The following proportional, derivative controller has two tuning parameters: K and τ_d

$$u(t) = K\left[e(t) + \tau_d \frac{de(t)}{dt}\right]$$

We want to apply the above controller to the following equation:

$$\begin{aligned}
\frac{d}{dt}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} &= \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & \alpha & 0 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \beta \end{bmatrix}\mu \\
\frac{d}{dt}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} &= \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & \alpha & 0 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \beta \end{bmatrix}\mu
\end{aligned}$$

The above equation is the model of a plant.

$$\begin{gathered}
a = b + c \\
a\,b\,c\,d = f + g + h
\end{gathered}$$

$$\begin{aligned}
a &= b + c \\
a\,b\,c\,d &= f + g + h
\end{aligned}$$

$$\begin{aligned}
\alpha &= \beta + \gamma \\
\alpha + \beta &= \frac{\gamma}{\delta} + \delta \int \mu d\mu \\
\alpha + \beta\mu &= \gamma\delta
\end{aligned}$$

$$u(t) = K\left[e(t) + \tau_d \frac{de(t)}{dt}\right] \tag{1}$$

We want to apply the above controller to the following equation:

$$\frac{d}{dt}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & \alpha & 0 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \beta \end{bmatrix}\mu \tag{2}$$

The above equation 2 is the model of a plant.

$$u(t) = K\left[e(t) + \tau_d \frac{de(t)}{dt}\right]$$

We want to apply the above controller to the following equation:

$$\frac{d}{dt}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 \\ 0 & 0 & 0 \\ 0 & \alpha & 0 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ \beta \end{bmatrix}\mu \tag{3}$$

The above equation 3 is the model of a plant.

$$|x| = \begin{cases} x & \text{if } x \geq 0 \\ -x & \text{if } x \leq 0 \end{cases}$$

This example shows `aligned` equations within an `align` environment.

$$\begin{aligned} a &= b + c + d \\ &\quad + e + f + g + x + y + z \end{aligned} \tag{4}$$

$$\begin{aligned} i + j + k &= l + m + n \\ &\quad + o + p + q \end{aligned} \tag{5}$$