Performance of Image-Based Visual Servoing System Report

Introduction:

In the performance evaluation, an initial camera pose of [pi/9, -pi/7, -pi/8] in Euler Angles for orientation was chosen and a position of [-0.4, 0.1, -4.3] in Cartesian coordinates was chosen. Note that the performance evaluation was done with the image plane points plotting simulation turned off so that the convergence rate will be at the maximum speed.

In this report, the following questions need to be answered:

What is the optimal gain value (experimentally) for the case where feature depths are known exactly? That is, what gain value leads to the fastest convergence?

What is the optimal gain value (experimentally) for the case where feature depths are estimated? That is, what gain value leads to the fastest convergence?

How much worse is the performance with estimated depths compared to with known depths? Is the difference significant?

Discussion:
From Figure 1, it can be seen that there is a clear minimum where feature depths are known exactly. A gain of 1.0 achieves the fastest convergence. The figure shows all the gain values until the visual servoing system breaks down when singular value matrices start appearing.

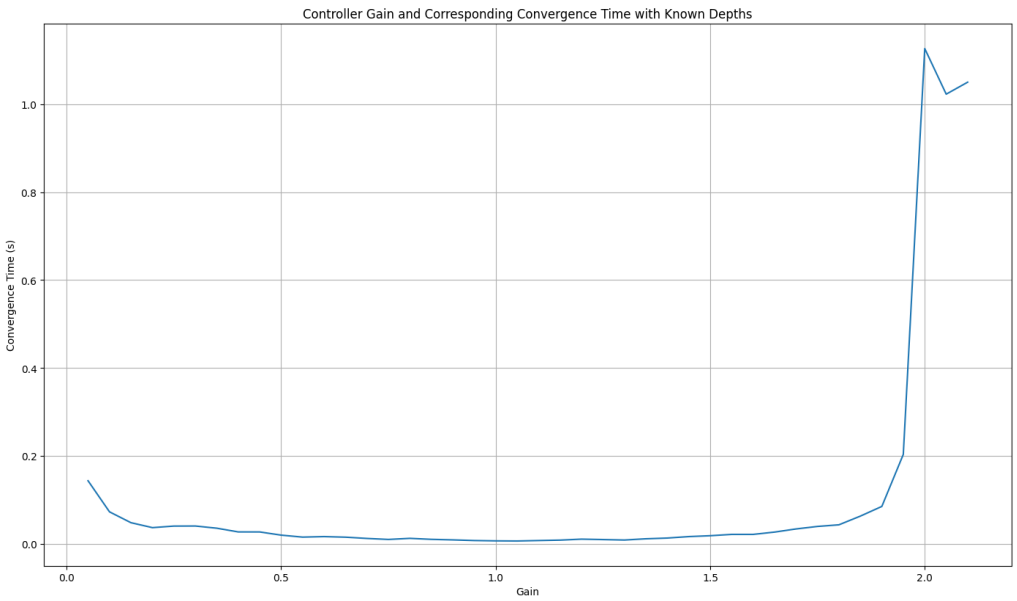

Figure 1: Controller Gain and Corresponding Convergence Time of Visual Servoing System with Known Depths

From Figure 2, it can be seen that there is a clear minimum where feature depths are known exactly. A gain of 1.0 achieves the fastest convergence. The figure shows all the gain values until the visual servoing system breaks down when singular value matrices start appearing.

