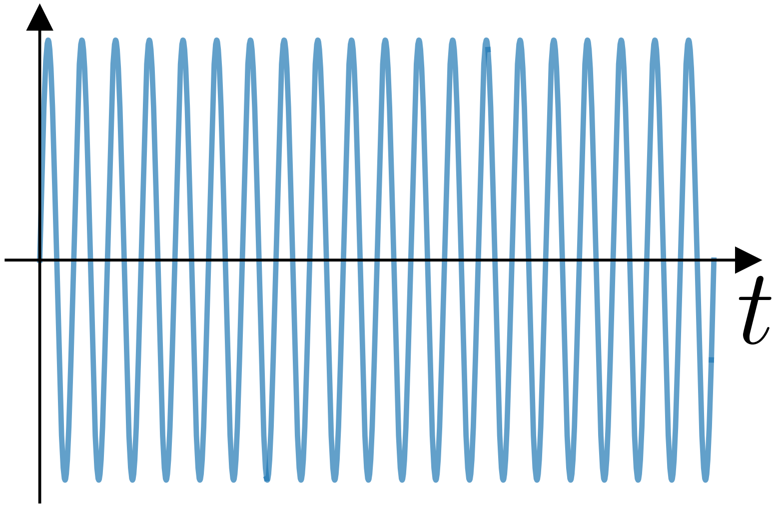
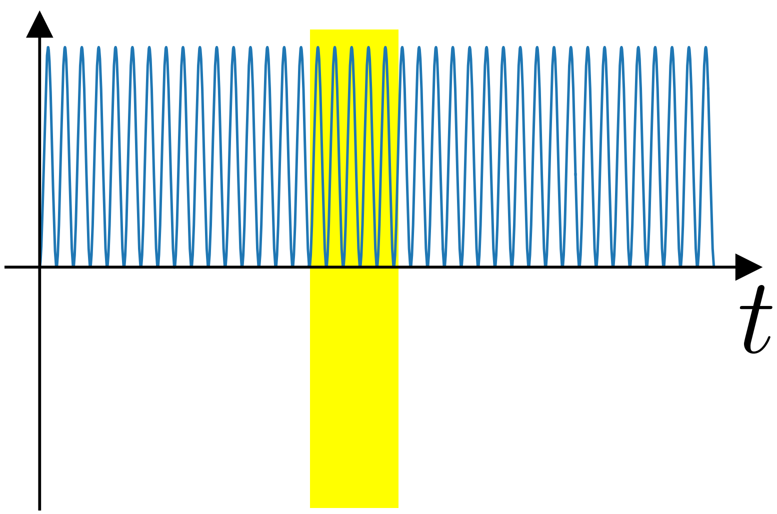
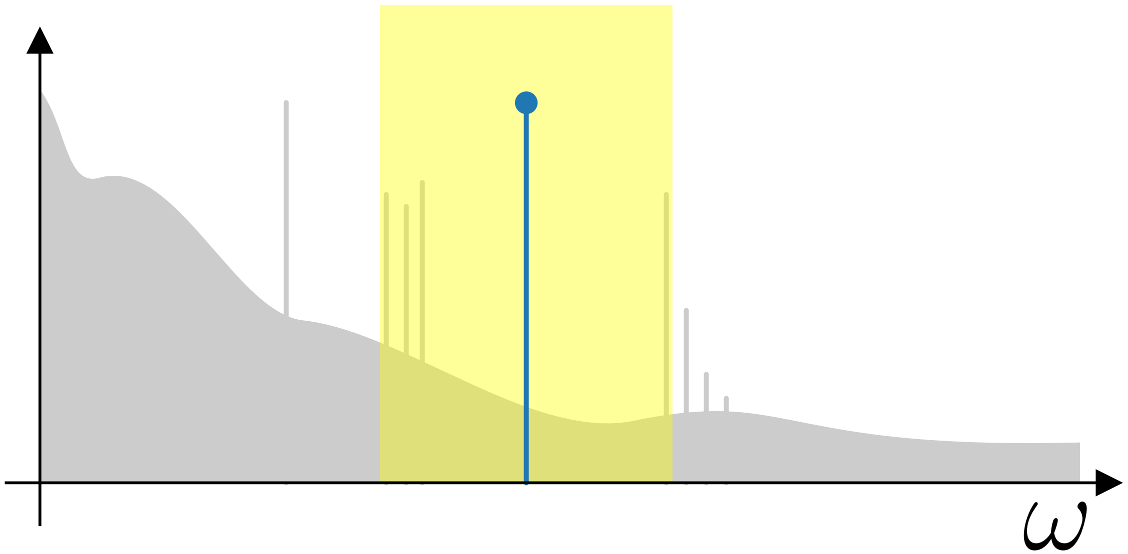
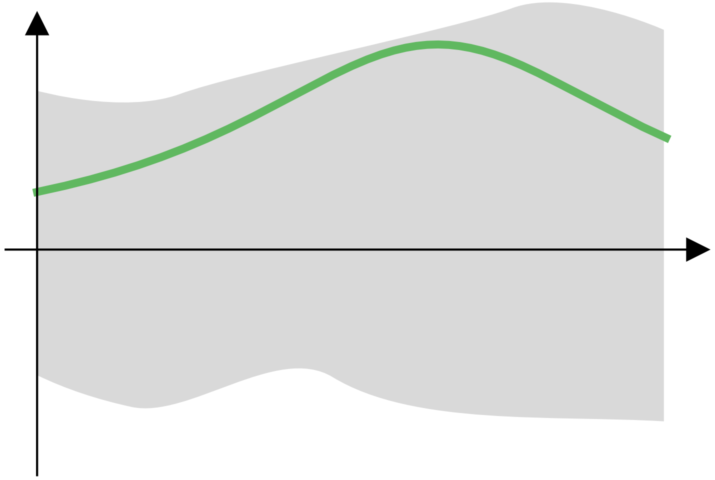


