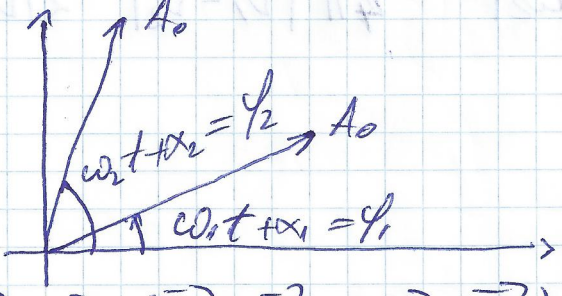
5. Prezentați fenomenul de "bătăi" obținut la compunerea oscilațiilor. Câte oscilații cu frecvența semnalului purtător se obțin în intervalul de timp corespunzător unei bătăi?

$$\begin{cases} x_1 = A_0 \cos(\omega_1 t + \alpha_1) \\ x_2 = A_0 \cos(\omega_2 t + \alpha_2) \end{cases}$$

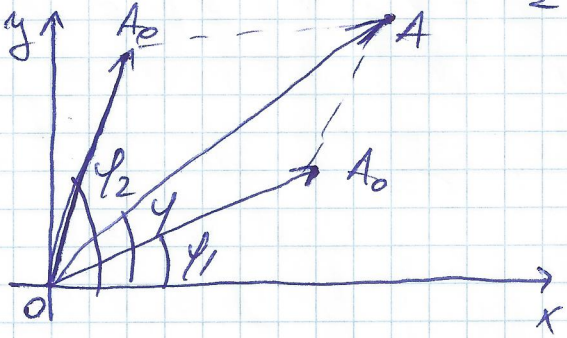


$$|\vec{A_1}| = |\vec{A_2}| = A_0$$

$$\vec{A} \cdot \vec{A} = (\vec{A_1} + \vec{A_2})(\vec{A_1} + \vec{A_2}) \Rightarrow A^2 = A_1^2 + A_2^2 + 2A_1A_2\cos(\varphi_1 - \varphi_2)$$

$$\Rightarrow A^2 = 2A_0^2(1 + \cos(\varphi_1 - \varphi_2)) = 4A_0^2\cos^2\frac{\varphi_1 - \varphi_2}{2} \Rightarrow$$

$$\Rightarrow A = 2A_0\left|\cos\frac{\varphi_1 - \varphi_2}{2}\right| \Rightarrow A = 2A_0\left|\cos\frac{(\omega_1 - \omega_2)t + \alpha_1 - \alpha_2}{2}\right|$$



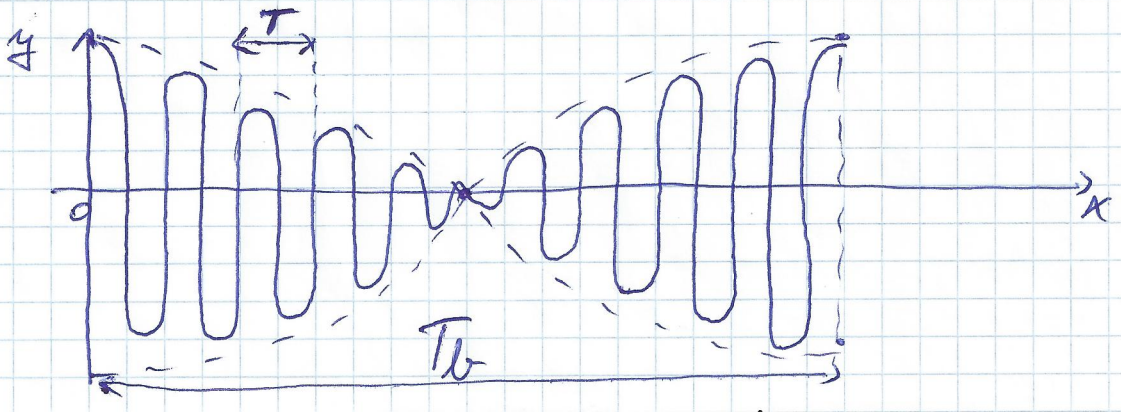
$$\varphi_1 = \omega_1 t + \alpha_1$$

$$\varphi_2 = \omega_2 t + \alpha_2$$

$$\varphi = \frac{\varphi_1 + \varphi_2}{2}$$

$$X = A\cos\left(\frac{\omega_1 + \omega_2}{2}t + \frac{\alpha_1 + \alpha_2}{2}\right) \qquad X = x_1 + x_2 \Rightarrow$$

$$\Rightarrow A\cos\left(\frac{\omega_1 + \omega_2}{2}t + \frac{\alpha_1 + \alpha_2}{2}\right) = 2A_0\cos\left(\frac{\omega_1 - \omega_2}{2}t + \frac{\alpha_1 - \alpha_2}{2}\right)\cos\left(\frac{\omega_1 + \omega_2}{2}t + \frac{\alpha_1 + \alpha_2}{2}\right) = X$$



$$\omega = \frac{2\pi}{T} = 2\pi\nu \qquad \omega_n = \frac{\omega_1 + \omega_2}{2} \Rightarrow T = \frac{2\pi}{\omega_n} = \frac{4\pi}{\omega_1 + \omega_2}$$

$$\omega_m = \frac{|\omega_1 - \omega_2|}{2}$$

$$T_б = \frac{2\pi}{2\omega_m} = \frac{2\pi}{|\omega_1 - \omega_2|}$$

$$N = \frac{T_б}{T} = \frac{\omega_1 + \omega_2}{2|\omega_1 - \omega_2|} = \frac{2\pi(\nu_1 + \nu_2)}{4\pi|\nu_1 - \nu_2|} = \frac{\nu_1 + \nu_2}{2|\nu_1 - \nu_2|}$$