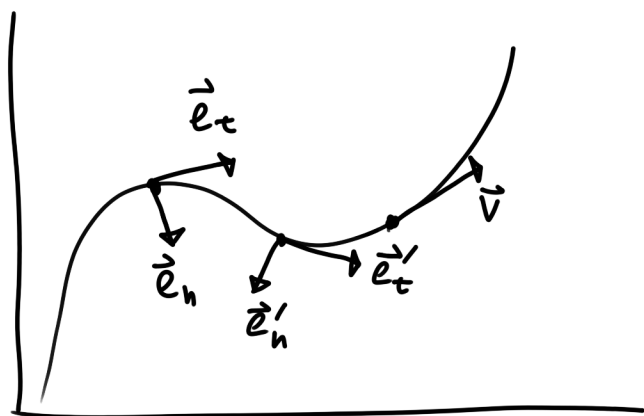# Tangential and Normal Components
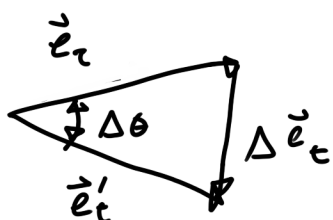

$\vec{e}_t$ tangential

$\vec{e}_n$ normal

$\vec{e}_t$, $\vec{e}_n$ unit vectors

$$\Delta \vec{e}_t = \vec{e}_t' - \vec{e}_t$$

$$|\Delta \vec{e}_t| = 2 \sin\left(\Delta\theta / 2\right)$$

$$\lim_{\Delta\theta \to 0} \frac{|\Delta \vec{e}_t|}{\Delta\theta} = \lim_{\Delta\theta \to 0} \frac{2\sin\left(\Delta\theta/2\right)}{\Delta\theta} = 1$$

$$\vec{e}_n = \frac{d\vec{e}_t}{d\theta}$$

$$\vec{V} = V \vec{e}_t$$

$$\vec{a} = \frac{d\vec{V}}{dt} = \frac{d}{dt} V \vec{e}_t = \frac{dV}{dt} \vec{e}_t + V \frac{d\vec{e}_t}{dt}$$

$$\frac{d\vec{e}_t}{dt} = \frac{d\vec{e}_t}{d\theta} \frac{d\theta}{ds} \frac{ds}{dt}$$

$$= \vec{e}_n \frac{1}{r} V$$

$$\vec{a} = \frac{dv}{dt} \vec{e}_t + \frac{V^2}{r} \vec{e}_n$$