

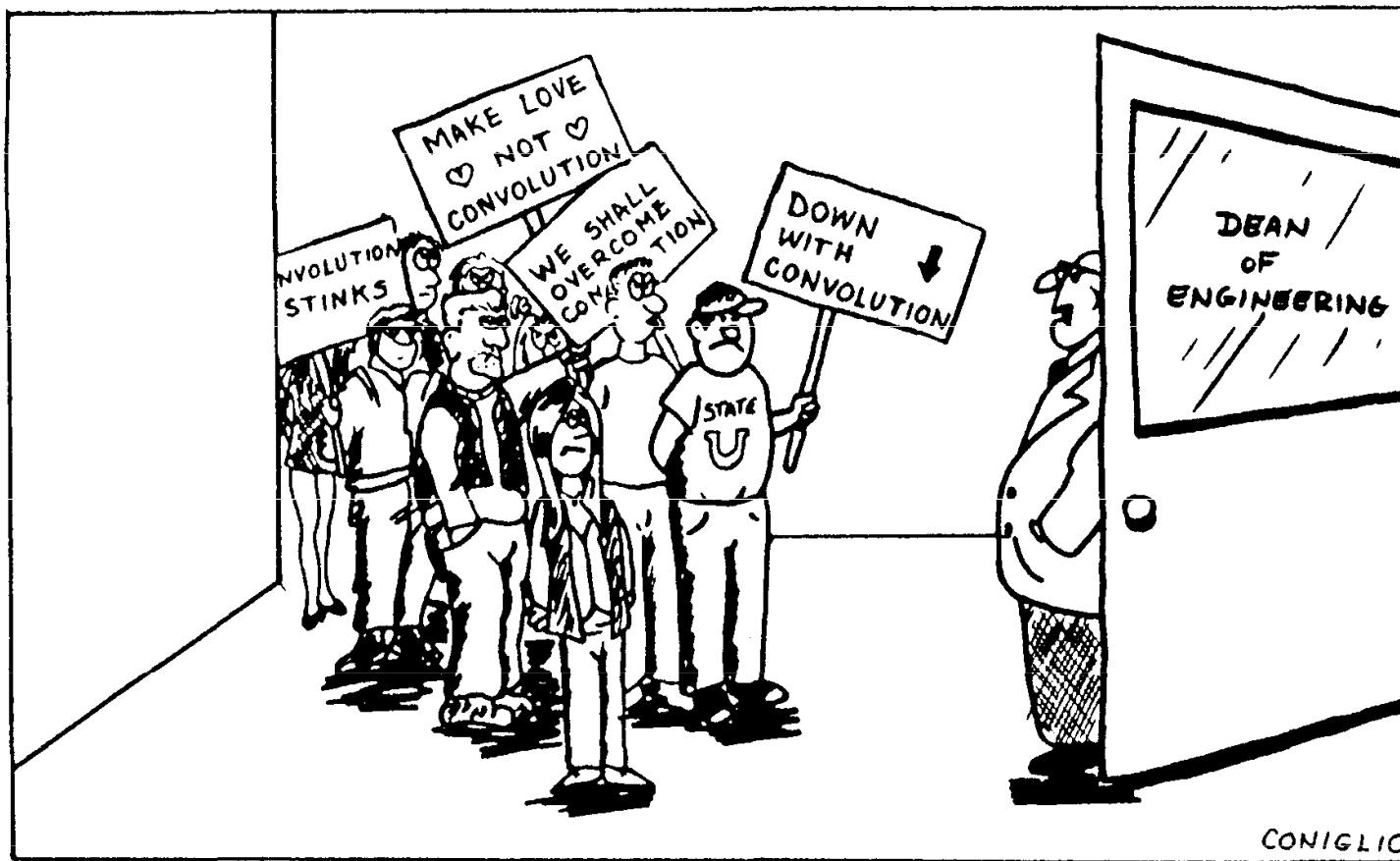


ZPRACOVÁNÍ A ANALÝZA BIOSIGNÁLŮ



KONVOLUCE

KONVOLUCE



Convolution: its bark is worse than its bite!

