

$$\begin{bmatrix} \delta x \\ \delta y \end{bmatrix} = \left( \begin{bmatrix} x_{in} \\ y_{in} \end{bmatrix} - \begin{bmatrix} 320 & 240 \end{bmatrix} \right) \cdot \begin{bmatrix} 89.5/640 \\ 71.5/480 \end{bmatrix}$$

$$\begin{bmatrix} l_{(1)t} \\ l_{(2)t} \\ l_{(3)t} \\ l_4 \end{bmatrix} = MotorPositionToLength \left( \begin{bmatrix} p_{(1)t} \\ p_{(2)t} \\ p_{(3)t} \\ p_4 \end{bmatrix} + 0.3533 + tension \right) + startingLengths$$

$$\begin{bmatrix} x_t \\ y_{current} \end{bmatrix} = forward_{kinematics} \left( \begin{bmatrix} l_{(1)t} \\ l_{(2)t} \\ l_{(3)t} \\ l_4 \end{bmatrix} \right)$$

Check boundaries  
Proportional control

$$\begin{bmatrix} \delta l_1 \\ \delta l_{(2)t} \\ \delta l_{(3)t} \\ \delta l_4 \end{bmatrix} = inversekinematics \left( \begin{bmatrix} x_t + \delta x \\ y_{current} + \delta y \end{bmatrix} \right) - \begin{bmatrix} l_{(1)t} \\ l_{(2)t} \\ l_{(3)t} \\ l_4 \end{bmatrix}$$

$$\begin{bmatrix} p_{(1)t+1} \\ p_{(2)t+1} \\ p_{(3)t+1} \\ p_4 \end{bmatrix} = motorLengthToPosition \left( \begin{bmatrix} \delta l_1 \\ \delta l_{(2)t} \\ \delta l_{(3)t} \\ \delta l_4 \end{bmatrix} \right) + \begin{bmatrix} p_{(1)t} \\ p_{(2)t} \\ p_{(3)t} \\ p_4 \end{bmatrix} - tension$$

$$\vec{l}_t = Pos2Len (\vec{p}_t + 0.3533 + tension) + startingLength$$

$$(x_t, y_t) = forwardKinematics \left( \vec{l}_t \right)$$

Boundary check  
Proportional control:

$$x = \begin{bmatrix} \delta x_t \\ \delta y_t \end{bmatrix}$$

$$g = \vec{x} \cdot \vec{x}^T \cdot 0.0394444$$

$$\delta \vec{l}_t = inverseKinematics \left( \begin{bmatrix} x_t \\ y_t \end{bmatrix} + \begin{bmatrix} \delta x_t \\ \delta y_t \end{bmatrix} \right) - \vec{l}_t$$

$$\vec{p}_{t+1} = Len2Pos \left( \delta \vec{l}_t \right) + \vec{p}_t - tension$$

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Global speed scalar function: proportional control:  
global speed scalar =

$$g = \begin{bmatrix} \delta x_t \\ \delta y_t \end{bmatrix} \cdot \begin{bmatrix} \delta x_t & \delta y_t \end{bmatrix} \cdot 0.03944444$$


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Motor speed stuff

$$\vec{l} = \begin{bmatrix} l_1 \\ l_2 \\ l_3 \\ l_4 \end{bmatrix} \quad x = \max(\vec{l})$$

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$$x = \max \vec{l}$$

$$\vec{s} = \frac{g}{x} \cdot \vec{l}$$


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motor position to length:

$$l = \frac{(180/\pi) \cdot p \cdot 4 \cdot \pi}{360}$$

$$length = (position - pi) * 20$$

motor length to position:

$$p = \frac{360 * l}{\pi * spoolD * (180/\pi) * 4}$$

$$p = \frac{len}{20}$$


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kinematic controller start loop:

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xin,yin = data in  
dx,dy = scaled(xin,yin)

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new lengths = findnewlengths(dx,dy):

$$\vec{l}_t = Pos2Len(\vec{p}_t + 0.3533 + tension) + startingLength$$

$$(x_t, y_t) = forwardKinematics(\vec{l}_t)$$

check boundaries  
proportional control:

$$g = \begin{bmatrix} \delta x_t \\ \delta y_t \end{bmatrix} \cdot \begin{bmatrix} \delta x_t & \delta y_t \end{bmatrix} \cdot 0.03944444$$

$$\delta \vec{l}_t = inverseKinematics\left(\begin{bmatrix} x_t \\ y_t \end{bmatrix} + \begin{bmatrix} \delta x_t \\ \delta y_t \end{bmatrix}\right) - \vec{l}_t$$

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newlengths = findnewlengths(dx,dy) = speeds = calcSpeeds(newlengths)

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calculate speeds:

$$x = \max(\delta \vec{l}_t)$$
$$\vec{s} = \frac{g}{x} \cdot \vec{l}$$

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set speeds:

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calculate new positions:

$$\vec{p}_{t+1} = Len2Pos(\delta \vec{l}_t) + \vec{p}_t - tension$$

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end of kinController loop

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first box:

input:

$$\begin{bmatrix} \delta x \\ \delta y \end{bmatrix} = \left( \begin{bmatrix} x_{in} \\ y_{in} \end{bmatrix} - \begin{bmatrix} 320 & 240 \end{bmatrix} \right) \cdot \begin{bmatrix} 89.5/640 \\ 71.5/480 \end{bmatrix}$$

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second box:  
calculate current lengths:

$$\vec{l}_t = Pos2Len(\vec{p}_t + 0.3533 + tension) + startingLength$$

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third box:  
calculate current position:

$$(x_t, y_t) = forwardKinematics(\vec{l}_t)$$

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forth box:  
check boundaries

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fifth box:  
proportional control:

$$g = \begin{bmatrix} \delta x_t \\ \delta y_t \end{bmatrix} \cdot \begin{bmatrix} \delta x_t & \delta y_t \end{bmatrix} \cdot 0.03944444$$

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sixth box:  
calculate new changes in length:

$$\delta \vec{l}_t = inverseKinematics\left(\begin{bmatrix} x_t \\ y_t \end{bmatrix} + \begin{bmatrix} \delta x_t \\ \delta y_t \end{bmatrix}\right) - \vec{l}_t$$

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seventh box:  
calculate new speeds:

$$x = \max \left( \delta \vec{l}_t \right)$$
$$\vec{s} = \frac{g}{x} \cdot \vec{l}$$

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eighth box:  
set speeds.

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ninth box:  
calculate new positions:

$$\vec{p}_{t+1} = Len2Pos \left( \delta \vec{l}_t \right) + \vec{p}_t - tension$$

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tenth box:  
set new positions

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