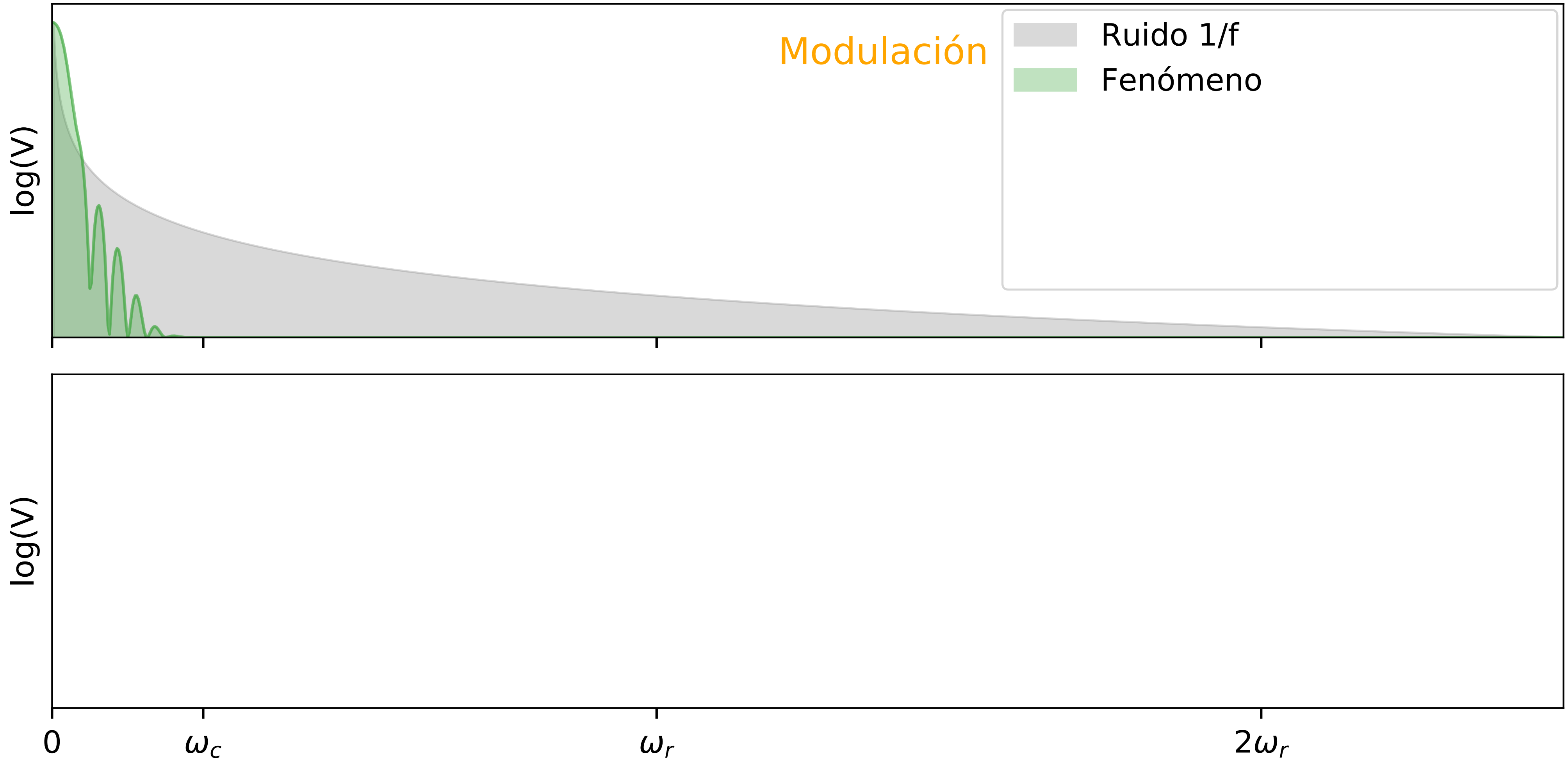




Mejora de la relación señal/ruido



$$S(t)$$



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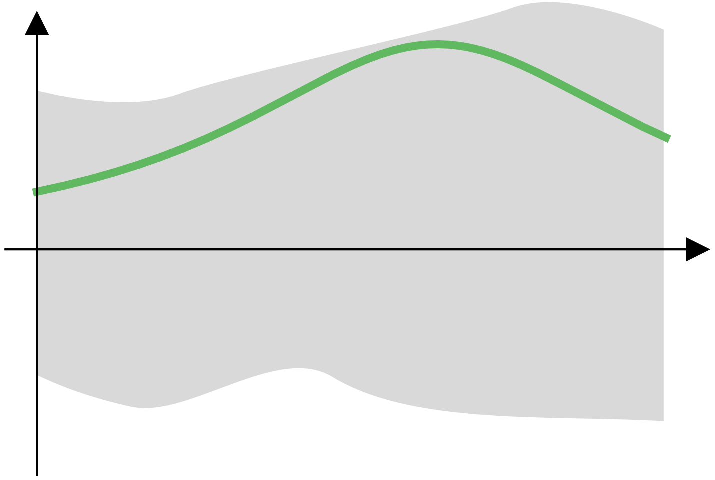
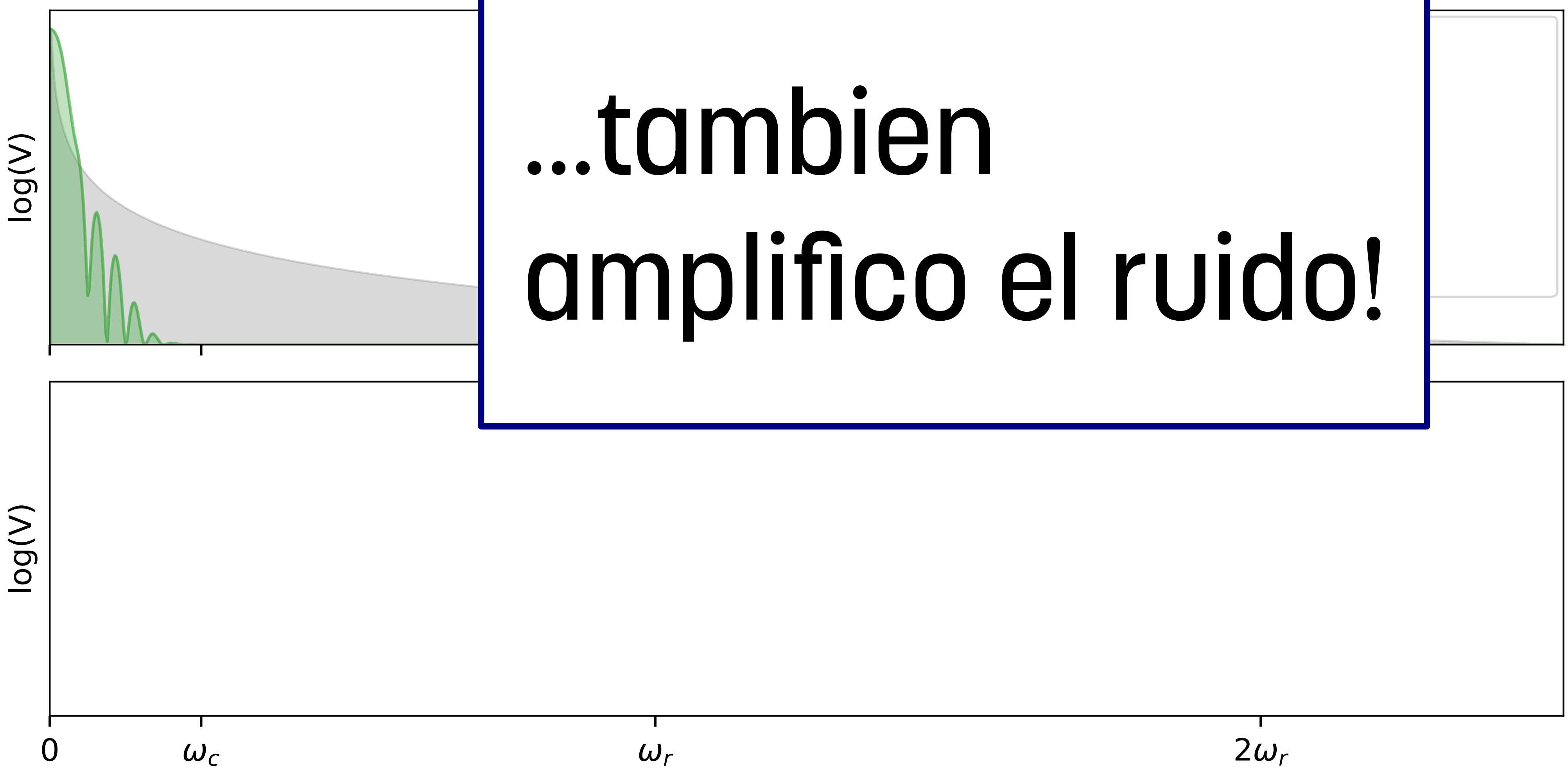
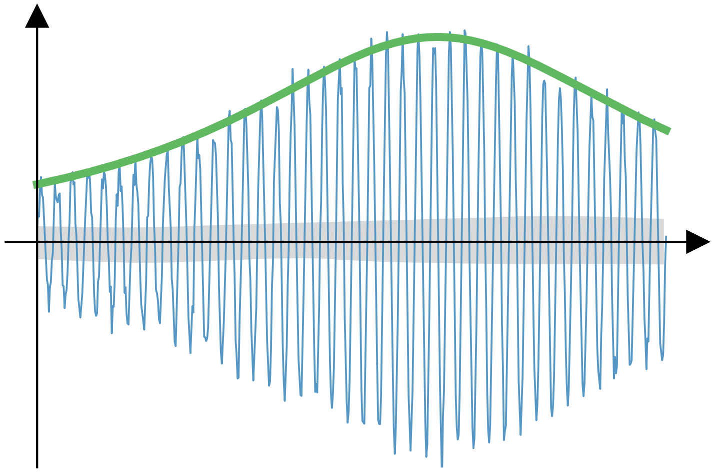




