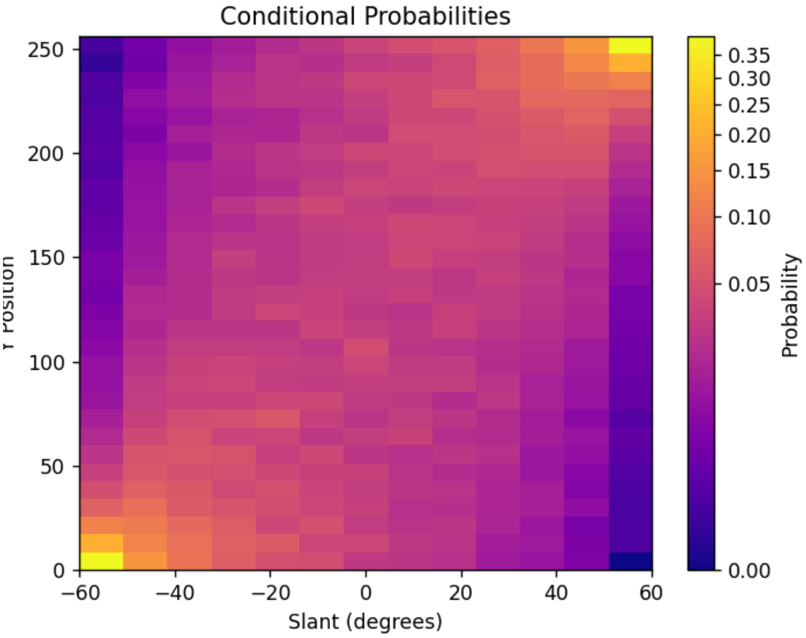
Filippo Grosso – Assignment 4

PROBLEM 1

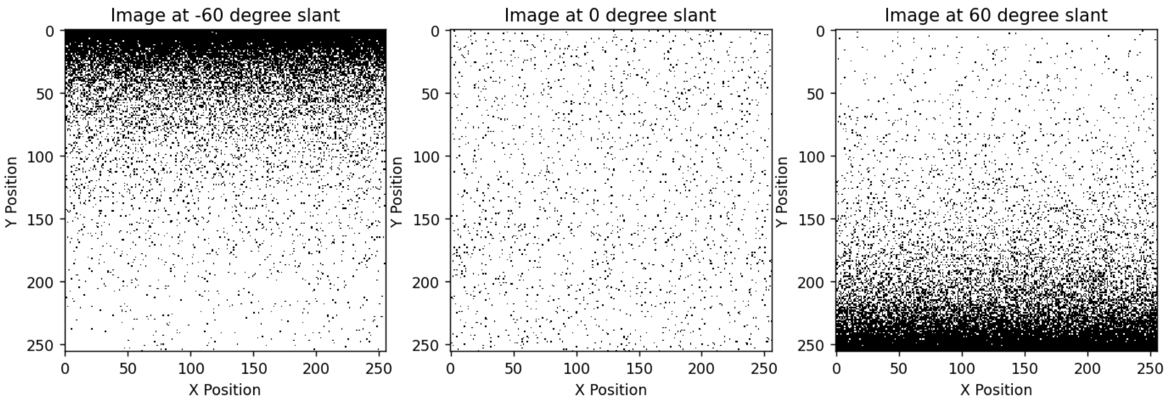
Part (a):

Submit a plot showing the estimated conditional probability function as an image. Use a colorbar so that the values are apparent. Label the axes. Briefly discuss what the plot shows. Discuss at least one example image to illustrate these probabilities.



As we can see from the plot the conditional probability of a dot appearing given a certain slant presents different distributions based on the slant.

When the slant is high in either direction the probability of a dot appearing at either the 0 bin or the 256 bin is very high and decreasing from there, this is because the points tend to concentrate on the part of the plane further away from the camera. When the slant is 0 the distribution is almost uniform as points have an equal probability of appearing. This is not perfectly represented in the above plot as the probability distribution is still an estimation. Moreover the small changes in distribution are accentuated by the power scale applied to the color bar to better accentuate the difference between small values.



Part (b):

Give a 5x2 plots as follows. For each of the five surfaces slants (-60, -30, 0, 30, 60), plot (1) the number of points in each y bin, and (2) the log likelihood as a function of slant. Briefly discuss the plots and explain *any features.*

First, we see how points spread up and down across the image. Interestingly, as the slant angle gets bigger, the points don't just spread out evenly or in a simple way. There's a more complex pattern happening. Second, we have graphs that tell us which angles are most likely based on what we see in the images. These graphs have different heights, which means some angles fit the data better than others. Together, these charts give us clues about how the slanted surfaces might look from the camera's view and any quirks in how we got the data.

From the first column of the plot we can see that the number of points in each bin heavily depends on the slant, for a slant of 0 the distribution clearly resembles a uniform distribution as it should. For a slant of 30 the distribution peaks at 0 or 256 and decreases slowly at 0, in an almost linear fashion. For slants of +- 60 the behaviour is much stronger, almost quadratic behaviour, and has peaks at 0 and 256 respectively. One thing we have to note is that the number of points at the last bin and second to last in both are very similar, this shouldn’t be in theory but its possible that the plane is overcrowded at this point and therefore the distribution of points on the image doesn’t really represent the real one.

As for the second column we can see the max likelihood slant that our function estimates. Its important to note that as we are speaking about log of a value smaller than 1 these values will be negative, the one with a lower absolute value will be the max likelihood slant in this case.

We can see that in the case of the 0 slant the function correctly estimates the slant being 0 as this is the max f the curve, the difference however isn’t that strong -8000 against -10000 meaning the function isn’t that sure of the slant.

For the 30 and -30 the value correctly estimates the slant although it doesn’t perfectly discern between the neighbouring slants,the difference in log likelihood isn’t that big. The function is very sure however that the slant isn’t in the opposite direction as it gives a value of -15000 in both cases vs more than -10000 for the correct slant.

Lastrly for true slants of 60 and -60 the function isn't perfectly sure of the true slant, likely due to the overcrowding issue presented earlier. It shows slightly higher peaks at 50 and -50 respectively. In this case the function is extremely sure that the slant isn't in the opposite direction as it gives a value of -100000 in this case as opposed to around 25000 for the correct one.