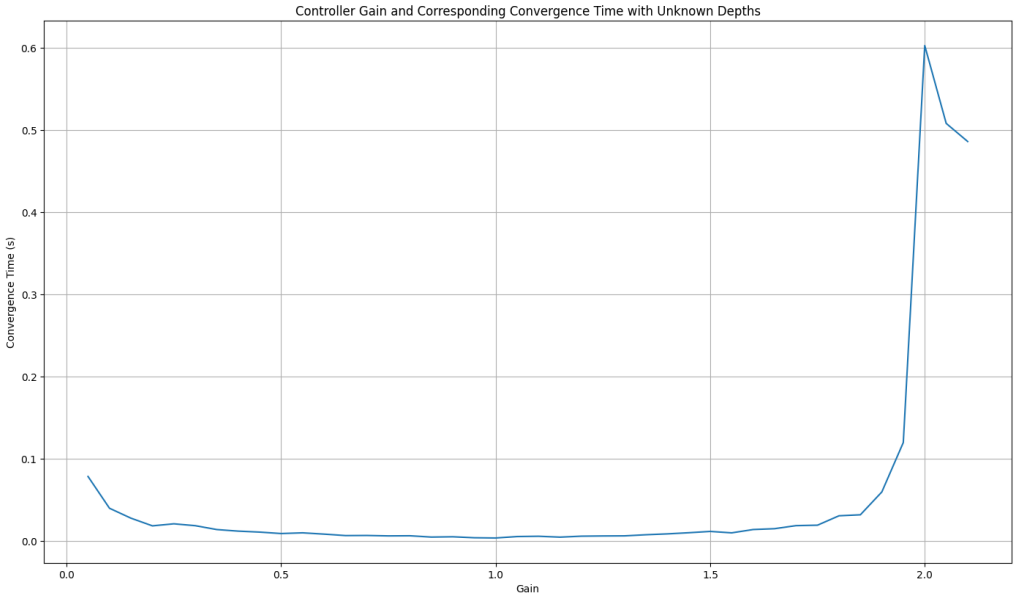

Figure 2: Controller Gain and Corresponding Convergence Time of Visual Servoing System with Known Depths

Figure 3 shows the difference in convergence time between the visual servoing system using known depths and estimated depths. The convergence time for the estimated depth is higher for all gain values than the convergence time for the estimated depths, between a range from less than 0.005 seconds to more than 0.030 seconds. Interestingly, where the difference between the convergence time is the least is close to 1.0 gain, the optimal gain for both systems. Overall, there is not a significant difference between using known depths and estimated depths.Fig

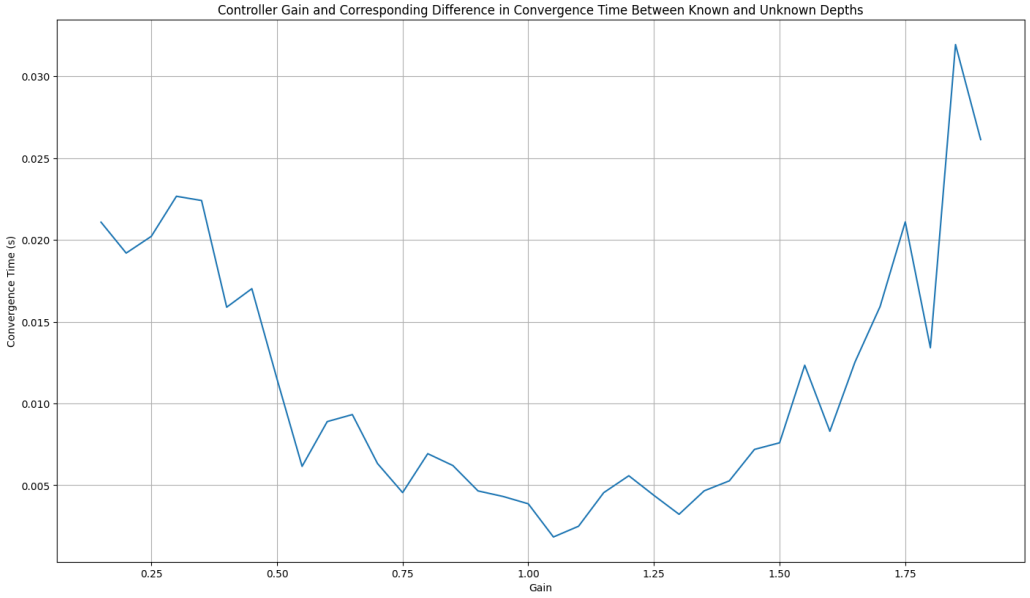

Figure 3: Controller Gain and Corresponding Difference in Convergence Time Between Known and Unknown Depths for the Visual Servoing System