Beat Frequency: Add 2 waves close in frequency

S_1:  ω_1

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S_2:  ω_2 ⟶ time

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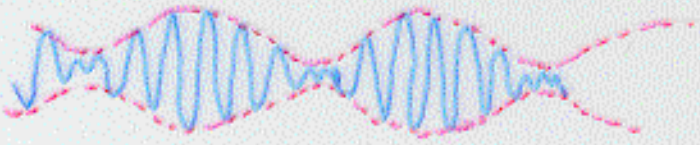

2nd wave gradually falls in and out of phase with first

⇒ periodic "beats" of constructive / destructive interference

Resulting $S_1 + S_2 = S_m \cos \omega_1 t + S_m \cos \omega_2 t$

$= 2 S_m \cos \underbrace{\tfrac{1}{2}(\omega_1 - \omega_2)t}_{\omega_{beat}} \cos \underbrace{\tfrac{1}{2}(\omega_1 + \omega_2)t}_{\omega_{av}}$

Resulting oscillation is at average ang. frequency but with amplitude modulated at ω_{beat}.

Sound intensity $\propto (\text{amplitude})^2$ is max. when $\cos(\omega_{beat} t) = \pm 1$

⇒ # of beats / s $f_{beat} = f_1 - f_2$

- can be used to tune instruments
- can hear beats from twin-engine aircraft when engines' rpm is close, but not identical.