Operational Statistics for SAR Imagery Report

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1 Experiment Environment

Win10,RStdio

2 Some Statistical Distribution

During the entire course of Synthetic Aperture Rader(SAR), I was exposed to some statistical distribution like K distribution, Gamma distribution etc. And simulated them by using matlab, python, and R. In this section, I'd like to introduce each distribution function and image.

2.1 Exponential Distribution

The distribution function is defined as:

$$f(x) = \frac{1}{\sigma^2} e^{\frac{-x}{\sigma^2}} \tag{1}$$

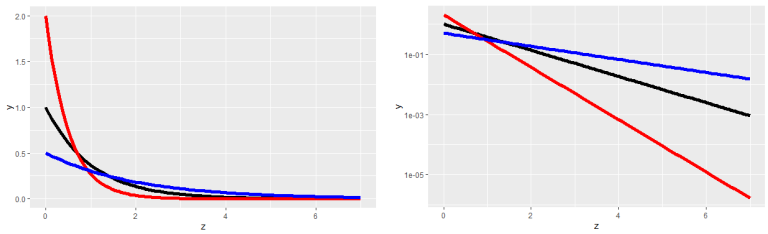

图 1: Exponential distribution with means 1/2,1 and 2(red,black,blue,resp.) of Cartesian coordinates(left) and logarithmic coordinates(right)

The distribution with means 1/2,1 and 2 is plotted as figure 1.

2.2 Gamma Distribution

After that, here come the Gamma distribution which is defined as:

$$f_Z(z, L, \sigma^2) = \frac{L^L}{\sigma^{2L}\Gamma(L)} z^{L-1} exp\{-Lz/\sigma^2\} \tag{2}$$

Where $\Gamma(v)$ is the Gamma function given by $\Gamma(v) = \int_{R_+} t^{v-1}e^{-t}dt$

Figure 2 is shown that three cases of the Gamma distribution with uni-tary mean and shape parameters (Looks) equal to 1 (the Exponen-tial distribution), 3 and 8,then convert it to logarithmic coordinates.

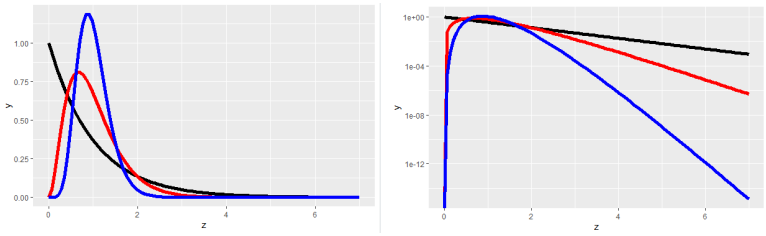

图 2: Gamma distribution of Cartesian coordinates(left) and logarithmic coordinates(right)

2.3 K Distribution

This distribution function is defined as :

$$f_Z(z,\alpha,\lambda,L) = \frac{2\lambda L}{\Gamma(\alpha)\Gamma(L)}\lambda L z^{\frac{\alpha+L}{2}-1}K_{\alpha-L}(2\sqrt{\lambda L z}) \tag{3}$$

Where $\alpha > 0$ measures the roughness,$\lambda > 0$ is a scale parame-ter, and K_v is the modified Bessel function of order v . This special function is given by $K_v(z) = \int_0^\infty e^{-z}cosh(vt)dt$.

For this function, figure 3 shows the distribution with unitary mean ($\alpha \in 1, 3, 8$ in red, blue, black, resp.),then convert it to logarithmic coordinates.

