Error Propagation

Analog devices have a ± error of half of their smallest unit of measurement.

Digital devices have ± error of their smallest unit of measure

Error propagation equation:

Tells you the ± 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.

$A = WL$ $W = 5 \pm 0.5$ in $L = 10 \pm 0.5$ in

$A = 50 in^2$ $\sigma_A = ?$

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

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

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