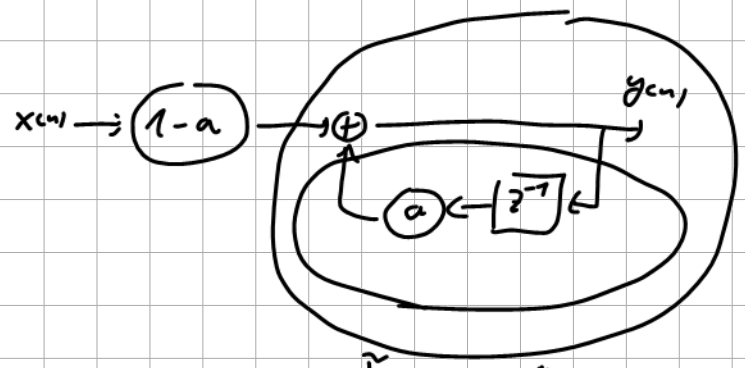
$$y[n] = a \cdot y[n-1] + (1-a) \cdot x[n]$$

n	x[n]	y[n]
-1	0	0
0	1	$(1-a) \cdot a^0$
1	0	$(1-a) \cdot a^1$
2	0	$(1-a) \cdot a^2$
3	0	$(1-a) \cdot a^3$
4	0	