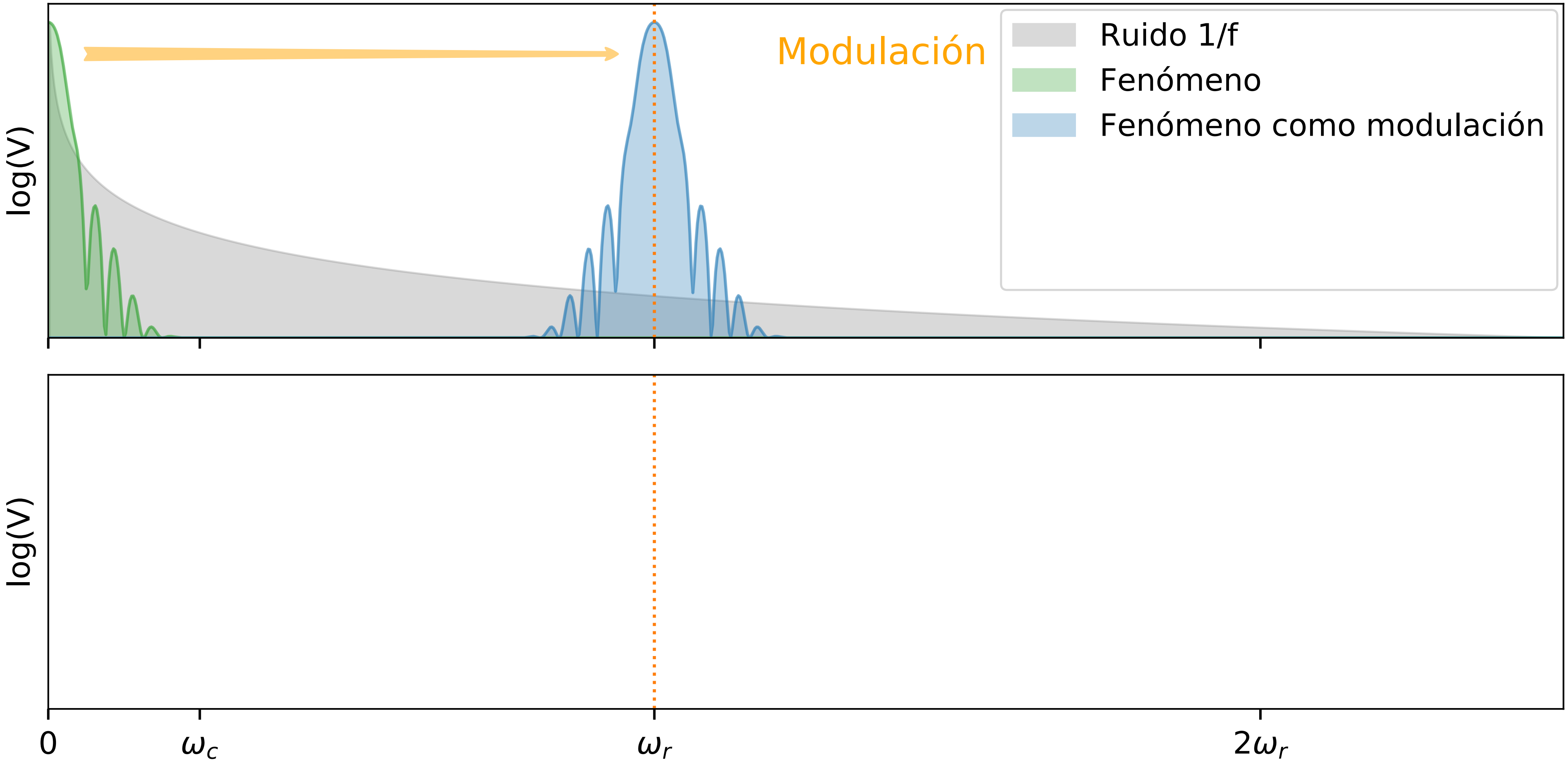
Si lo amplifico...

