$$\frac{\partial p_{as}}{\partial t} = \frac{1}{C_{as}} \left(\frac{p_{lv} - p_{as}}{R_{as}} - \frac{p_{as} - p_{vs}}{R_s} \right)$$

$$\frac{\partial p_{vs}}{\partial t} = \frac{1}{C_{vs}} \left(\frac{p_{as} - p_{vs}}{R_s} - \frac{p_{vs} - p_{rv}}{R_{vs}} \right)$$

$$\frac{\partial p_{ap}}{\partial t} = \frac{1}{C_{ap}} \left(\frac{p_{rv} - p_{ap}}{R_{ap}} - \frac{p_{ap} - p_{vp}}{R_p} \right)$$

$$\frac{\partial p_{vp}}{\partial t} = \frac{1}{C_{vp}} \left(\frac{p_{ap} - p_{vp}}{R_p} - \frac{p_{vp} - p_{lv}}{R_{vp}} \right)$$

$$\frac{dV_{lv}}{dt} = \frac{p_{vp} - p_{lv}}{R_{vp}} - \frac{p_{lv} - p_{as}}{R_{as}}$$

$$\frac{dV_{rv}}{dt} = \frac{p_{vs} - p_{rv}}{R_{vs}} - \frac{p_{rv} - p_{ap}}{R_{ap}}$$

$$p_{lv} = E_{lv} \left(V_{lv} - V_{0,lv} \right)$$

$$p_{rv} = E_{rv} \left(V_{rv} - V_{0,rv} \right)$$

$$R_{as} = \min \left(R_{as,0} + \exp\left(-2 \left(p_{lv} - p_{as}\right)\right), 20 \right)$$

$$R_{vp} = \min \left(R_{vp,0} + \exp\left(-2 \left(p_{vp} - p_{lv}\right)\right), 20 \right)$$

$$R_{vs} = \min\left(R_{us,0} + \exp\left(-2\left(p_{vs} - p_{rv1}\right)\right), 20\right)$$

$$R_{ap} = \min\left(R_{ap,0} + \exp\left(-2\left(p_{rv} - p_{ap1}\right)\right), 20\right)$$

$$E_t = \begin{cases} E_d + \frac{(E_s - E_d)}{2}\cos\left(1 - \frac{\pi t}{T_s}\right) & t < T_s \\ E_d + \frac{(E_s - E_d)}{2}\cos\left(\frac{\pi}{T_r}(t - T_s)\right) & T_s < t < T_s + T_r \\ E_d & T_s + T_r < t < T \end{cases}$$