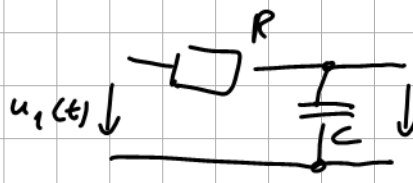


$$\tilde{h}[n] = a^n$$

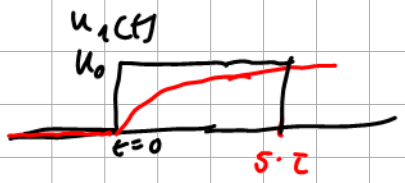
$$h[n] = (1-a) \cdot \tilde{h}[n]$$

Length until vanish

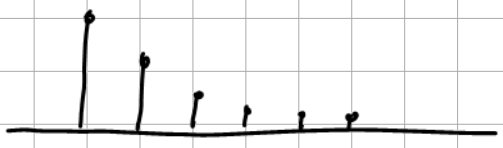
RC-LP



$$u_2(t) = U_0 \cdot (1 - e^{-t/\tau}) \qquad \tau = R \cdot C$$



$$h[n] = (1-a) \cdot a^n$$



$$h[n_0] = h[0] \cdot e^{-5}$$

$n_0 = ?$

$$(1-a) \cdot a^{n_0} = (1-a) \cdot a^0 \cdot e^{-5}$$

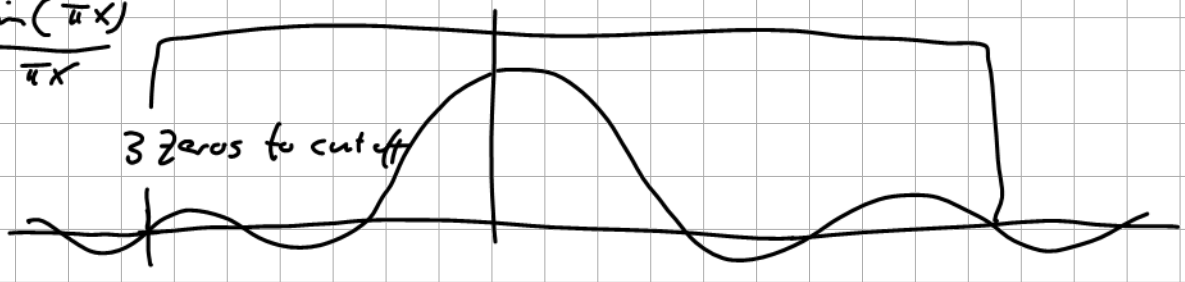
$$a^{n_0} = e^{-5}$$

$$\log_a a^{n_0} = \log_a \cdot e^{-5}$$

$$n_0 = -5 / \log_e (a)$$

$$n_0 = \frac{\ln e^{-5}}{\ln a}$$

$$\mathrm{sinc}(x) = \frac{\sin(\pi x)}{\pi x}$$



$$y(t) = x(t-T) = x(t) * \delta(t-T)$$

$$\varphi_{xy}(\tau) = x(-\tau) * y(\tau)$$

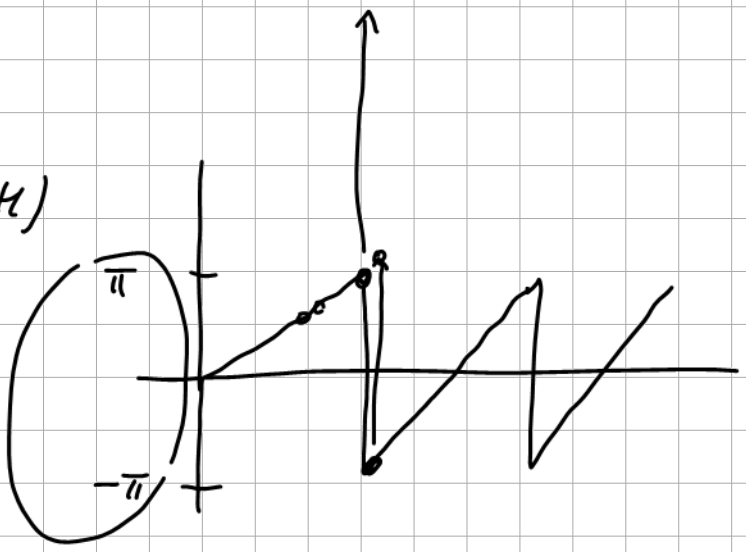
$$\varphi_{xx}(\tau) = x(-\tau) * x(\tau) \quad \leftarrow \text{has only one maximum at } \tau = 0$$

$$\varphi_{xy}(\tau) = x(-\tau) * x(\tau) * \delta(\tau - T)$$

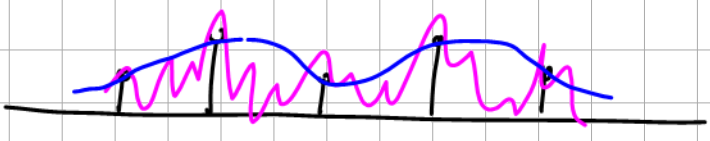
$$= \varphi_{xx}(\tau) * \delta(\tau - T)$$

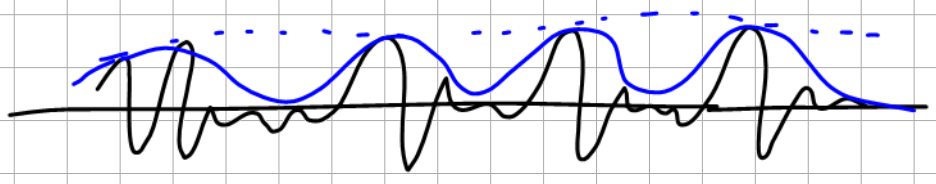
Unwrapping

np. angle (H)

