

## 1-2 Instantaneous Freq

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2:08 PM

### Instantaneous frequency

$$x(t) = A \cos(\theta(t))$$

↳ generalized angle

Q: what is the freq. of  $x(t)$  around  $t = t_0$ ?

Observation: If  $\theta(t) = 2\pi f_0 t + \theta$

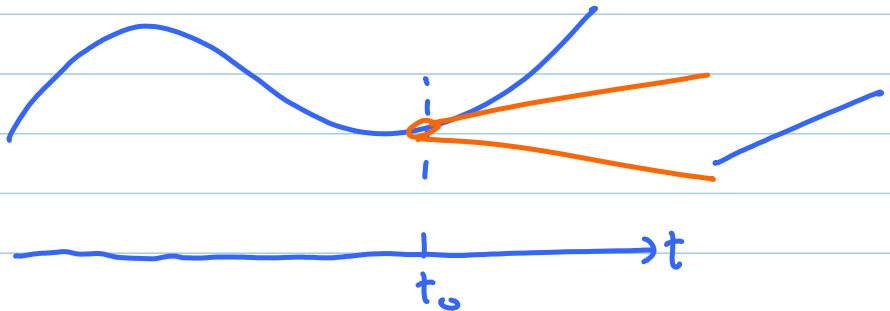
$$x(t) = A \cos(2\pi f_0 t + \theta)$$

then

$$f(t) = f_0 \quad \forall t$$

Now, let's consider general  $\theta(t)$ .

Plot  $\theta(t)$



When we only focus on small interval around  $t_0$ ,

$$\theta(t) \approx mt + c = \theta'(t_0)t + c$$

↑  
 $\theta'(t_0)$

Near  $t = t_0$

$$\cos(\theta(t)) \approx \cos(\theta'(t_0)t + c)$$

$$\cos(\theta(t)) \approx \cos\left(\underbrace{\theta'(t_0)}_{2\pi f_0} t + c\right)$$

$$\rightarrow f_0 = \frac{1}{2\pi} \theta'(t_0)$$