KONVOLUCE

☑ spojité signály

$$s_1(t) * s_2(t) = \int_{-\infty}^t s_1(x) \cdot s_2(t-x) \cdot dx \approx S_1(\omega) \cdot S_2(\omega)$$

☑ diskrétní signály

$$s_1(n) * s_2(n) = \sum_{i=0}^n s_1(i) \cdot s_2(n-i) \approx S_1(z) \cdot S_2(z)$$

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$$\begin{aligned} s_1(t) * s_2(t) &= \int_{-\infty}^{\infty} s_1(\tau) \cdot s_2(t - \tau) \cdot d\tau = \\ &= \int_{-\infty}^{\infty} s_1(t - \tau) \cdot s_2(\tau) \cdot d\tau \quad \approx S_1(\omega) \cdot S_2(\omega) \end{aligned}$$

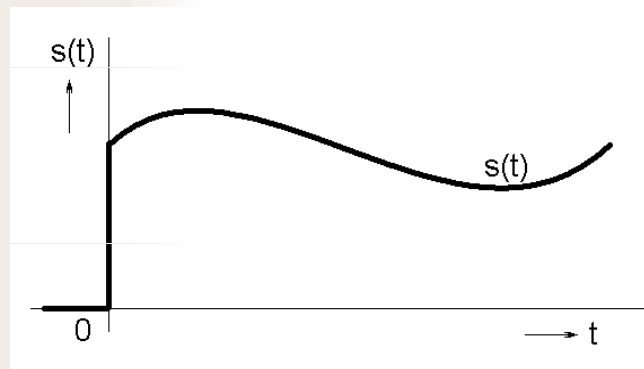
Důkaz:

$$\begin{aligned} s_1(t) * s_2(t) &= \int_{-\infty}^{\infty} s_1(\tau) \cdot s_2(t - \tau) \cdot d\tau = \left. \begin{array}{l} x = t - \tau \\ \tau = t - x \\ d\tau = -dx \end{array} \right| = \\ &= - \int_{\infty}^{-\infty} s_2(x) \cdot s_1(t - x) \cdot dx = s_2(t) * s_1(t) \end{aligned}$$

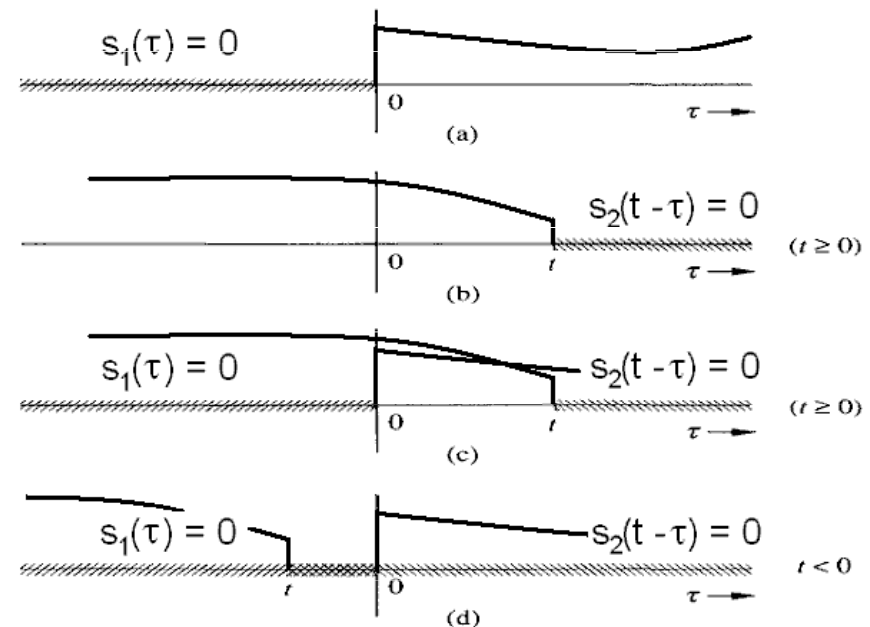
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Konvoluce kauzálních signálů:

- pro kauzální signály platí $s(t) = 0$ pro $t < 0$



$$s_1(t) * s_2(t) = \int_0^t s_1(\tau) \cdot s_2(t - \tau) \cdot d\tau$$



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Distributivní zákon:

$$f_1(t) * [f_2(t) * f_3(t)] = [f_1(t) * f_2(t)] * f_3(t)$$

Asociativní zákon:

$$f_1(t) * [f_2(t) + f_3(t)] = f_1(t) * f_2(t) + f_1(t) * f_3(t)$$

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Zákon o posunu v čase:

Je – li

$$f_1(t) * f_2(t) = c(t),$$

pak

$$f_1(t) * f_2(t - T) = c(t - T),$$

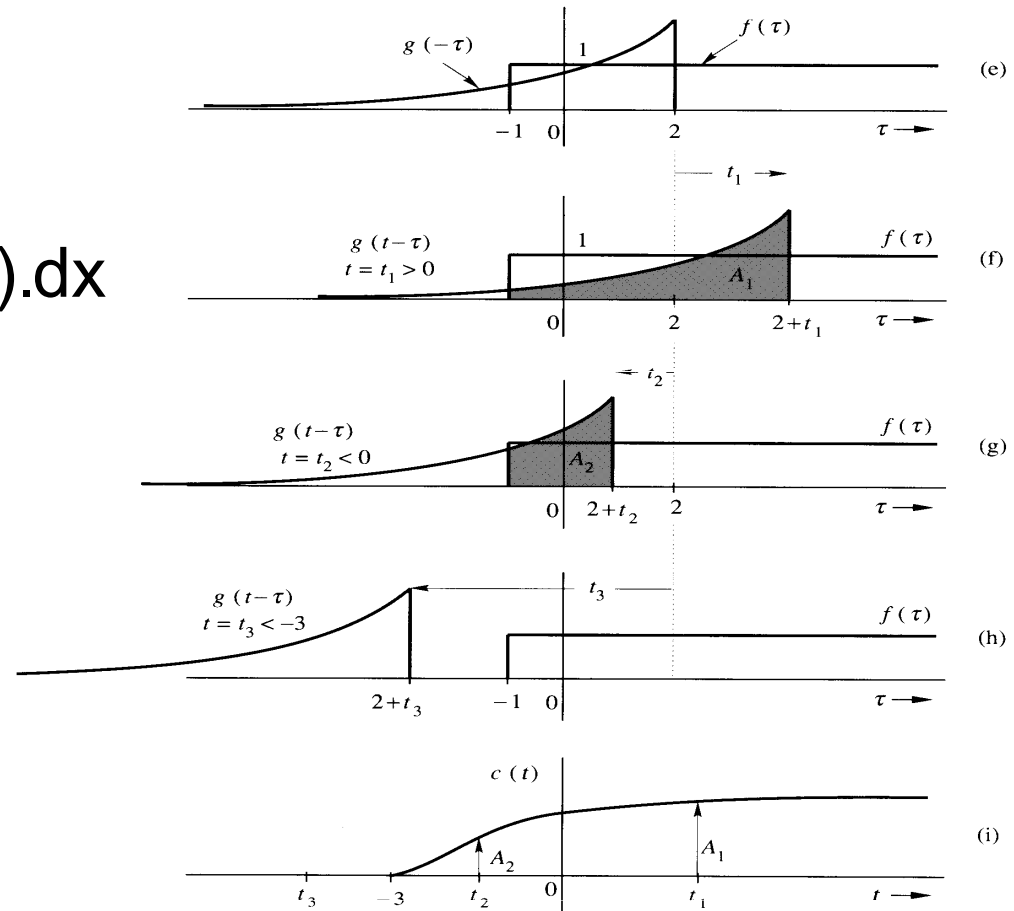
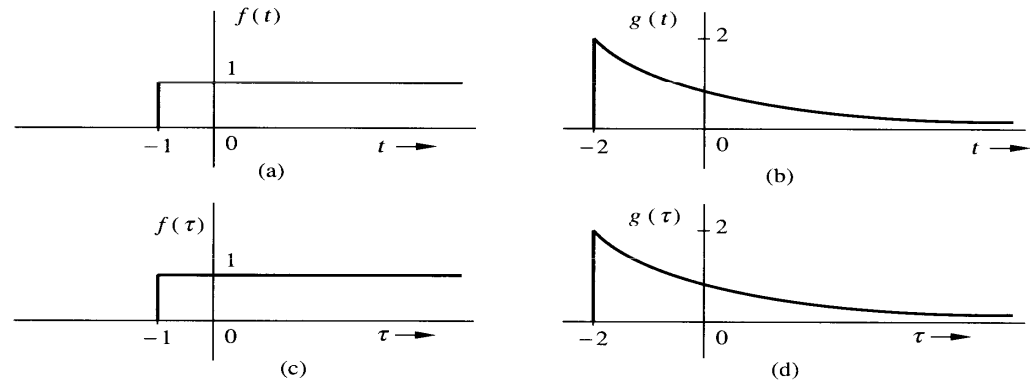
$$f_1(t - T) * f_2(t) = c(t - T)$$

