15-663 Homework Assignment 4 Report

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1 Lightfield rendering, depth from focus, and confocal stereo

Sub-aperture views

We can get a sub-aperture view corresponding to a specific pair of (u_0, v_0) simply by specifying them as the first 2 dimensions of the 5-D array derived in the previous step. Figure 1 shows the mosaic from all the sub-aperture views.

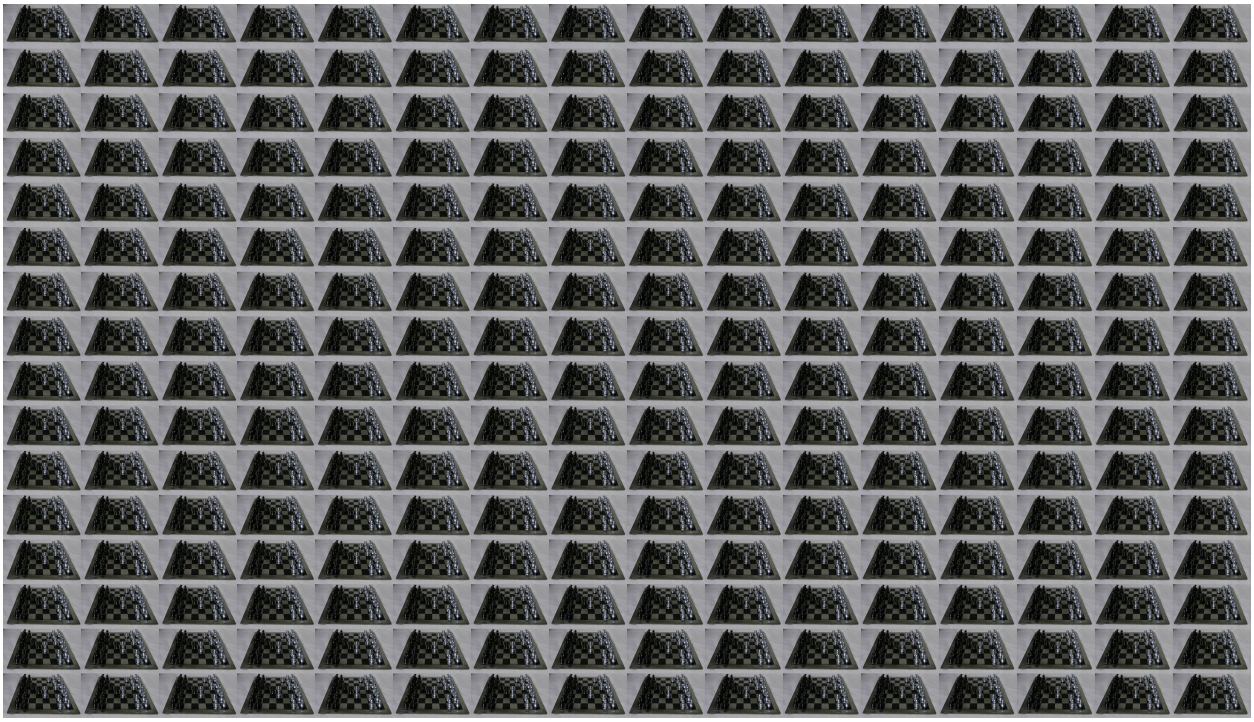

Figure 1: Sub-aperture mosaic

Refocusing and focal-stack simulation

Figure 2 shows a focal stack with maximum aperture and the focusing depth d ranging from 0 to 1.6, with step of 0.4.

(a) d = 0

(b) d = 0.4

(c) d = 0.8

(d) d = 1.2

(e) d = 1.6

Figure 2: Focal stack

All-in-focus image and depth from focus

Using the focal stack derived from the previous step, and a choice of $\sigma_1 = 3$ and $\sigma_2 = 5$, I get the all-in-focus image shown in figure 3 and the depth map 4. I observe that regions within empty checkerboard cells usually have their depths incorrectly estimated. This is because being a single-colored region, they lack in high-frequency components, resulting in difficulties in evaluating their sharpness weight. However, it does not affect the blended all-in-focus image since the blended color in those region will be approximately the same however their weights are assigned.