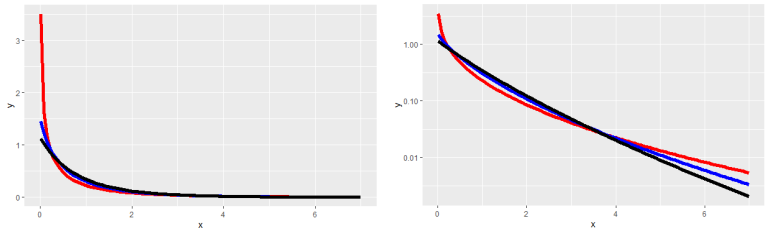

图 3: K distribution of Cartesian coordinates(left) and logarithmic coordinates(right)

2.4 G_0 Distribution

The G_0 distribution function is defined as:

$$f_Z(z,\alpha,\gamma,L) = \frac{L^L\Gamma(L-\alpha)}{\gamma^\alpha\Gamma(L)\Gamma(-\alpha)}\frac{Z^{l-1}}{(\gamma+Lz)^{L-\alpha'}} \tag{4}$$

Figure 4 shows the distribution with unitary mean ($\alpha \in -1.5, -3, -8$ in red, blue, black, resp.),then convert it to logarithmic coordinates.

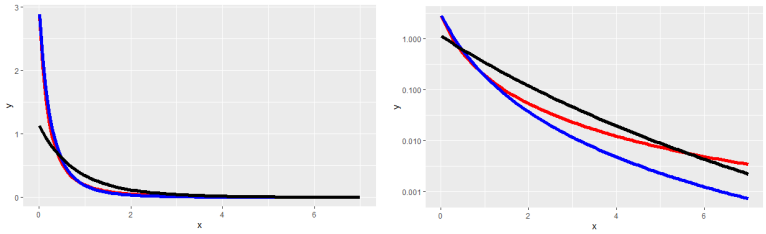

图 4: G_0 distribution of Cartesian coordinates(left) and logarithmic coordinates(right)

3 SAR Image Analysis

In this section, I analysis an image from the given data.Figure 5 shows that the image I choosed.And figure 6 shows that the histogram.

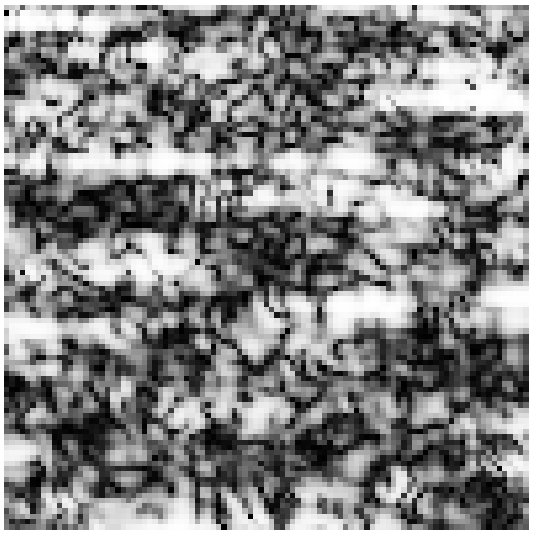

图 5

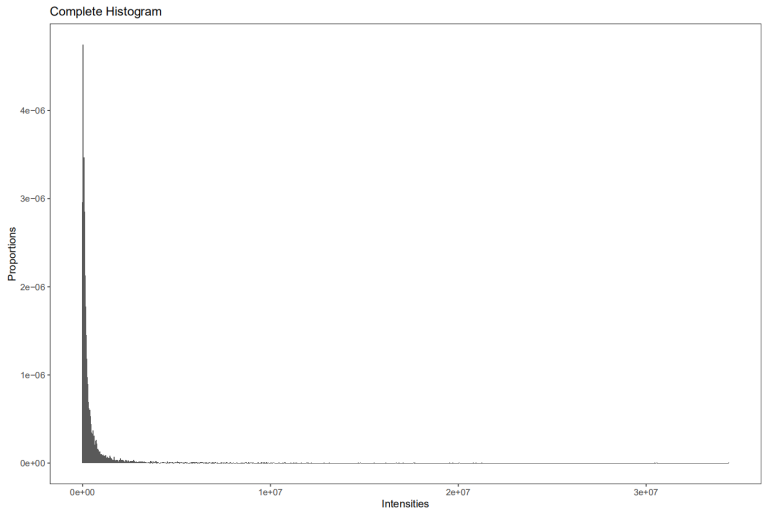

图 6