a

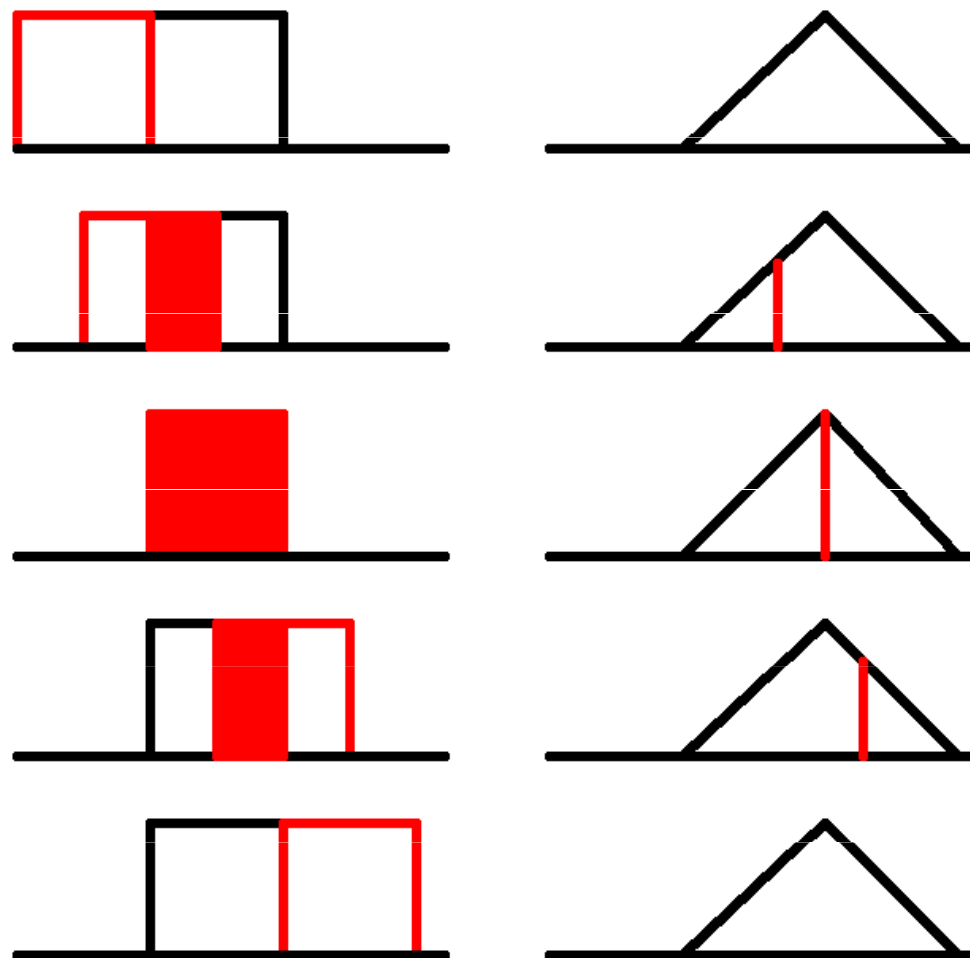
$$f_1(t - T_1) * f_2(t - T_2) = c(t - T_1 - T_2)$$