Focal-aperture stack and confocal stereo

I generate the focal-aperture stack with square aperatures with values of u and v ranging from 4 and 16, with step length of 4, and focusing depths d ranging from 0 to 1.6, with step

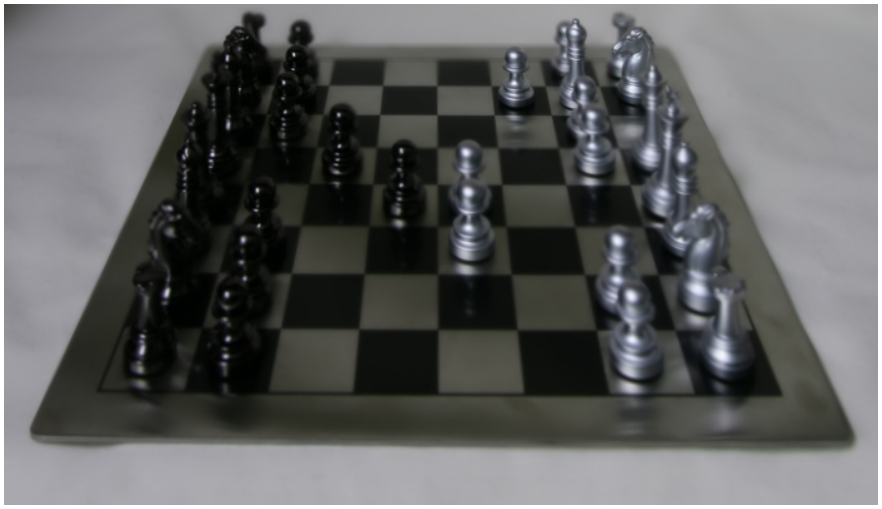

Figure 3: All-in-focus

length of 0.4. This creates a focal-aperture stack with 20 images, as shown in figure **??**. The aperture grows larger from top to bottom and the focusing depths grows larger from left to right. Using the focal-aperture stack, I reconstruct a depth map as shown in figure **??**.

