

## Error Propagation

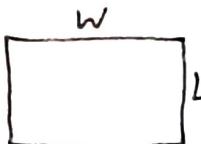
Analog devices have a  $\pm$  error of half of their smallest unit of measurement.

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.



$$A = WL \quad W = 5 \pm 0.5 \text{ in} \quad L = 10 \pm 0.5 \text{ in}$$

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

$$\sigma_A = \sqrt{\left(\frac{\partial A}{\partial W}\right)^2 \sigma_W^2 + \left(\frac{\partial A}{\partial L}\right)^2 \sigma_L^2} \quad \frac{\partial A}{\partial W} = L \quad \frac{\partial A}{\partial L} = W \quad \sigma_W = 0.5 \quad \sigma_L = 0.5$$

$$\sigma_A = \sqrt{10^2 0.5^2 + 5^2 0.5^2} = 5.59 \text{ in} \quad A = 50 \pm 5.59 \text{ in}^2$$

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