

## Error Propagation

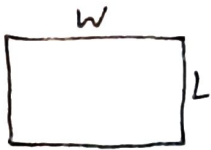
Analog devices have a  $\pm$  error of half of their smallest unit of measurement.

Digital devices have  $\pm$  error of their smallest unit of measure

Error propagation equation:

Tells you the  $\pm$  error of the result of an equation that uses other measurements, each with their own error.

Ex: Find the error of the area of a rectangle.



$$A = WL$$

$$W = 5 \pm 0.5 \text{ in}$$

$$L = 10 \pm 0.5 \text{ in}$$

$$A = 50 \text{ in}^2 \quad \sigma_A = ?$$

$$\sigma_A = \sqrt{\left(\frac{\partial A}{\partial W}\right)^2 \sigma_W^2 + \left(\frac{\partial A}{\partial L}\right)^2 \sigma_L^2}$$

$$\frac{\partial A}{\partial W} = L$$

$$\frac{\partial A}{\partial L} = W$$

$$\sigma_W = 0.5$$

$$\sigma_L = 0.5$$

$$\sigma_A = \sqrt{10^2 0.5^2 + 5^2 0.5^2} = 5.59 \text{ in}$$

$$A = 50 \pm 5.59 \text{ in}^2$$

$$\% \text{Error} = \frac{|Expected - Theoretical|}{Theoretical} \times 100$$