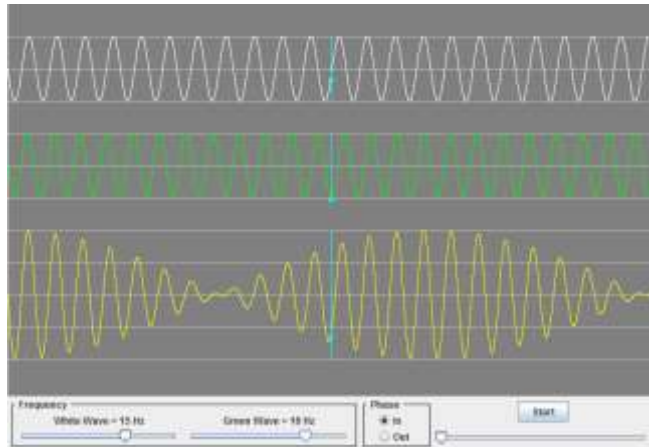# Trillingen met frequenties die weinig van elkaar verschillen

$$y_1 = A_1 \sin(\omega_1 t)$$

$$y_2 = A_2 \sin(\omega_2 t)$$

Berekeningen

$$y_1 = A_1 \sin(\omega_1 t) \quad \omega_1 = \omega + \Delta\omega$$

$$y_2 = A_2 \sin(\omega_2 t) \quad \omega_2 = \omega - \Delta\omega$$
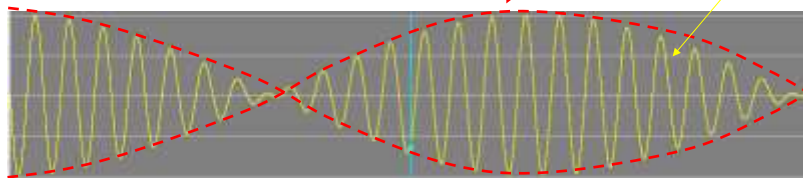
$$y = y_1 + y_2 = A\sin\omega_1 t + A\sin\omega_2 t$$

$$= 2A\sin\frac{\omega_1 + \omega_2}{2}t \cdot \cos\frac{\omega_1 - \omega_2}{2}t$$

$$\omega_1 + \omega_2 = 2\omega$$
$$\omega_1 - \omega_2 = 2\Delta\omega$$

$$y = 2A\sin\omega t \cos\Delta\omega t$$

$$y = 2A\cos\Delta\omega t \sin\omega t$$

$$y = 2A\cos\Delta\omega t \sin\omega t$$

Amplitude maximaal: $\quad |\cos\Delta\omega t| = 1 \qquad \Delta\omega t = n.\pi$

$$\frac{\omega_1 - \omega_2}{2}t = n.\pi \qquad \pi(f_1 - f_2)t = n.\pi$$

Tijdstip van maximale amplitude: $\quad t = \dfrac{n}{(f_1 - f_2)}$

Tijd tussen 2 maxima: $\quad \Delta t = \dfrac{n+1}{(f_1 - f_2)} - \dfrac{n}{(f_1 - f_2)} = \dfrac{1}{(f_1 - f_2)}$

Aantal zwevingen per tijdseenheid $\quad \dfrac{1}{\Delta t} = f_1 - f_2$

De frequentie: $\quad f = \dfrac{f_1 + f_2}{2}$

Voorbeeld

De bewegingsvergelijking van de resulterende trilling:

$\quad$ y = y1 + y2 = 5,0 sin 200t + 5,0 sin 190t

$\quad$ y = 5,0.2 sin ((200t + 190t)/2) cos ((200t – 190t)/2)

$\quad$ y = 10 cos 5t sin 195t

Maximale amplitude: Amax = 2A = 2. 5,0 m = 10 m

Tijdstip van maximale amplitude: $\quad f_1 = \dfrac{\omega_1}{2\pi} = \dfrac{200}{2\pi} = 31{,}8 Hz$

$$t = \frac{n}{f_1 - f_2} = \frac{n}{31{,}8 - 30{,}2} = \frac{n}{1{,}6} \qquad f_2 = \frac{\omega_2}{2\pi} = \frac{190}{2\pi} = 30{,}2 Hz$$

$$t = 0{,}625s; 1{,}25s; 1{,}88s...$$

Tijdstip tussen 2 maxima: 0,625s

Aantal zwevingen per tijdseenheid:

$$f_1 - f_2 = 31,8 - 30,2 = 1,6 \; zwevingen$$

Frequentie van de trilling:

$$f = \frac{f_1 + f_2}{2}$$

$$f = \frac{31,8 + 30,2}{2} = 31 Hz$$