Überlagerung von Schwingungen gleicher Frequenz und gleicher Raumrichtung

$$x_1(t) = \hat{x}_1 \cos(\omega t + \varphi_{01})$$
$$x_2(t) = \hat{x}_2 \cos(\omega t + \varphi_{02})$$

komplexe Schreibweise: $x_1(t) = \hat{x}_1 \exp\{i(\omega t + \varphi_{01})\}$

$x_2(t) = \hat{x}_2 \exp\{i(\omega t + \varphi_{02})\}$

$$x_{neu} = x_1 + x_2 = \hat{x}_1 \exp\{i(\omega t + \varphi_{01})\} + \hat{x}_2 \exp\{i(\omega t + \varphi_{02})\}$$

$$\boxed{x_{neu} = \hat{x}_{neu} \exp\{i(\omega t + \varphi_{neu})\}}$$

$$\hat{x}_{neu}^2 = x_{neu} \cdot x_{neu}{}^* = (\hat{x}_1 \exp\{i(\omega t + \varphi_{01})\} + \hat{x}_2 \exp\{i(\omega t + \varphi_{02})\})(\hat{x}_1 \exp\{-i(\omega t + \varphi_{01})\} + \hat{x}_2 \exp\{-i(\omega t + \varphi$$

$$\hat{x}_{neu}^2 = (\hat{x}_1{}^2 + \hat{x}_2{}^2 + \hat{x}_1 \hat{x}_2 (\exp\{i(\varphi_{01} - \varphi_{02})\} + \exp\{-i(\varphi_{01-}\varphi_{02})\})$$

Amplitude: $\boxed{\hat{x}_{neu} = \sqrt{(\hat{x}_1{}^2 + \hat{x}_2{}^2 + 2\hat{x}_1 \hat{x}_2 \cos(\varphi_{01} - \varphi_{02})}}$

Phase: $\tan\varphi = \dfrac{Im(z)}{Re(z)}$

$$\boxed{\tan\varphi_{neu} = \frac{(\hat{x}_1 \sin\varphi_{01} + \hat{x}_2 \sin\varphi_{02})}{(\hat{x}_1 \cos\varphi_{01} + \hat{x}_2 \cos\varphi_{02})}}$$