...tambien amplifico el ruido!

Mejora de la relación señal/ruido



$$S(t)\cos^2(\omega_r t)$$



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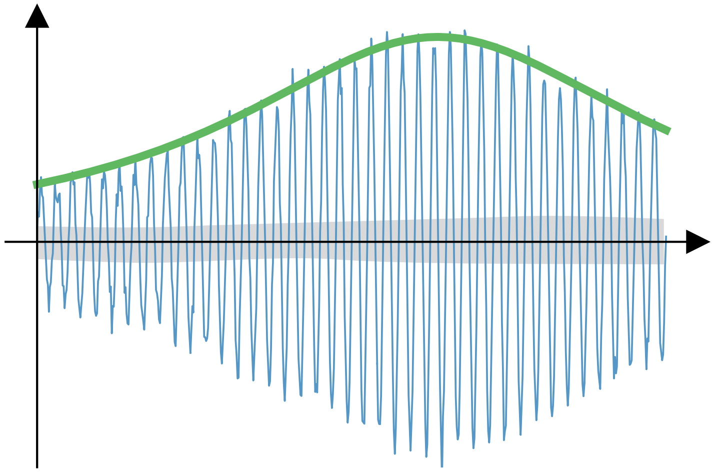
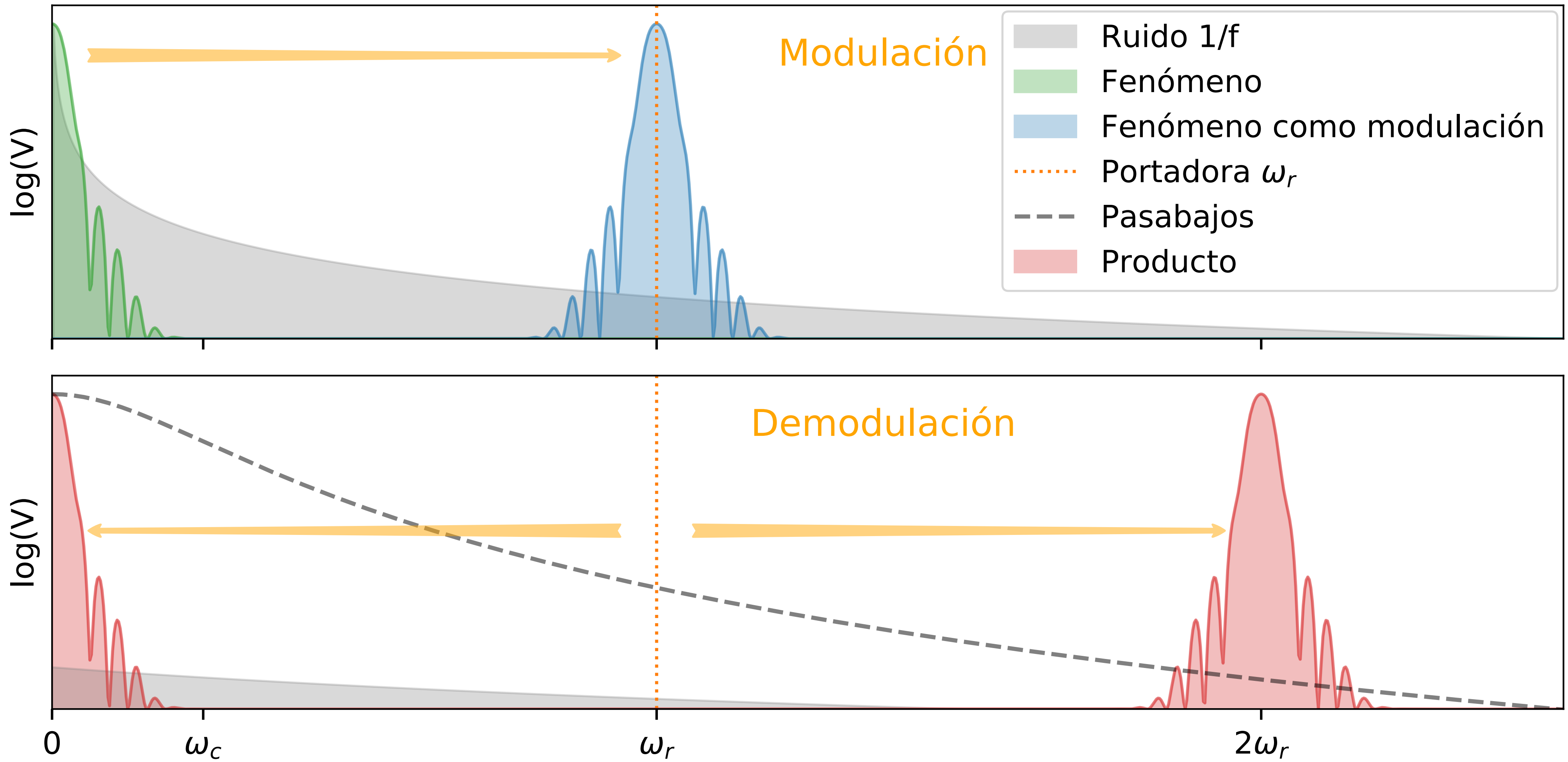


$$S(t)\cos^2(\omega_r t) = S(t)\left(\frac{1}{2} + \frac{\cos(2\omega_r t)}{2}\right)$$