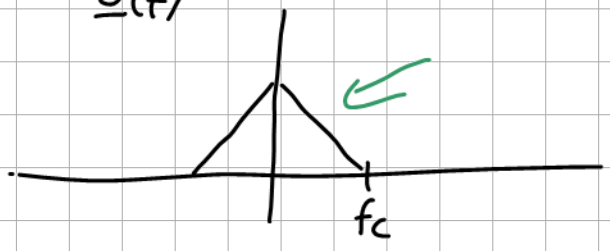


Envelope – smooth



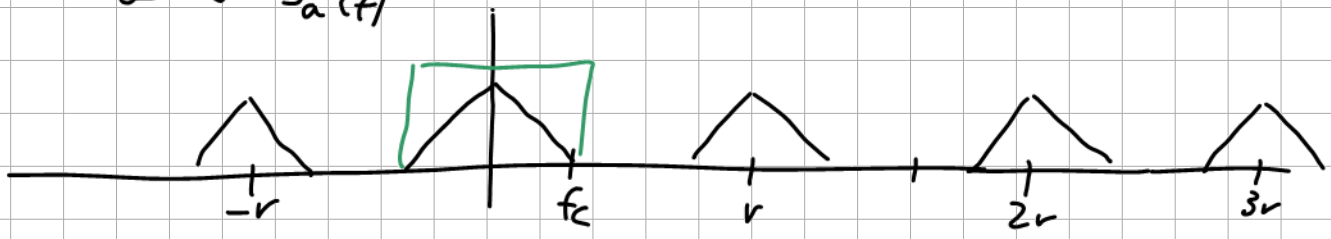


$s(t) \circ\!\!-\!\!\bullet S(f)$



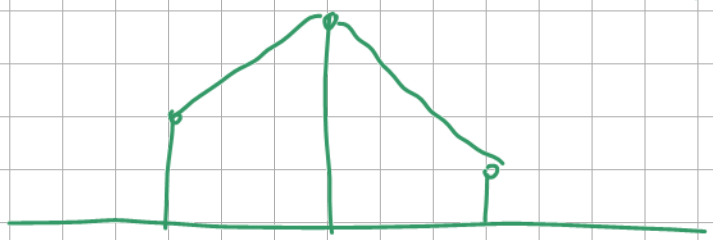
$r \geq f_c \cdot 2$

$s(n) \circ\!\!-\!\!\bullet S_a(f)$



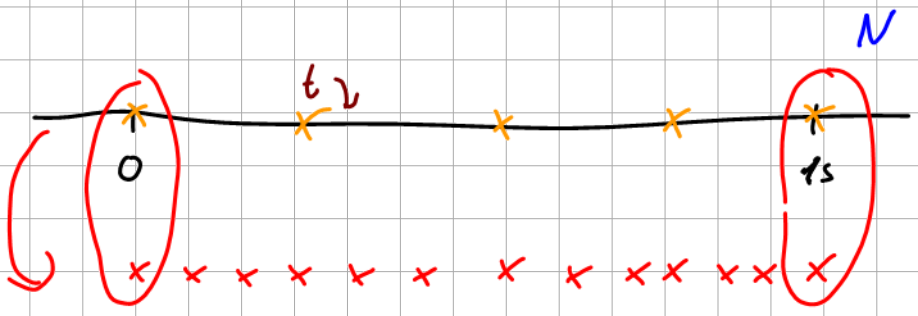
Interpolation

Linear Interpolation



Upsampled Time Axis

USFactor = 3



$(N-1) \cdot USF + 1$

r = 4 Hz

r = 12 Hz
USF = 3

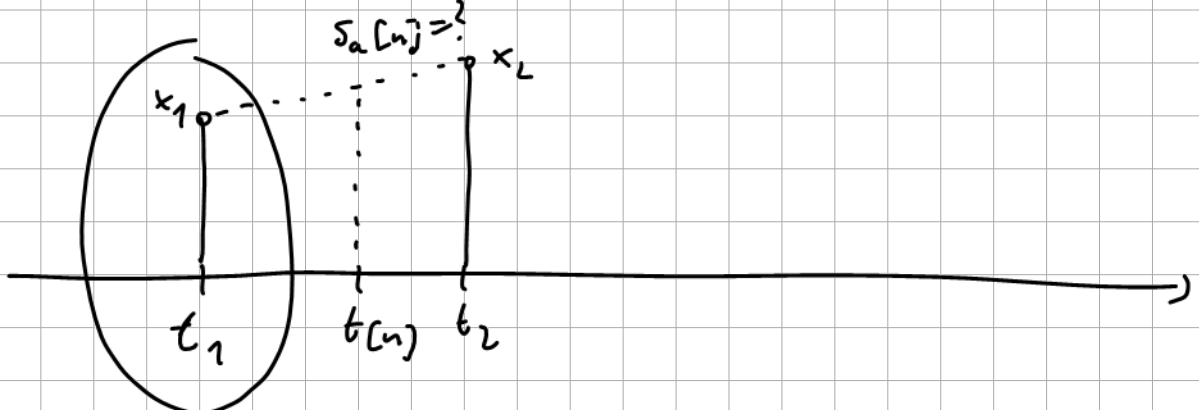
t shape[0] = 10 USF = 5

$\tilde{t}$ shape[0] ≃ 50

n = np.arange (10) = [0 1 2 3 4 ... 9]

r = 1000 Hz

np.arange [...] / r



$f = m \cdot t + \sigma$ $\quad m = \frac{x_2 - x_1}{t_2 \cdot t_1}$

$$x_1 = m \cdot t_1 + \sigma \qquad \Rightarrow \qquad \sigma = x_1 - m \cdot t_1$$

$$f = m \cdot t + x_1 - m \cdot t_1$$

$$s_a(n) = m \cdot t[n] + x_1 - m \cdot t_1$$

$$= \frac{x_2 - x_1}{t_2 - t_1} t[n] + x_1 - \frac{x_2 - x_1}{t_2 - t_1} \cdot t_1$$

$$= \frac{x_2 - x_1}{t_2 - t_1} \left(t[n] - t_1 \right) + x_1$$