BetaFlight RC Curve Math (Caution: Still needs sorted)

$$R = Rate, \quad rc_R = RC\ Rate, \quad rc_E = RC\ Expo$$

$$0 \le R \le 0.99 \quad R < \left(1 - \frac{rc_R'}{\omega_{MAX}/200}\right)$$

$$rc_R' = \begin{cases} rc_R & rc_R \le 2.0 \\ rc_R + 14.58 \cdot (rc_R - 2) & rc_R > 2.0 \end{cases} = \begin{cases} rc_R & rc_R \le 2.0 \\ 15.58 \cdot rc_R - 29.16 & rc_R > 2.0 \end{cases}$$

$$\omega_{MAX} = 200 \cdot \left(\frac{1}{1-R}\right) \cdot rc_R', \quad \omega_{MAX} \le 1998 \left(\frac{deg}{sec}\right), \quad rc_R' < 9.99 \cdot (1-R)$$

$$\text{if } rc_R > 2.0, \text{ then } rc_R' = 15.58 \cdot rc_R - 29.16 < 9.99 \cdot (1-R); \quad rc_{R,MAX} = \frac{9.99 + 29.16}{15.58} \approx 2.512837, \quad R = 0$$

$$0 \le rc_R \le 2.5128$$

$$x = [1000, \ 2000]\ (\mu sec), \quad \hat{x} = \frac{x - 1500}{500}, \quad -1 \le \hat{x} \le 1$$

$$v(\hat{x}) = \hat{x} \cdot \left(1 - rc_E \cdot (1 - |\hat{x}|^3)\right) = (1 - rc_E) \cdot \hat{x} + rc_E \cdot \hat{x} \cdot |\hat{x}|^3, \quad for \quad 0 \le rc_E \le 1 \quad -1 \le v(\hat{x}) \le +1$$

$$\omega(v(\hat{x})) = 200 \cdot rc_R' \cdot \frac{v(\hat{x})}{1 - R \cdot |v(\hat{x})|},$$

$$\frac{d\omega}{d\hat{x}} = \frac{d\omega}{dv} \cdot \frac{dv}{d\hat{x}} = 200 \cdot rc_R' \cdot \left(\frac{1 \cdot (1 - R \cdot v) - (-R) \cdot v}{(1 - R \cdot v)^2}\right)\left(\frac{dv}{d\hat{x}}\right) = 200 \cdot rc_R' \left(\frac{1}{(1 - R \cdot v)^2}\right) \cdot \left(\frac{dv}{d\hat{x}}\right)$$

$$\frac{d\omega}{d\hat{x}} = \left(\frac{200 \cdot rc_R'}{(1 - R \cdot v(\hat{x}))^2}\right) \cdot \left((1 - rc_E) + 4 \cdot rc_E \cdot x^3\right), \quad \frac{d\omega}{d\hat{x}}(0) = \omega_{MID}' = 200 \cdot rc_R' \cdot (1 - rc_E)$$

$$rc_E = 1 - \frac{\omega_{MID}'}{200 \cdot rc_R'} = 1 - \frac{\omega_{MID}'}{\omega_{MAX}(1 - R)} > 0 \quad (1 - R) > \frac{\omega_{MID}'}{\omega_{MAX}} \quad R < 1 - \frac{\omega_{MID}'}{\omega_{MAX}}$$

$$\omega_{MAX} = 200 \cdot \left(\frac{1}{1-R}\right) \cdot rc_R', \quad rc_R' = \frac{\omega_{MAX}}{200}(1 - R)$$