Catenary Problem
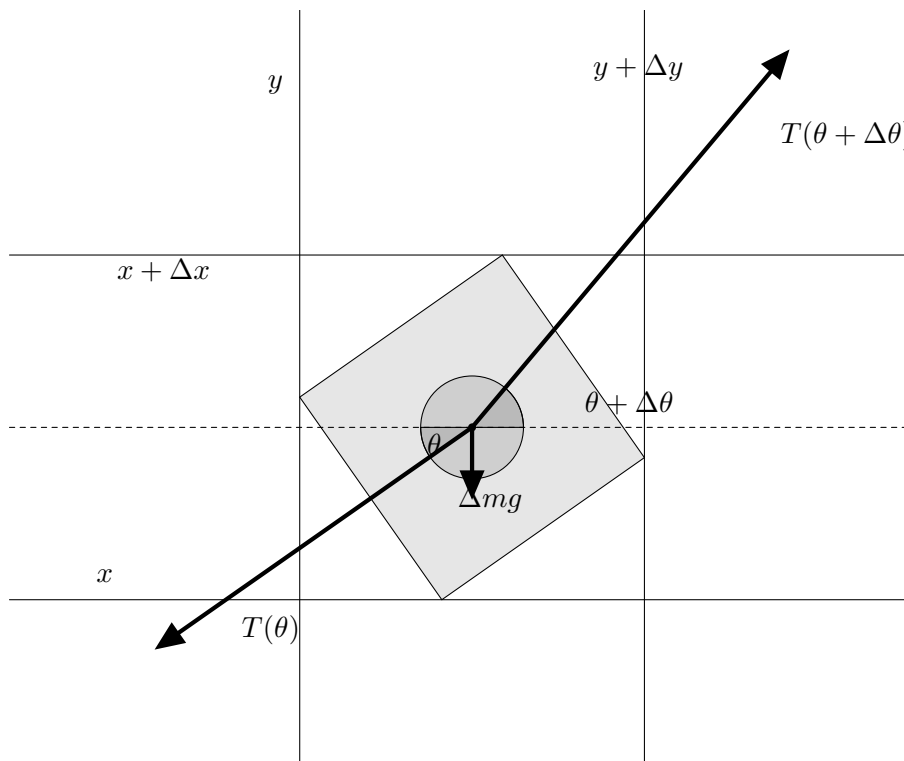

$$\hat{T}: \qquad T(\theta)\cos\theta = T(\theta + \Delta\theta)\cos(\theta + \Delta\theta)$$

$$T(\theta) = \frac{T(\theta + \Delta\theta)\cos(\theta + \Delta\theta)}{\cos\theta}$$

$$T(\theta) - T(\theta + \Delta\theta) = \frac{T(\theta + \Delta\theta)\cos(\theta + \Delta\theta)}{\cos\theta} - T(\theta + \Delta\theta)$$

$$= \frac{T(\theta + \Delta\theta)}{\cos\theta}(\cos(\theta + \Delta\theta) - \cos\theta)$$

$$\lim_{\Delta\theta \to 0} \frac{T(\theta) - T(\theta + \Delta\theta)}{\Delta\theta} = \lim_{\Delta\theta \to 0} \frac{T(\theta + \Delta\theta)}{\cos\theta} \cdot \frac{\cos(\theta + \Delta\theta) - \cos\theta}{\Delta\theta}$$

$$-\frac{d}{d\theta}T(\theta) = \frac{T(\theta)}{\cos\theta}\frac{d}{d\theta}\cos\theta$$

$$\frac{dT}{d\theta} = T(\theta)\tan\theta$$

$$\ln\left(T(\theta)\right) = C - \ln\left(\cos\theta\right)$$

$$T(\theta) = c\sec\theta$$