Llamo $\alpha = EI$ por comodidad.

Grilla: $x_i = ih$, $i = 0, \dots, n$, $x_i \in [0,L]$

Utilizo las diferencias finitas: $y'(x) \approx \frac{y_{i+1} - y_{i-1}}{2h}$

$$y''(x) \approx \frac{y_{i+1} - 2y_i + y_{i+1}}{h^2}$$

Luego: $\alpha y'' = \frac{1}{2} w_0 (Lx - x^2)\left(1 + (y')^2\right)^{\frac{3}{2}} \iff \alpha y'' + \frac{1}{2} w_0 (x^2 - Lx)\left(1 + (y')^2\right)^{\frac{3}{2}} = 0$

Con las diferencias finitas:

$$\frac{\alpha}{h^2}(y_{i+1} - 2y_i + y_{i-1}) + \frac{1}{2} w_0 (x_i^2 - Lx_i)\left(1 + \frac{(y_{i+1} - y_{i-1})^2}{4h^2}\right)^{\frac{3}{2}} = 0$$

Dado que $y_0 = y(0) = 0$, $y_n = y(L) = 0$:

<u>$i=1$</u>

$$F_1(y_1, \dots, y_{n-1}) = \frac{\alpha}{h^2}(y_2 - 2y_1) + \frac{1}{2} w_0 (x_1^2 - Lx_1)\left(1 + \frac{y_2^2}{4h^2}\right)^{\frac{3}{2}} = 0$$

<u>$i \in \{2, \dots, n-2\}$</u>

$$F_i(y_1, \dots, y_{n-1}) = \frac{\alpha}{h^2}(y_{i+1} - 2y_i + y_{i-1}) + \frac{1}{2} w_0 (x_i^2 - Lx_i)\ 1 + \left(\frac{(y_{i+1} - y_{i-1})^2}{4h^2}\right)^{\frac{3}{2}} = 0$$

<u>$i=n-1$</u>

$$F_{n-1}(y_1, \dots, y_{n-1}) = \frac{\alpha}{h^2}(-2y_{n-1} + y_{n-2}) + \frac{1}{2} w_0 (x_{n-1}^2 - Lx_{n-1})\left(1 + \frac{y_{n-2}^2}{4h^2}\right)^{\frac{3}{2}} = 0$$

Luego qeeremos resolver $F(Y_1, \cdots, Y_{n-1}) = 0$ donde

$F(Y_1, \cdots, Y_{n-1}) = (F_1, \cdots, F_{n-1})$.

Para esto utilizamos Newton. Sabiendo que:

$$\frac{\partial F_i}{\partial Y_k} = \begin{cases} -\dfrac{2\alpha}{h^2} & K = i \\ \dfrac{\alpha}{h^2} + \dfrac{3}{2}(4h^2)^{\frac{2}{3}}(X_i^2 - LX_i)(Y_{i+1} - Y_{i-1})\left(4h^2 + (Y_{i+1} - Y_{i-1})^2\right)^{\frac{1}{2}} & K = i+1 \text{ ó } k = i-1 \\ 0 & \text{c.c.} \end{cases}$$