TECHNICKÁ UNIVERZITA V LIBERCI
Fakulta přírodovědně-humanitní
a pedagogická

Skládání kmitů

FYZ1 – Přednáška 13
HRW – kapitoly

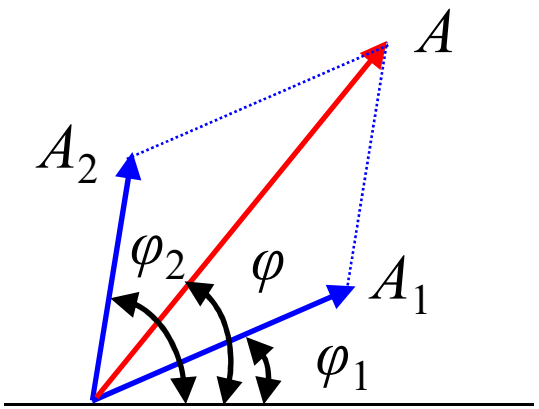
Skládání kmitů stejné frekvence

- Výpočtem

$$A^2 = A_1^2 + A_2^2 + 2A_1A_2\cos(\varphi_2 - \varphi_1)$$

$$\tan\varphi = \frac{A_1\sin\varphi_1 + A_2\sin\varphi_2}{A_1\cos\varphi_1 + A_2\cos\varphi_2}$$

- Graficky pomocí fázorů

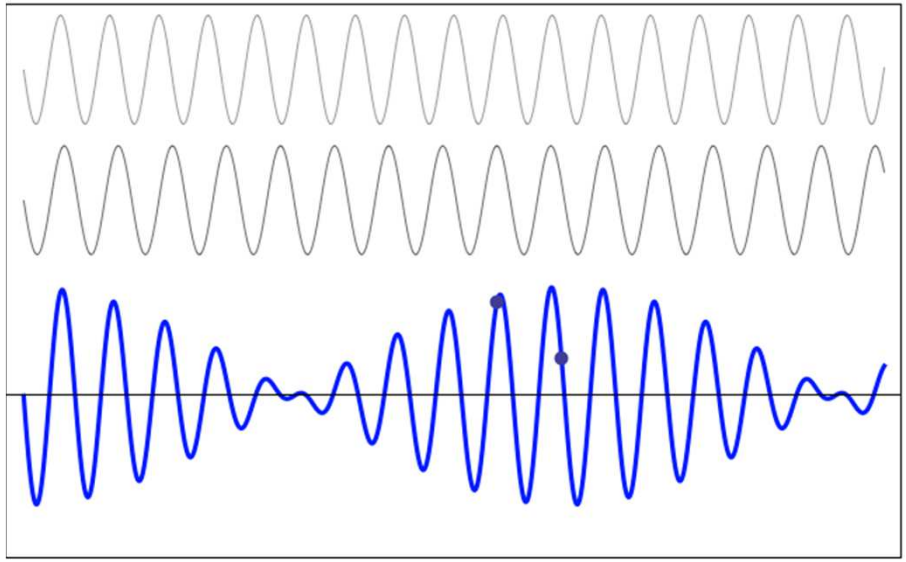


Rázy

Kmity stejné amplitudy (pro jednoduchost)

