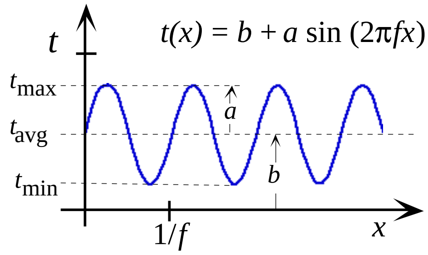
The Diffraction Efficiency of a Sinusoidal Transmission Grating:



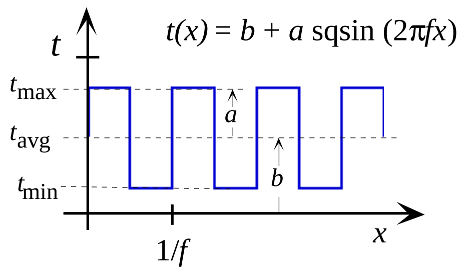
$$DE_0 = b^2$$

$$DE_{+1} = DE_{-1} = \left(\frac{a}{2}\right)^2$$

$$DE_{m=\pm 2, \pm 3\ldots} = 0$$

$$DE_{+1,\,MAX} = 6.25\%$$

The Diffraction Efficiency of a Square-Wave Transmission Grating:



$$DE_0 = b^2$$

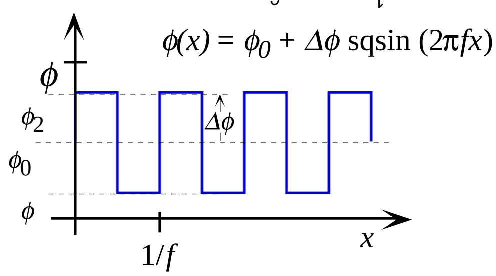
$$DE_{+1} = DE_{-1} = \left(\frac{2a}{\pi}\right)^2$$

$$DE_{+1,\,MAX} = 10.1\%$$

$$DE_{m=\text{even}} = 0 \qquad DE_{m=\text{odd}} = \frac{1}{m^2}\, DE_{+1}$$

$$\sum_{m\neq 0} DE_m = a^2 = 25\%_{\max}$$

The Diffraction Efficiency of a Square-Wave Phase Grating:



$$DE_0 = \cos^2\Delta\phi$$

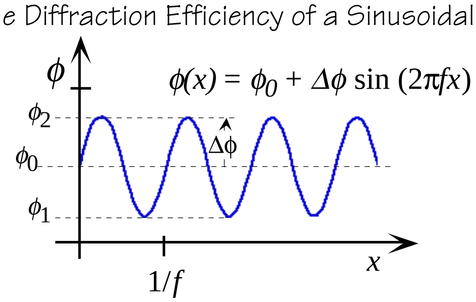
$$DE_{+1} = DE_{-1} = \left(\frac{2}{\pi}\sin\Delta\phi\right)^2$$

$$DE_{+1,\,MAX} = 40.5\% \quad @\Delta\phi = \pi/2 = 90°$$

$$DE_{m=\text{even}} = 0 \qquad DE_{m=\text{odd}} = \frac{1}{m^2}\, DE_{+1}$$

$$\sum_{m\neq 0} DE_m = \sin^2 \Delta\phi = 100\%_{\max}$$

The Diffraction Efficiency of a Sinusoidal Phase Grating:

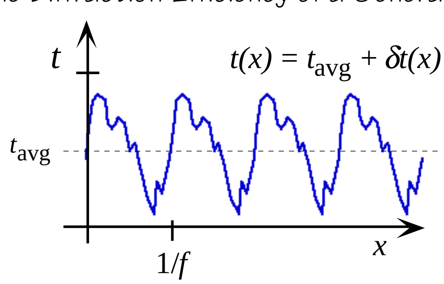


$$DE_0 = J_0^2(\Delta\phi)$$

$$DE_{+1} = DE_{-1} = J_1^2(\Delta\phi)$$

$$DE_{+1,\,MAX} = 33.8\% \quad @\Delta\phi = 1.86 = 0.59\pi = 107°$$

The Diffraction Efficiency of a Generalized (complex transmittance) Grating:



$$DE_0 = \left|t_{avg}\right|^2$$

$$DE_{+1,\,MAX} = 100\%$$

DE_{+1} = power spectrum component

$$\sum_{m\neq 0} DE_m = \overline{|t(x)|^2} - DE_0 = \overline{|\delta t\ |^2}$$

$$\equiv \text{var}\ t = \sigma_t^2$$

note: These all assume that the grating is "optically thin." That is, that $Q = \dfrac{2\pi\,\lambda\,\text{thickness}}{n\,d^2\ \cos\theta_0} \ll 1$