1.2 Fourier Transform and Modulation

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11:27 AM

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$$x(t) = \int_{-\infty}^{\infty} X(f) e^{j2\pi f t}\, df \quad \underset{\mathcal{F}^{-1}}{\overset{\mathcal{F}}{\rightleftarrows}} \quad X(f) = \int_{-\infty}^{\infty} x(t) e^{-j2\pi f t}\, dt$$

time domain

$$e^{j2\pi f_0 t} \xrightarrow{\mathcal{F}} \delta(f - f_0)$$

$$\delta(t) \xrightarrow{\mathcal{F}} 1$$

$$1 \xrightarrow{\mathcal{F}} \delta(f)$$

$$\int_{-\infty}^{\infty} x(\tau) y(t-\tau)\, d\tau = x(t) * y(t) \xrightarrow{\mathcal{F}} X(f) Y(f)$$

$$x(t) y(t) \xrightarrow{\mathcal{F}} X(f) * Y(f) = \int_{-\infty}^{\infty} X(\mu) Y(f-\mu)\, d\mu$$

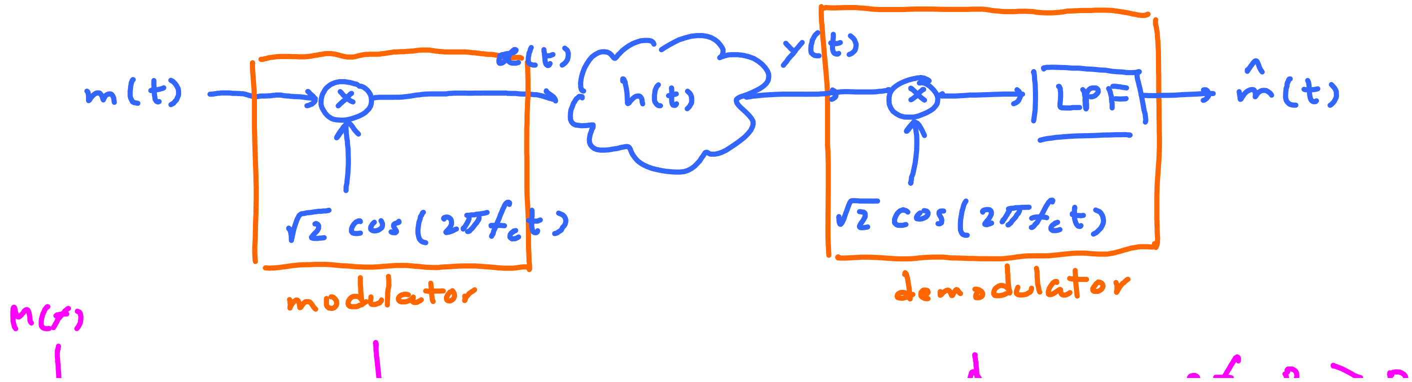
$$x(t) e^{j2\pi f_0 t} \longrightarrow X(f) * \delta(f - f_0) = X(f - f_0)$$

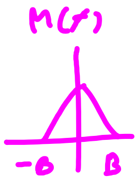
$$\underbrace{x(t) \cos(2\pi f_c t)}_{} \longrightarrow \frac{1}{2}\left(X(f - f_c) + X(f + f_c) \right)$$

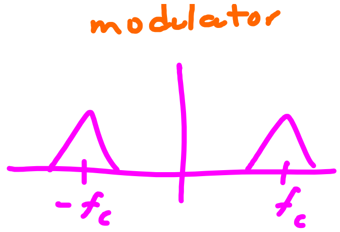
Euler's formula $e^{jx} = \cos(x) + j\sin(x)$

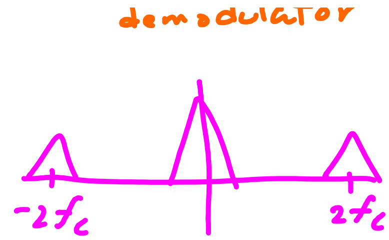
$$\frac{1}{2}\left(e^{j2\pi f_c t} + e^{-j2\pi f_c t} \right)$$

Modulation









$2f_c - B > B$

$f_c > B$

Assume $m(t)$ is bandlimited ($M(f) = 0$ for $|f| > B$.)

$f_c > B$ (usually, $f_c \gg B$)

LPF : $H_{LP}(f)$