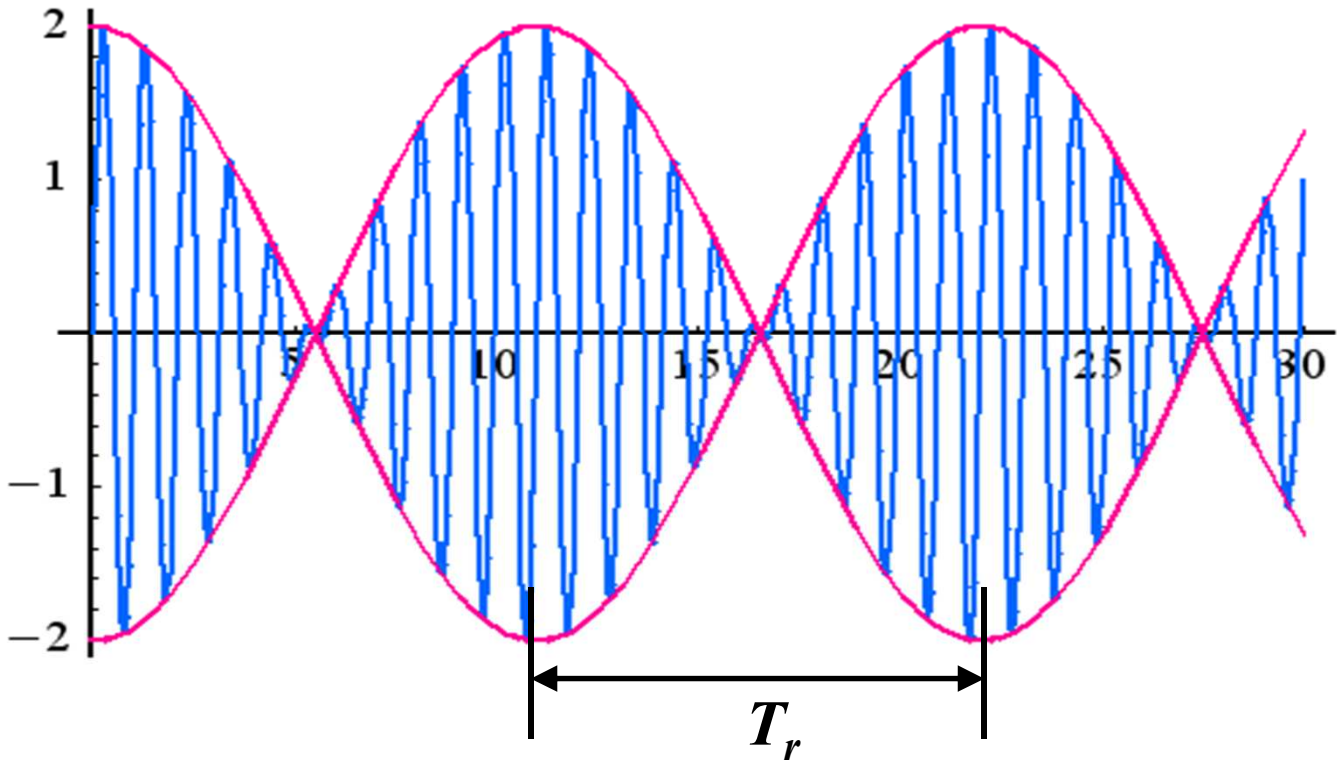
$$y_1 = A\sin(\omega_1 t + \varphi_1)\,, y_2 = A\sin(\omega_2 t + \varphi_2)$$

$$y = 2A\cos\left[\frac{1}{2}(\omega_1 - \omega_2)t + \frac{1}{2}(\varphi_1 - \varphi_2)\right]\sin\left[\frac{1}{2}(\omega_1 + \omega_2)t + \frac{1}{2}(\varphi_1 + \varphi_2)\right]$$



Rázy

Perioda rázů $f_r = |f_1 - f_2|, T_r = 1/f_r$



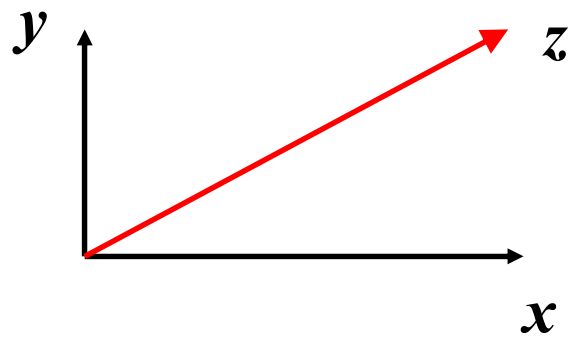
Lissajoussovy obrazce

Skládání kmitů různého směru

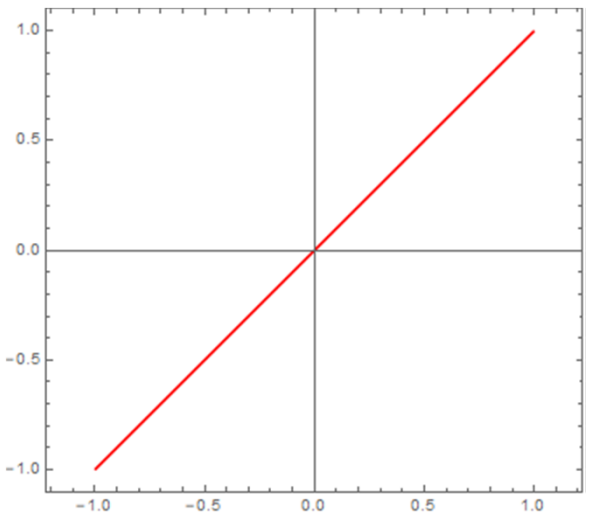
$$x = A_1 \sin(\omega_1 t + \varphi_1), y = A_2 \sin(\omega_2 t + \varphi_2)$$

$$\vec{z} = (x \quad y)$$

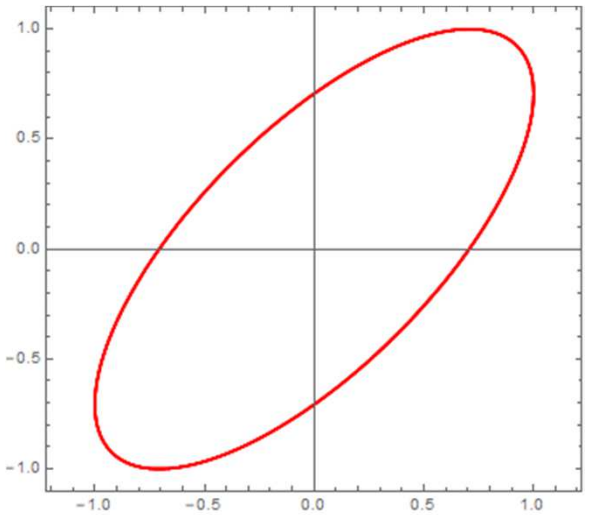
Jules Antoine Lissajous
(*1822 - †1880)