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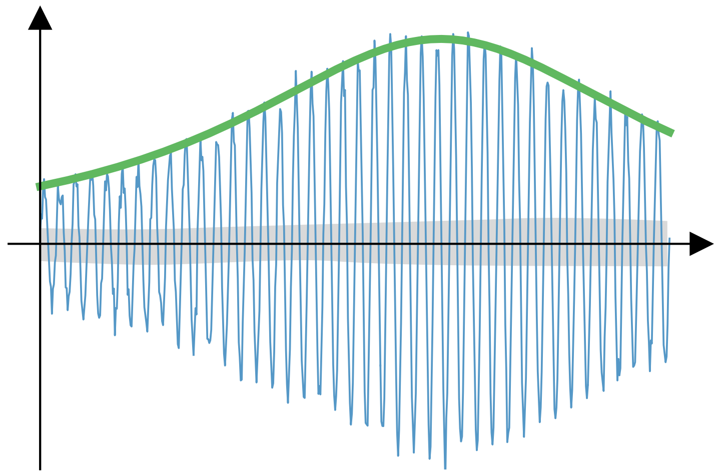
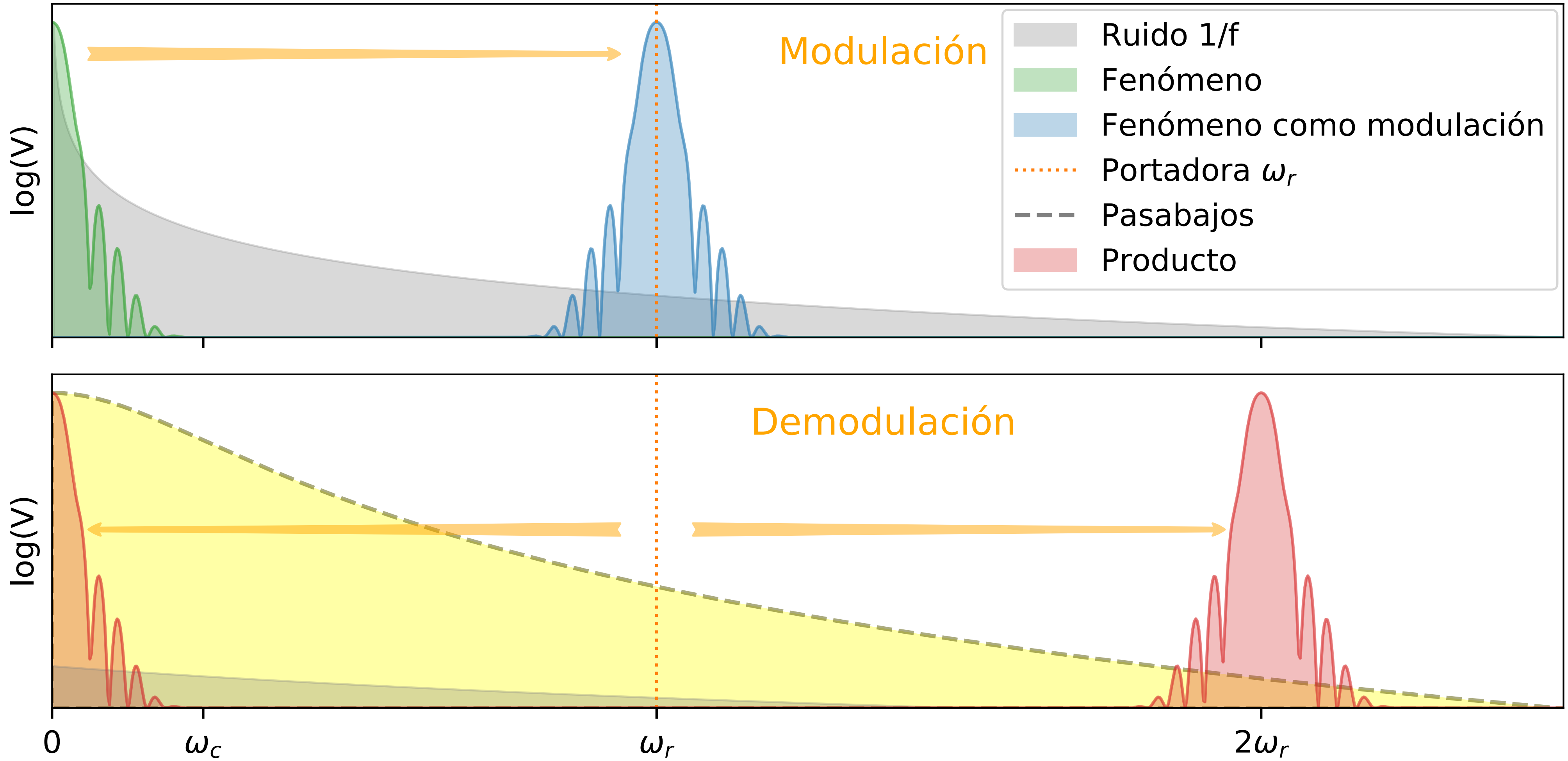


$$T_f > \tau > T$$

$$\omega_f < \omega_c < \omega_r$$



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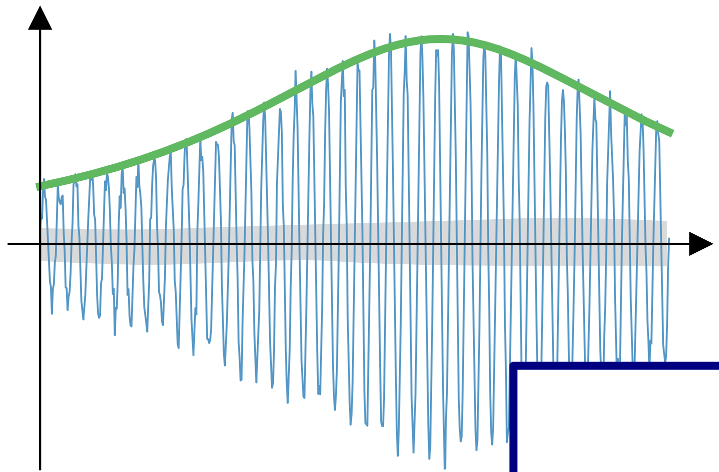
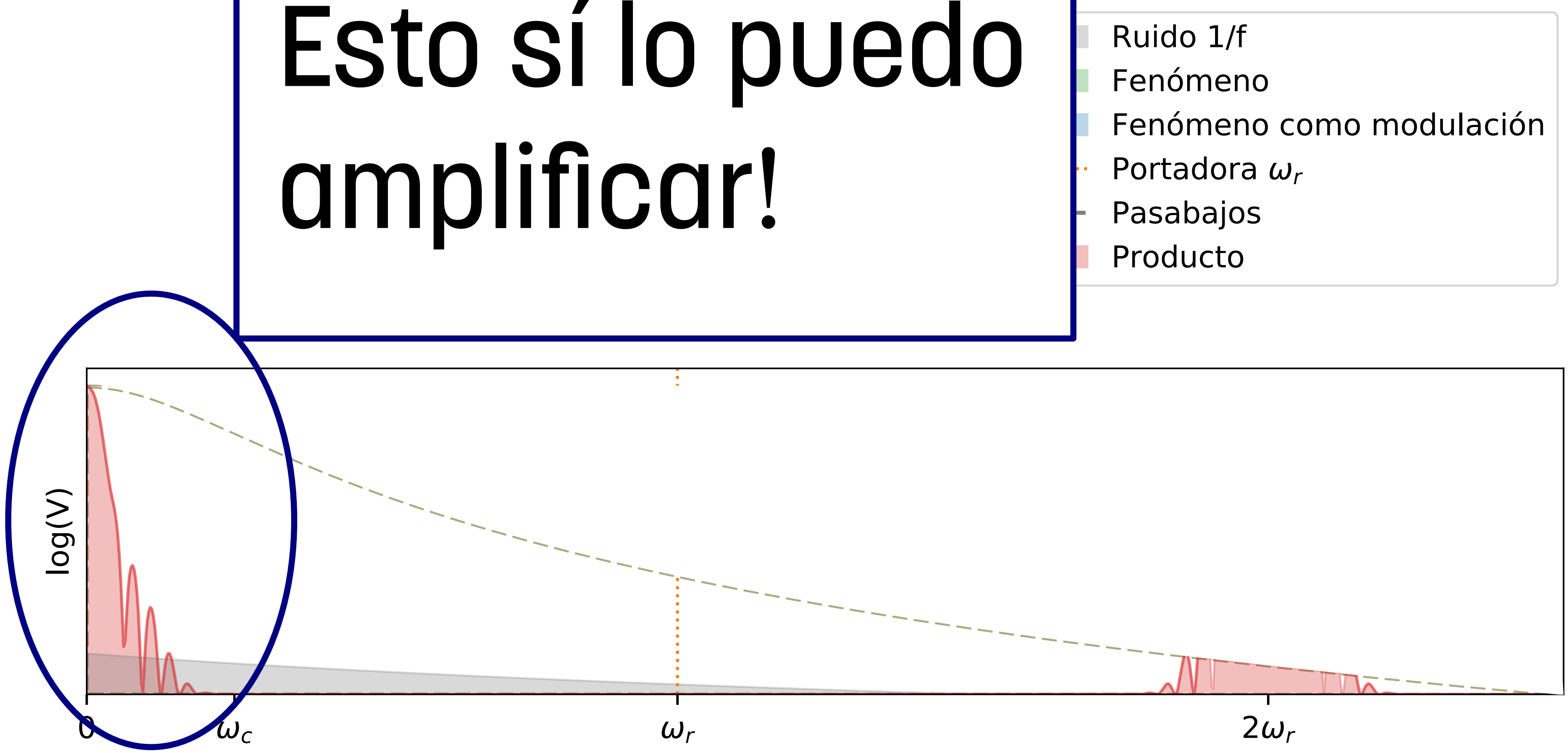