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$$s_1(t) * s_2(t) = \int_{-\infty}^t s_1(x) \cdot s_2(t-x) \cdot dx$$



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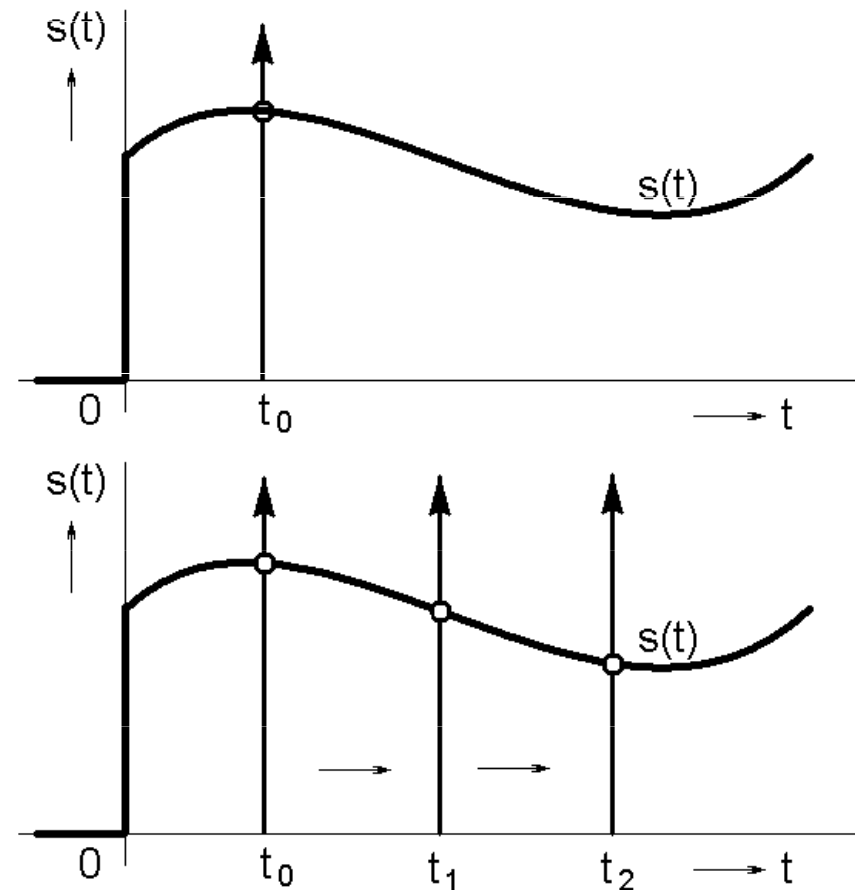
signálu s jednotkovým
impulsem

definice:

$$\int_{-\infty}^{\infty} s(t) \cdot \delta(t - t_0) dt = s(t_0)$$

konvoluce:

$$s(t) * \delta(t) = \int_{-\infty}^{\infty} s(t) \cdot \delta(t - \tau) d\tau = s(t)$$



DISKRÉTNÍ KONVOLUCE

