



OKawa Efficiency Based
18/ENG 63103
Biomedical Engineering

$$5n^2 + y^2 = 5 \quad - (1)$$

$$n^2 + y^2 = 4 \quad - (2)$$

$$y^2 = 5 - 5n^2$$

$$n^2 + (5 - 5n^2) = 4$$

$$5n^2 - n^2 - 1 = 0$$

$$4n^2 - 1 = 0$$

$$n = \frac{1}{2} \quad \text{or} \quad n = \frac{1}{2}$$

$$\text{at } n = \frac{1}{2}, y = \frac{\sqrt{15}}{2}$$

$$\text{at } n = \frac{1}{2}, y = \frac{\sqrt{15}}{2}$$

differentiating $5n^2 + y^2 = 5$

$$10n + 2y \frac{dy}{dn} = 0$$

$$\frac{dy}{dn} = \frac{-10n}{2y} = \frac{-5n}{y}$$

differentiate $n^2 + y^2 = 4$

$$2n + 2y \frac{dy}{dn} = 0$$

$$\frac{dy}{dn} = \frac{-2n}{2y} = \frac{-n}{y}$$

$$\text{at } n = \frac{1}{2} \text{ and } y = \frac{\sqrt{15}}{2}$$

$$\frac{-5n}{y} \rightarrow \frac{-5(\frac{1}{2})}{\frac{\sqrt{15}}{2}} = \frac{-\sqrt{15}}{3}$$

$$\text{at } n = \frac{1}{2}, y = \frac{\sqrt{15}}{2}$$

$$\frac{-n}{y} \rightarrow \frac{-\frac{1}{2}}{\frac{\sqrt{15}}{2}} = \frac{-\sqrt{15}}{3}$$

$$\text{at } n = \frac{1}{2} \text{ and } y = \frac{\sqrt{15}}{2}$$

$$\frac{-n}{y} = \frac{\frac{1}{2}}{\frac{\sqrt{15}}{2}} = \frac{\sqrt{15}}{3}$$

$$\tan(\theta_2 - \theta_1) = \frac{m_2 - m_1}{1 + m_1 m_2}$$

When $m_2 = \frac{\sqrt{15}}{3}$ and $m_1 = \frac{\sqrt{15}}{3}$

$$\tan(\theta_2 - \theta_1) = \frac{\frac{\sqrt{15}}{3} - \frac{\sqrt{15}}{3}}{1 + (\frac{\sqrt{15}}{3})(\frac{\sqrt{15}}{3})}$$

When $m_2 = \frac{\sqrt{15}}{3}$ and $m_1 = \frac{\sqrt{15}}{3}$

$$\tan(\theta_2 - \theta_1) = \frac{\frac{\sqrt{15}}{3} - \frac{\sqrt{15}}{3}}{1 + (\frac{\sqrt{15}}{3})(\frac{\sqrt{15}}{3})}$$

$$= \tan^{-1}\left(\frac{\frac{\sqrt{15}}{3}}{\frac{15}{9}}\right) = 37.76^\circ$$

$$\tan^{-1}\left(\frac{-\sqrt{15}}{3}\right) = -37.76^\circ$$

The angle between them

$$160 - 37.76 = 122.24^\circ$$