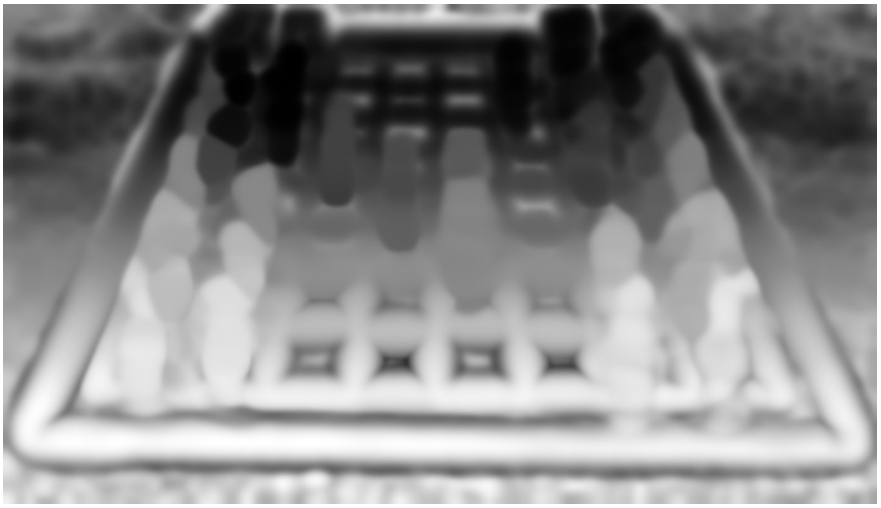

Figure 4: Depth from focus

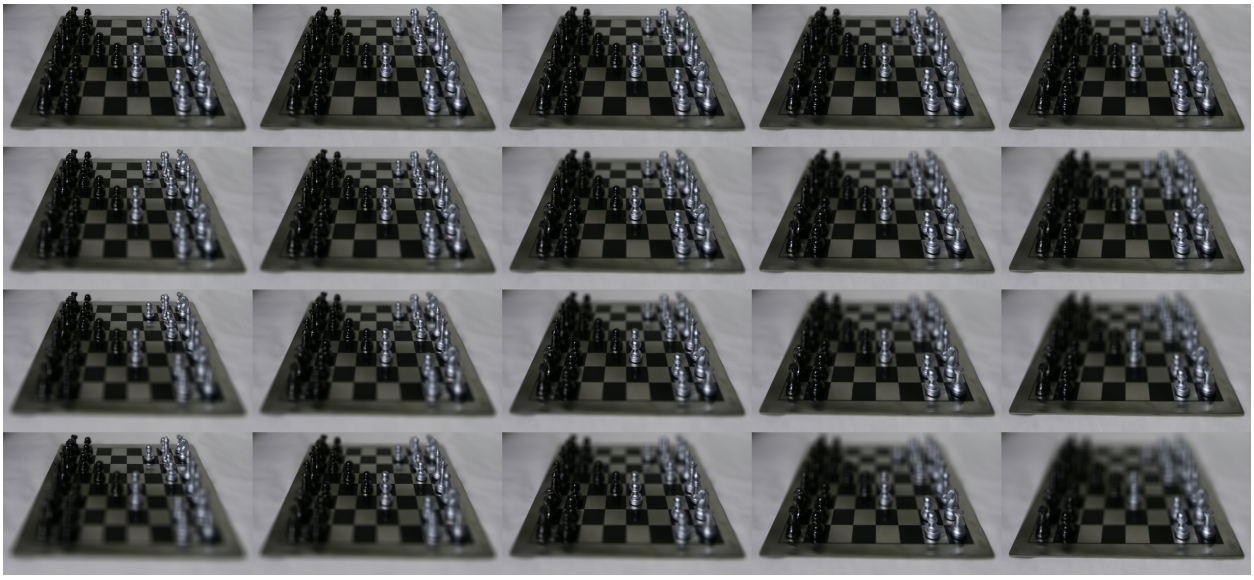

Figure 5: Focal-aperture stack

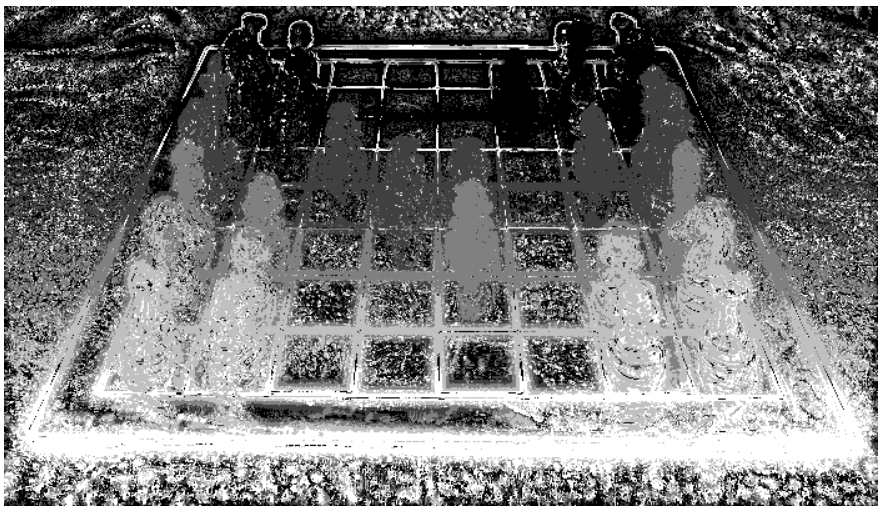

Figure 6: Confocal stereo