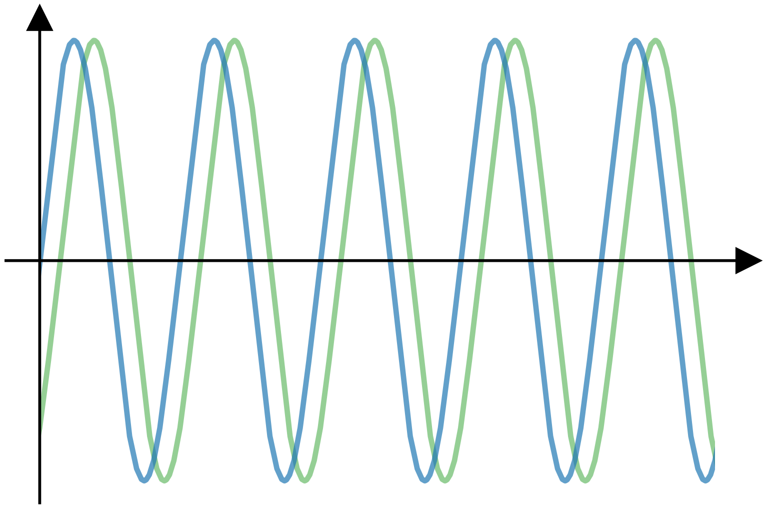
$$T_f > \tau > T$$

$$\omega_f < \omega_c < \omega_r$$

Esto sí lo puedo amplificar!

