$$\ddot{x} = \frac{1}{\rho r_0 R_{max}} \left[(P_i(t) - P_o(t)) \cdot r_0 - E\frac{h_0}{r_0}x - D\frac{h_0}{r_0}\dot{x} \right]$$

$$\ddot{x} = \frac{1}{\rho r_0 R_{max}} \left[(P_i(t) - P_o(t)) \cdot r_0 - 4\frac{E}{\pi^2} \cdot \frac{h_0^2}{r_0^2} \cdot \frac{h_0}{h_0 + r_0 + x}x - D\frac{h_0}{r_0}\dot{x} \right]$$

Let's say

$$y = \begin{pmatrix} y_1 \\ y_2 \end{pmatrix} = \begin{pmatrix} x \\ \dot{x} \end{pmatrix} \tag{1}$$

Then the derivative of y would be

$$\begin{pmatrix} \dot{y_1} \\ \dot{y_2} \end{pmatrix} = \begin{pmatrix} \dot{x} \\ \ddot{x} \end{pmatrix} \tag{2}$$

So we can conclude that the equation below.

$$\dot{y} = \begin{pmatrix} \dot{x} \\ \ddot{x} \end{pmatrix} = \begin{pmatrix} y_2 \\ aha \end{pmatrix} \tag{3}$$