Complex baseband representation

Bandpass signal (real-valued)

$$s(t) = \mathrm{Re}\left\{ s_l(t) e^{j 2\pi f_c t} \right\}$$

$s_l(t)$: complex-valued

$$s_l(t) = s_{lr}(t) + j s_{li}(t)$$

$$\Rightarrow s(t) = \mathrm{Re}\left\{ \left(s_{lr}(t) + j s_{li}(t) \right) \left(\cos(2\pi f_c t) + j \sin(2\pi f_c t) \right) \right\}$$

$$= s_{lr}(t) \cos(2\pi f_c t) - s_{li}(t) \sin(2\pi f_c t)$$