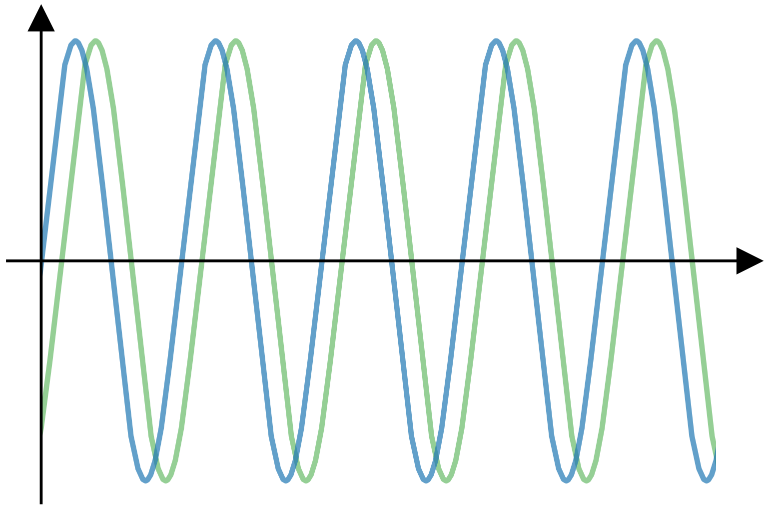


Medición de fase



$$F(\omega) = \frac{1}{\tau}\int_{-\tau}^{\tau} S(t)e^{-i\omega t}dt$$

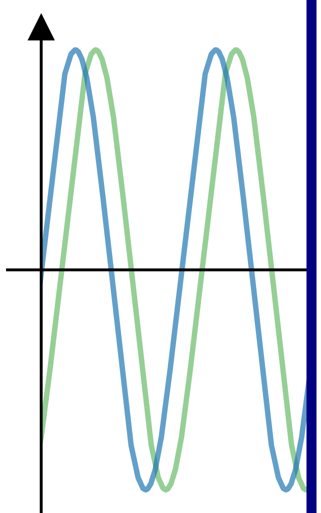
Medición de fase

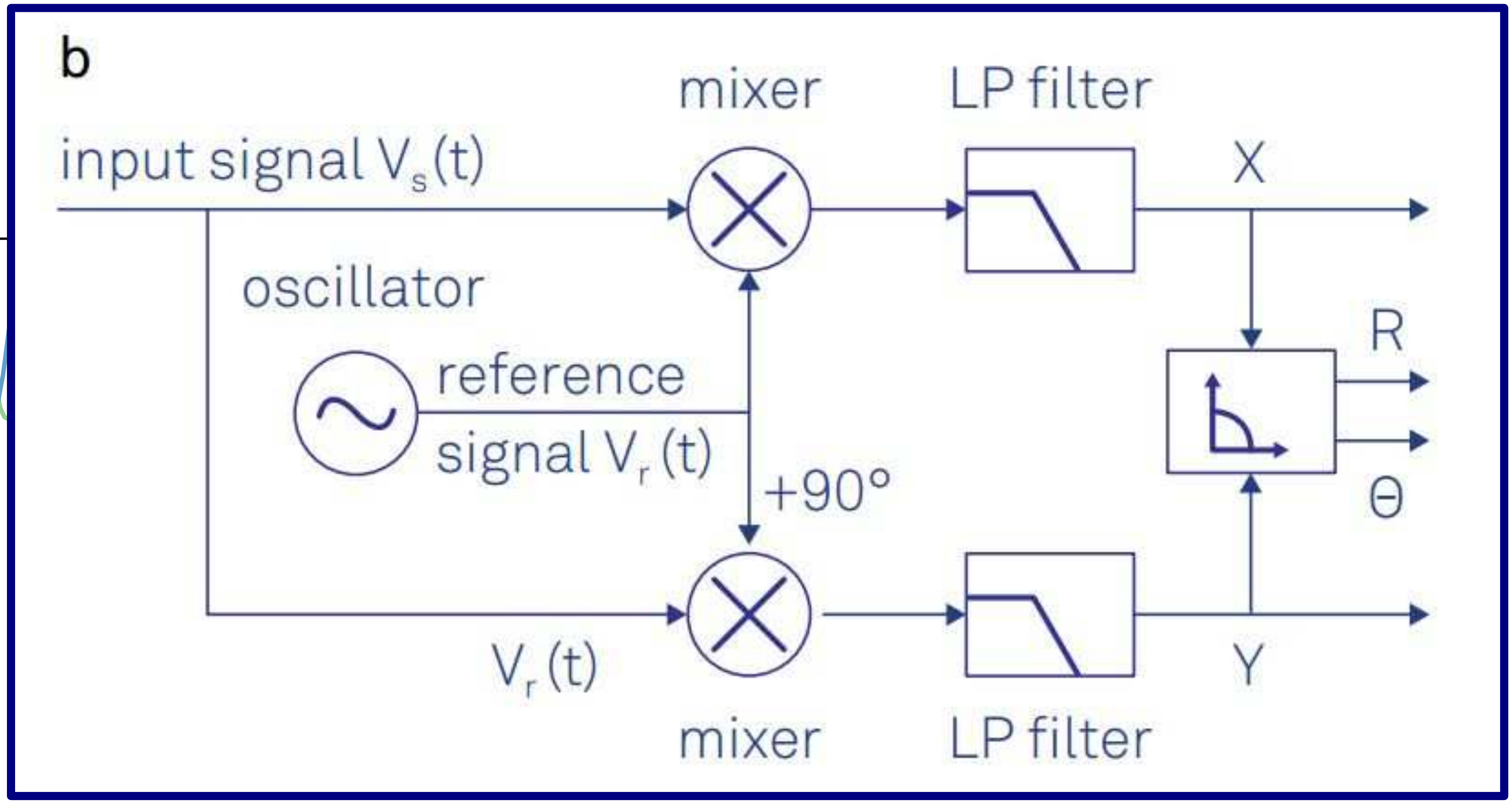


$$F(\omega) = \frac{1}{\tau}\int_{-\tau}^{\tau} S(t)e^{-i\omega t}dt =$$

$$= \underbrace{\frac{1}{\tau}\int_{-\tau}^{\tau} S(t)\cos(\omega t)dt}_{X} + i\underbrace{\frac{1}{\tau}\int_{-\tau}^{\tau} S(t)\sin(\omega t)dt}_{Y}$$

Medición de fase





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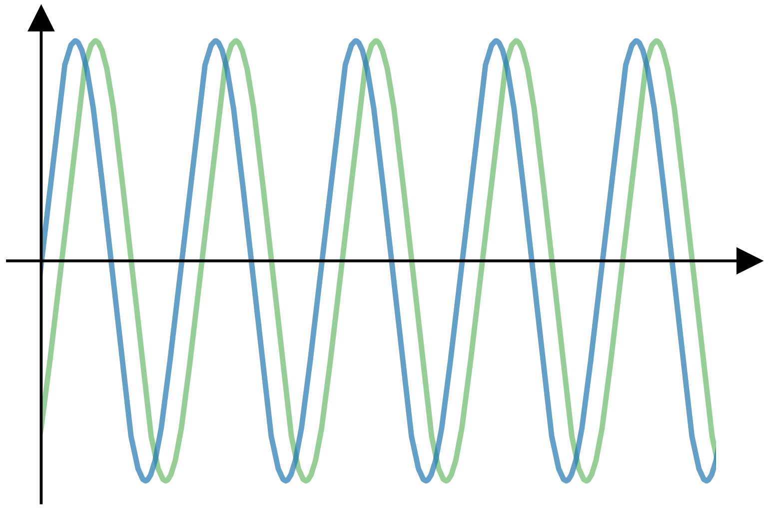

