Operational Statistics for SAR Imagery Course Assignment

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Basic model function

During the class, we first studied several deferent probability distributions which is used to fitting SAR image statistical model. We try to draw the distribution of Exponential. The function is:

$$f(x) = \frac{1}{\theta} e^{\frac{-x}{\theta}} \tag{1}$$

I used ggplot2 to draw this equation and then I converted that to log10. The plot is shown as Figure 1.

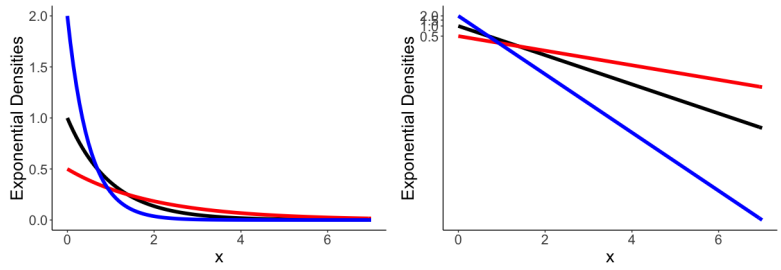

Figure 1: Exponential distribution(left) and Exponential distribution in log10(right)

Except this, we plot the distribution of Gamma. Function is:

$$f(x, \beta, \alpha) = \frac{\beta^{\alpha}}{\Gamma(\alpha)} x^{\alpha-1} e^{-\beta x} \tag{2}$$

Then I used ggplot2 to draw this equation and then I converted that to log10, too. The plot is shown as Figure 2.

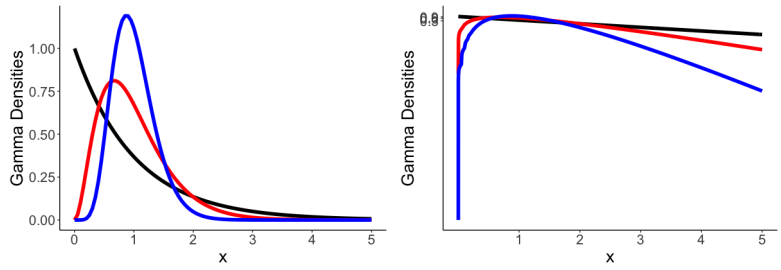

Figure 2: Gamma distribution(left) and Gamma distribution in log10(right)

Besides plot them by ggplot2. All of these function were first drawing by my usual tool MATLAB. And the figures are not showing here.

SAR Image Analysis

According to the assignment, I've taken a portion of the image from figure 3.4, which is in the lower left corner showing the forest. The original image and the captured image are shown below:

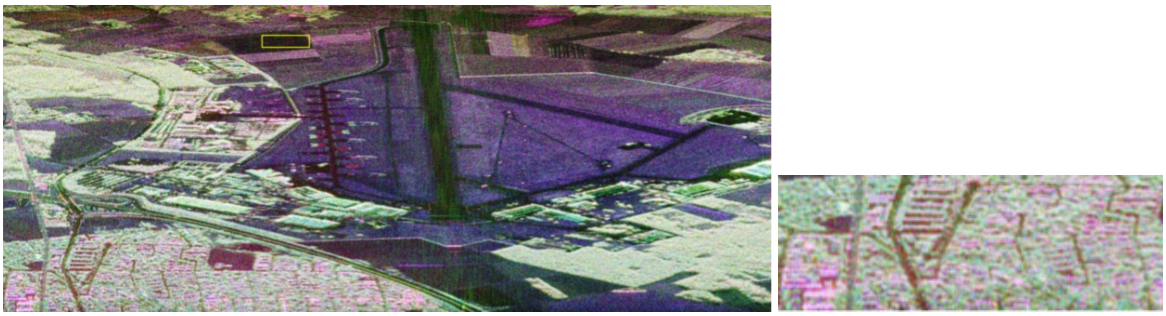

Figure 3: Original image(left) and Captured image(right)

For the captured image, I use function 'hist' to process it to be Gray histogram as Figure 4.

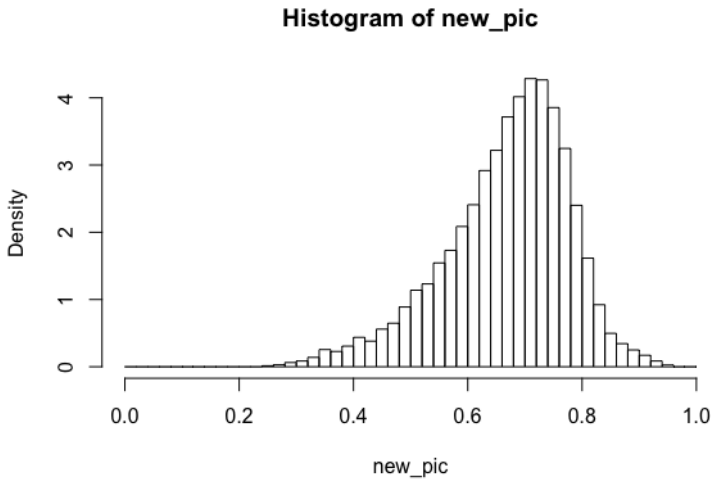

Figure 4: Gray histogram

After gathering the gray histogram, I try to modeling, in other words fitting, the histogram using the aforementioned function. It's obvious that the histogram is following the Gamma distribution. So I selected several different parameters to change the lines' shape in order to fitting the results. I compared the line's fitting outcom with the shape parameter being 3 and the scale parameter being 1/7, 1/8 and 1/9, respective. But in doing this, some problem occured. The maximum value of the histogram is nearly 40 and the fluctuations in the curve are very small and almost invisible because the top value of curve is just about 5 which is small in contrast to the histogram value. To solve this problem, I normalized the histogram but in this circumstance, the curve fit well in the high-light region and fit terriblly in the dark region. At last, I was inspired by my roommate who normalized the histogram to a larger number instead of to 1. By means of this tip, I successfully achieved the analyses.

Codes: The code to process the image is in the file ' SARexc.R '.

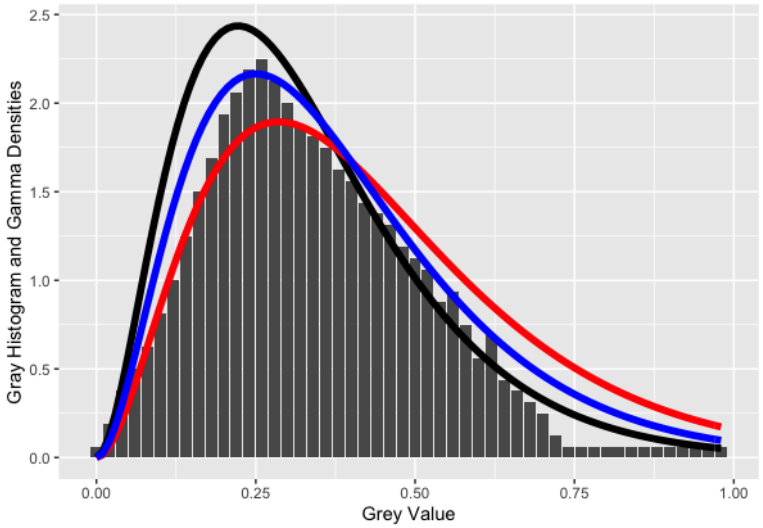

Figure 5: Final results