Reality Check 1

Suggested Activities (Python version)

1. Write a Python function for $f(\theta)$. The parameters $L_1, L_2, L_3, \gamma, x_1, x_2, y_2$ are fixed constants, and the strut lengths p_1, p_2, p_3 will be known for a given pose. The last line should look something like

    ```
    return N1**2 + N2**2 - p1**2 * D**2
    ```

    To test your code, set the parameters $L_1 = 2, L_2 = L_3 = \sqrt{2}, \gamma = \pi/2$, and $p_1 = p_2 = p_3 = \sqrt{5}$ from Figure 1.15. Then, substituting $\theta = -\pi/4$ or $\theta = \pi/4$ corresponding to Figures 1.15 (a,b), respectively, should make $f(\theta) = 0$.

2. Plot $f(\theta)$ on $[-\pi, \pi]$. As a check of your work, there should be roots at $\theta = \pm\pi/4$.

3. Reproduce Figure 1.15. The Python commands

    ```
    import matplotlib.pyplot as plt

    plt.plot([u1, u2, u3, u1],[v1, v2, v3, v1],'r-')
    plt.plot([0, x1, x2], [0, 0, y2], 'bo')
    plt.show()
    ```

    will plot a red triangle with vertices `(u1, v1)`,`(u2, v2)`,`(u3, v3)` and place small blue circles at the strut anchor points `(0,0)`,`(0,x1)`,`(x2,y2)`. In addition, draw the struts.

4. Solve the forward kinematics problem for the planar Stewart platform specified by $x_1 = 5, (x_2, y_2) = (0, 6), L_1 = L_3 = 3, L_2 = 3\sqrt{2}, \gamma = \pi/4, p_1 = p_2 = 5, p_3 = 3$. Begin by plotting $f(\theta)$. Use an equation solver of your choice to find all four poses (roots of $f(\theta)$), and plot them. Check your answers by verifying that p_1, p_2, p_3 are the lengths of the struts in your plot.

5. Change strut length to $p_2 = 7$ and re-solve the problem. For these parameters, there are six poses.

6. Find a strut length p_2, with the rest of the parameters as in Step 4, for which there are only two poses.

7. Calculate the intervals in p_2, with the rest of the parameters as in Step 4, for which

there are 0, 2, 4, and 6 poses, respectively.