List of Equations

Accuracy = $\pm$ (max(abs(Y_{actual} -Y_{sensor}))+ $3\sigma_y$)

Linearity = $\pm$ (max(abs($Y_{actual} - Y_{sensor}$)))

Repeatability = $\pm 3\sigma_y$

$$A = \frac{\sum xy}{\sum x^2}$$

$$A = \frac{n\sum xy - \left(\sum x\right)\left(\sum y\right)}{n\sum x^2 - \left(\sum x\right)^2}$$

$$B = \left(\sum y - A\sum x\right)/n$$

$$Y_{sensor} = \frac{Y_{volts}}{A}$$

$$Y_{sensor} = \frac{\left(Y_{volts} - B\right)}{A}$$

$$\frac{\Delta R}{R} = G\varepsilon$$

$$f_n = \frac{1}{2\pi}\sqrt{\frac{k}{m}}$$

$$V_{in} = V_S\left(\frac{R_{in}}{R_{in} + R_S}\right)$$

If $R = \frac{XYZ}{P}$ then $\Delta R = |R|\left(\left|\frac{\Delta X}{X}\right| + \left|\frac{\Delta Y}{Y}\right| + \left|\frac{\Delta Z}{Z}\right| + \left|\frac{\Delta P}{P}\right|\right)$

If $R = X + Y - Z$ then

$$\Delta R = |\Delta X| + |\Delta Y| + |\Delta Z|$$

$$a_{ADC} = \pm\frac{V_{FS}}{2^{ENOB}}$$

$$\frac{Y_{out}(s)}{Y_{true}(s)} = \frac{K_s}{\tau_s s + 1}$$

$$\tau_s = 0.455 t_r$$

$$\tau_s = \frac{1}{\omega_b} = \frac{1}{2\pi f_b}$$

$$y_{out}(t) = y_{out}(0)e^{-\frac{t}{\tau_s}} + K_s\left(1 - e^{-\frac{t}{\tau_s}}\right)y_{true}$$

$$t \geq -\tau_s \ln\left(\frac{0.1|a_y|}{\max\left(y_{max} - y_{out}(0), y_{out}(0) - y_{min}\right)}\right)$$

$$\Delta y_{out}(t) = |a_y| + \max\left(y_{max} - y_{out}(0), y_{out}(0) - y_{min}\right)e^{-\frac{t}{\tau_s}}$$

$$y_{out}(t) = A_{out}(\omega)\sin\left(\omega t + \phi(\omega)\right)$$
$$= K_s M(\omega) A_{true}\sin\left(\omega t + \phi(\omega)\right)$$

$$M(\omega) = \frac{1}{\sqrt{1 + \omega^2\tau_s^2}}$$

$$\phi(\omega) = -\tan^{-1}(\omega\tau_s)$$

$$t_d = -\frac{\phi}{\omega}$$

$$\Delta A_{out}(\omega) = |a_y| + \left(1 - \frac{1}{\sqrt{1 + \omega^2\tau_s^2}}\right)A_{out}(\omega)$$

$$v_{est}(kT) = \frac{p\left(kT\right) - p((k-1)T)}{T}$$

$$\Delta v_{est} = \frac{T}{2}\max\left(|a_{true}|\right) + \frac{2\Delta p}{T}$$

$$T_{opt} = \sqrt{\frac{4\Delta p}{\max\left(|a_{true}|\right)}}$$

$$\Delta v_{est} = \frac{T}{2}\max\left(|a_{true}|\right) + \frac{\text{encoder's position resolution}}{T}$$

$$\Delta v_{est} = \frac{T}{2}\max\left(|a_{true}|\right) + \frac{6\sigma_p}{T}$$

$$F = ma$$

$$\tau = J\alpha$$