

Lehrstuhl für Informatik  
16 | ENG 017  
Mechatronik  
Engineering Mathematics

$$1) \quad x = \cos t + t \sin t$$
$$y = \sin t - t \cos t$$

$$\frac{dx}{dt} = -\sin t + t \cos t + \sin t$$

$$= t \cos t$$

$$\cancel{\frac{dy}{dt}} = \cancel{\frac{dy}{dt}} \times \cancel{\frac{dt}{dx}}$$

$$\frac{dy}{dt} = \cos t + t \sin t - \cos t = t \sin t$$

$$\frac{dy}{dx} = \frac{dy}{dt} \times \frac{dt}{dx}$$

$$= t \sin t \times \frac{1}{t \cos t}$$

$$\frac{dy}{dx} = \frac{t \sin t}{t \cos t}$$

$$= \tan t$$

$$\frac{d^2y}{dx^2} = t \sec^2 t \cdot \frac{dt}{dx}$$

$$\text{Recall } \frac{dt}{dx} = \frac{1}{t \cos t}$$

$$= t \sec^2 t \cdot \frac{1}{t \cos t}$$

$$= \frac{1}{\cos^3 t}$$

$$P_1 = \frac{[1 + (\frac{dy}{dx})^2]^{3/2}}{\frac{dy}{dx}}$$

$$= \frac{[1 + (t \tan t)^2]^{3/2}}{t \tan t}$$

$$= [1 + (t \tan t)^2]^{3/2} \times t^2 \cos^3 t$$

$$= [1 + t^2 \tan^2 t]^{3/2} \times t^2 \cos^3 t$$

$$= [1 + t^2 \tan^2 t] \times t^2 \cos^2 t$$

$$= t^2 \cos^2 t + t^3 \tan^2 t \cdot t^2 \cos^2 t$$

$$= t^2 \cos^2 t + t^5 \tan^2 t \cos^2 t$$

$$= t^2 (\cos^2 t + t^3 \tan^2 t \cos^2 t)$$

$$ii \quad \tan \theta = \frac{dy}{dx} = \frac{t \sin t}{t \cos t} = \tan t$$

$$\tan \theta = \tan t$$

$$x_1 = \cos t + t \sin t$$

$$y_1 = \sin t - t \cos t$$

$$n = \cos t + t \sin t - t \sin t$$

$$= \cos t$$

$$n = \sin t - t \cos t + t \cos t$$

$$= \sin t$$

$$n = \cos t$$