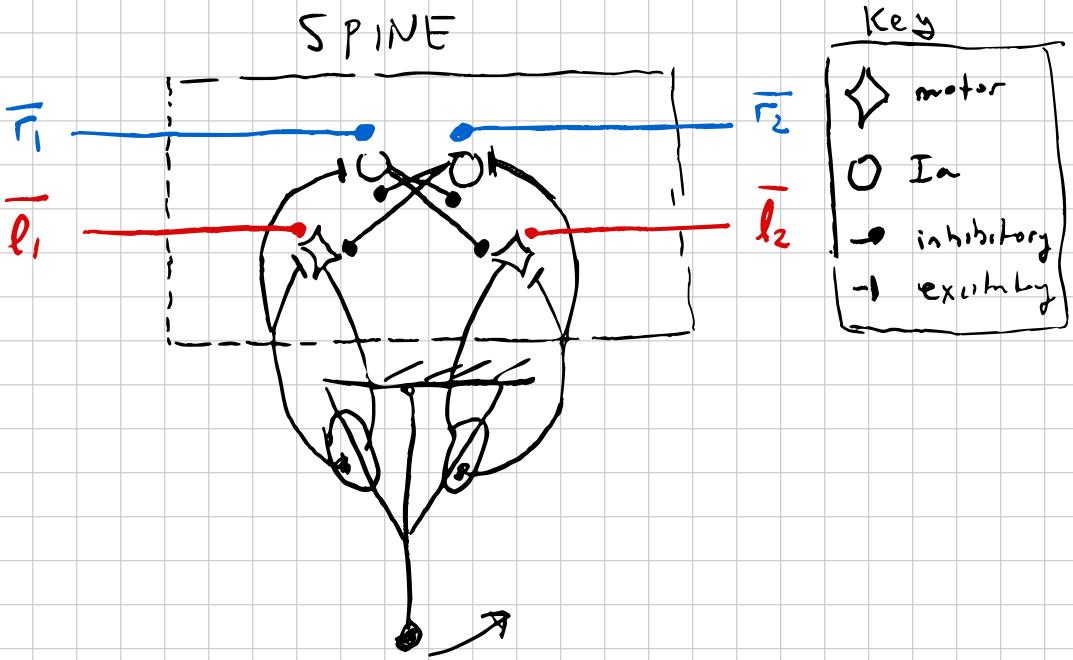

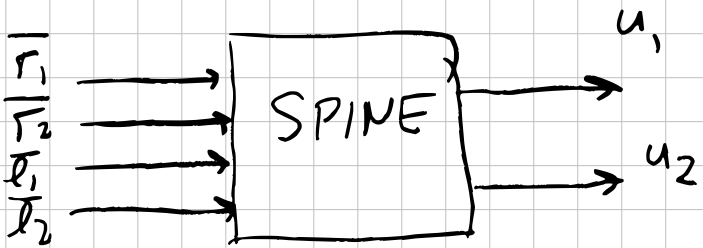

Spindle:

$$\begin{aligned} s_1 &= l_1 + \alpha \dot{l}_1 \\ s_2 &= l_2 + \alpha \dot{l}_2 \end{aligned} \qquad (1)$$

I_a:

$$\begin{aligned} z_1 &= s_1 - \beta z_1 - \bar{r}_1 \\ z_2 &= s_2 - \beta z_2 - \bar{r}_2 \end{aligned}$$

I_a:

$$z_1 = s_1 - z_2 - \bar{r}_1$$
$$z_2 = s_2 - z_1 - \bar{r}_2$$

$$\begin{bmatrix} z_1 + z_2 \\ z_2 + z_1 \end{bmatrix} = \begin{bmatrix} s_1 - \bar{r}_1 \\ s_2 - \bar{r}_2 \end{bmatrix}$$

$$\begin{bmatrix} 1 & \beta \\ \beta & 1 \end{bmatrix} \begin{bmatrix} z_1 \\ z_2 \end{bmatrix} = \begin{bmatrix} s_1 - \bar{r}_1 \\ s_2 - \bar{r}_2 \end{bmatrix}$$

A

$$A^{-1} = \frac{1}{1-\beta^2} \begin{bmatrix} 1 & -\beta \\ -\beta & 1 \end{bmatrix}$$

$$z_1 = \frac{1}{1-\beta^2} \left[s_1 - \bar{r}_1 - \beta(s_2 - \bar{r}_2) \right]$$
$$z_2 = \frac{1}{1-\beta^2} \left[s_2 - \bar{r}_2 - \beta(s_1 - \bar{r}_1) \right]$$

$$\boxed{\begin{aligned} z_1 &= \frac{1}{1-\beta^2} \left[s_1 - \beta s_2 + \beta \bar{r}_2 - \bar{r}_1 \right] \\ z_2 &= \frac{1}{1-\beta^2} \left[s_2 - \beta s_1 + \beta \bar{r}_1 - \bar{r}_2 \right] \end{aligned}} \quad (2)$$

Motor Neuron:

$$\boxed{\begin{aligned} u_1 &= s_1 - \bar{l}_1 - z_2 \\ u_2 &= s_2 - \bar{l}_2 - z_1 \end{aligned}} \quad (3)$$

Pseudo Code

INPUTS: $\bar{l}_R, \bar{l}_L, \bar{r}_R, \bar{r}_L$

$\alpha = c_1$ % $c_1 << 1$

$\beta = c_2$ % $c_2 < 1$

$$\begin{aligned} s_R &= \alpha \dot{l}_R + l_R \\ s_L &= \alpha \dot{l}_L + l_L \end{aligned} \quad (1)$$

$$\begin{aligned} z_R &= \frac{1}{1-\beta^2}\left[s_R - \beta s_L + \beta \bar{r}_L - \bar{r}_R\right] \\ z_L &= \frac{1}{1-\beta^2}\left[s_L - \beta s_R + \beta \bar{r}_R - \bar{r}_L\right] \end{aligned} \quad (2)$$

$$\begin{aligned} z_R &= \max(z_R, 0) \\ z_L &= \max(z_L, 0) \end{aligned} \quad (?)$$ Do we need this?

$$\begin{aligned} u_R &= s_R - \bar{l}_R - z_L \\ u_L &= s_L - \bar{l}_L - z_R \end{aligned}$$

$$\begin{aligned} u_R &= \max(u_R, 0) \\ u_L &= \max(u_L, 0) \end{aligned}$$

OUTPUT: u_R, u_L