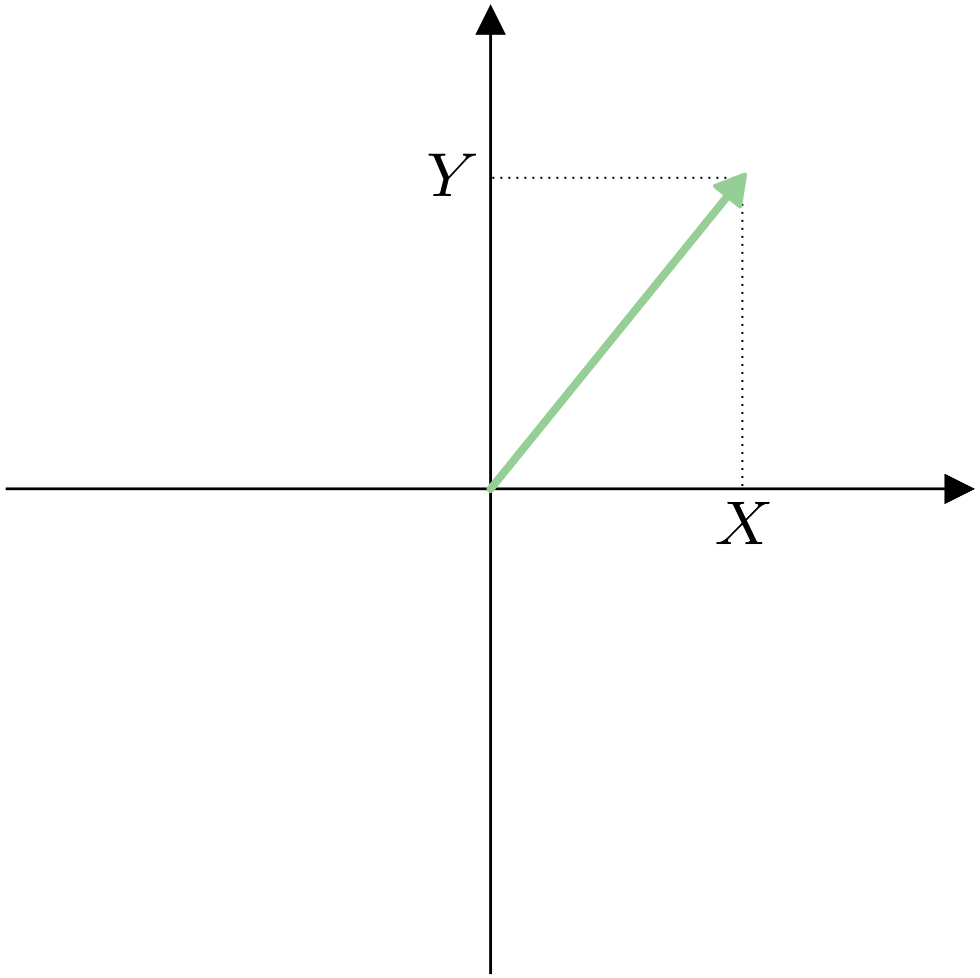

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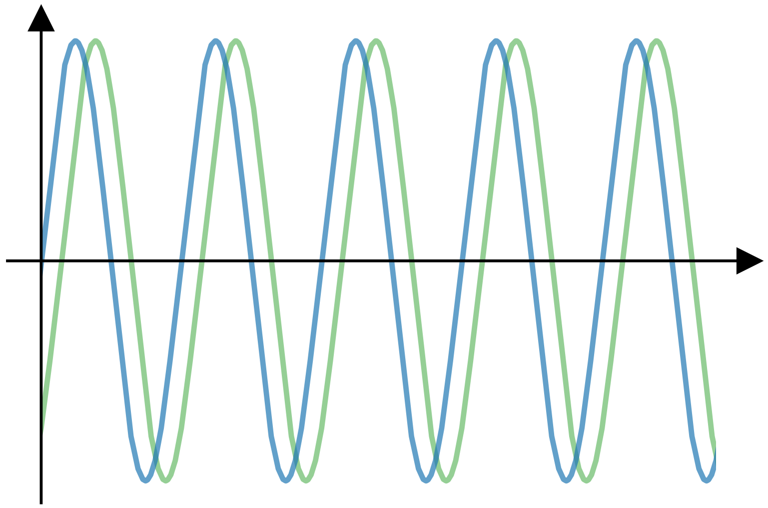

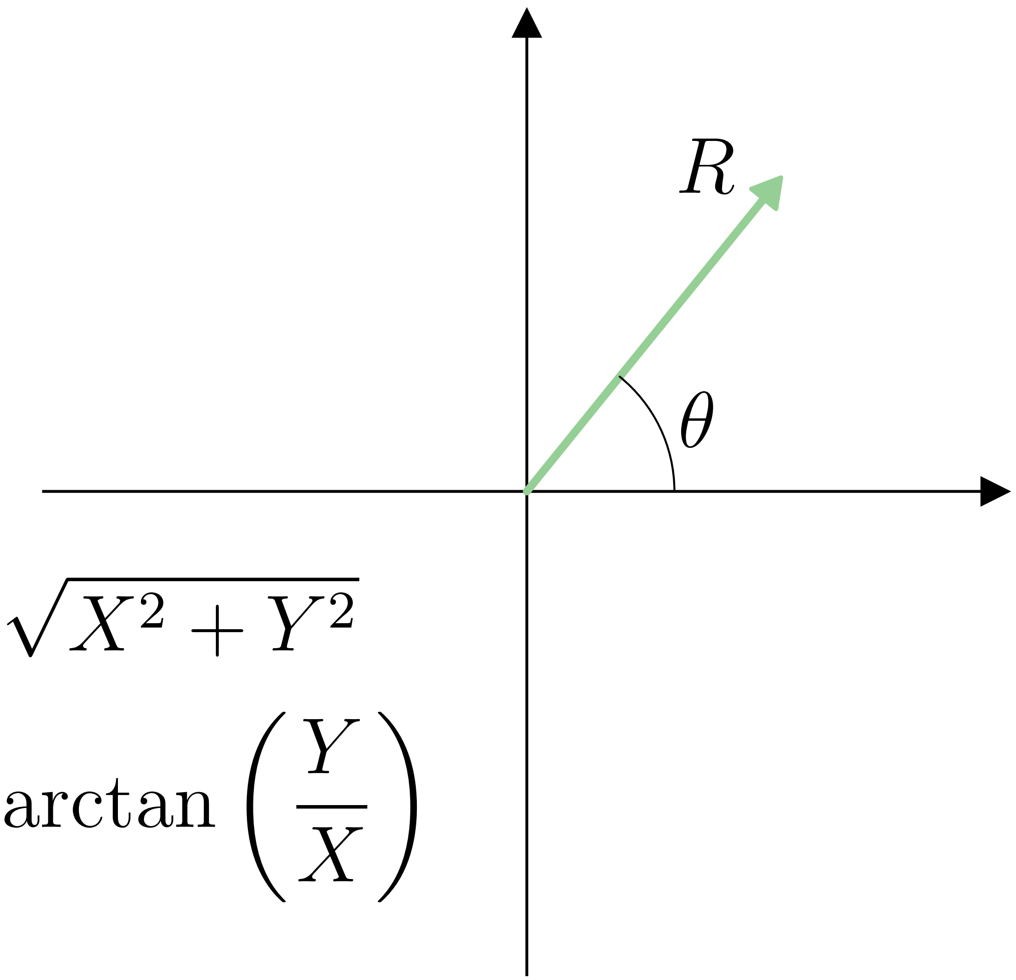

$$R = \sqrt{X^2 + Y^2}$$

$$\theta = \arctan\left(\frac{Y}{X}\right)$$

$$F(\omega) = \underbrace{\frac{1}{\tau}\int_{-\tau}^{\tau} S(t)\cos(\omega t)dt}_{X} + i\underbrace{\frac{1}{\tau}\int_{-\tau}^{\tau} S(t)\sin(\omega t)dt}_{Y}$$

SR830


STANFORD RESEARCH SYSTEMS
Model SR830 DSP Lock-In Amplifier
TIME CONSTANT
SENSITIVITY
SIGNAL INPUT
RESERVE
FILTERS
CHANNEL ONE
CHANNEL TWO
AUTO
SETUP
INTERFACE
REFERENCE
OFFSET
CH1 OUTPUT
CH2 OUTPUT
REF IN
SINE OUT
A/I
B

Otras opciones