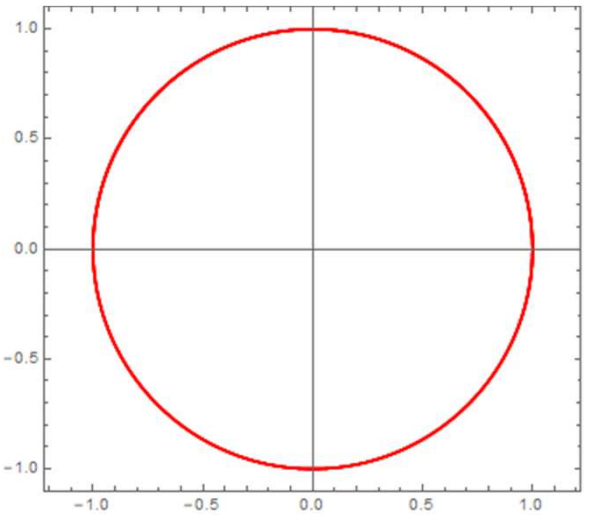
Lissajoussovy obrazce



$f_1:f_2=1:1$
$\varphi_1=0^o$, $\varphi_2=0^o$

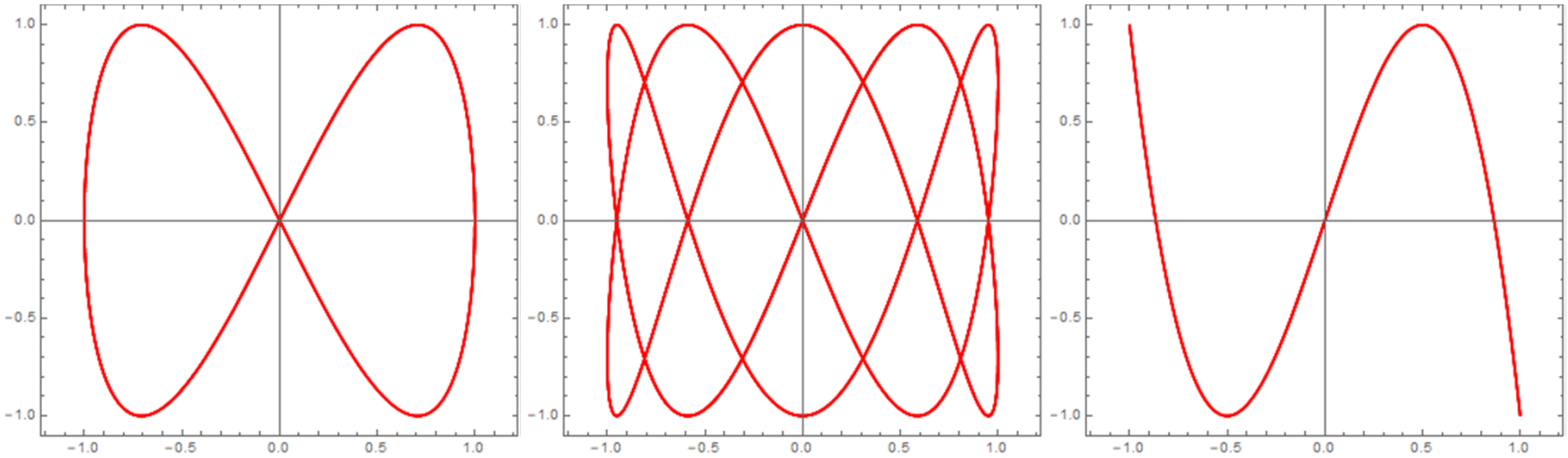


$f_1:f_2=1:1$
$\varphi_1=0^o$, $\varphi_2=45^o$



$f_1:f_2=1:1$
$\varphi_1=0^o$, $\varphi_2=90^o$

Lissajoussovy obrazce



$f_1:f_2=1:2$
$\varphi_1=0^o$, $\varphi_2=0^o$

$f_1:f_2=2:5$
$\varphi_1=0^o$, $\varphi_2=0^o$

$f_1:f_2=1:3$
$\varphi_1=0^o$, $\varphi_2=0^o$