5.10: Fringe Visibility

We have seen that when the interference term $\mathrm{Re}\langle U_1^* U_2 \rangle$ vanishes, no fringes form, while when this term is nonzero, there are fringes. The **fringe visibility** is expressed directly in measurable quantities (i.e. in intensities instead of fields). Given some interference intensity pattern $I(x)$ as in Figure $5.10.1$, the visibility is defined as

$$\mathcal{V} = \frac{I_{\max} - I_{\min}}{I_{\max} + I_{\min}}. \quad \text{fringe visibility.}$$

For example, if we have two perfectly coherent, monochromatic point sources emitting the fields U_1, U_2 with intensities $I_1 = |U_1|^2, I_2 = |U_2|^2$, then the interference pattern is with (5.6.13):

$$I(\tau) = I_1 + I_2 + 2\sqrt{I_1 I_2} \cos(\omega\tau + \varphi).$$

We then get

$$I_{\max} = I_1 + I_2 + 2\sqrt{I_1 I_2}, \quad I_{\min} = I_1 + I_2 - 2\sqrt{I_1 I_2},$$

so

$$\mathcal{V} = \frac{2\sqrt{I_1 I_2}}{I_1 + I_2}$$

In case $I_1 = I_2$, we find $\mathcal{V} = 1$. In the opposite case, where U_1 and U_2 are completely incoherent, we find

$$I(\tau) = I_1 + I_2,$$

from which follows

$$I_{\max} = I_{\min} = I_1 + I_2,$$

which gives $\mathcal{V} = 0$.

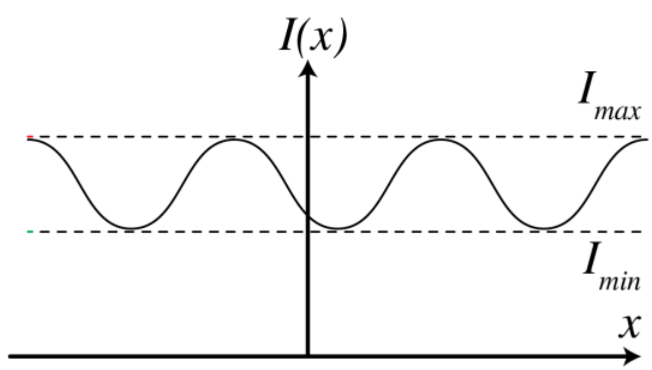

Figure 5.10.1: Illustration of $I_{\max}$ and $I_{\min}$ of an interference pattern $I(x)$ that determines the visibility $\mathcal{V}$.