**INDIAN INSTITUTE OF TECHNOLOGY ROORKEE**

**NPTEL**

**NPTEL ONLINE CERTIFICATION COURSE**

# Digital Image Processing of Remote Sensing data

## Lecture – 10
## Image Enhancement Techniques – II

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Hello everyone and I welcome to this tenth lecture of the digital image processing of remote sensing data course, we have reached to almost midway of this course in the previous lecture I have discuss the image announcement techniques part I in which we have discuss how radiometric corrections and atmosphere corrections can be perform also we have discussed linear contrast stretching some of the techniques of linear contrast stretching.

Now let us go for non linear contrast stretch men announcement where the input and output data values do not follow the linear relationship in case of linear contrast stretching and this is not true they where it has to follow the linear relationship input and output.

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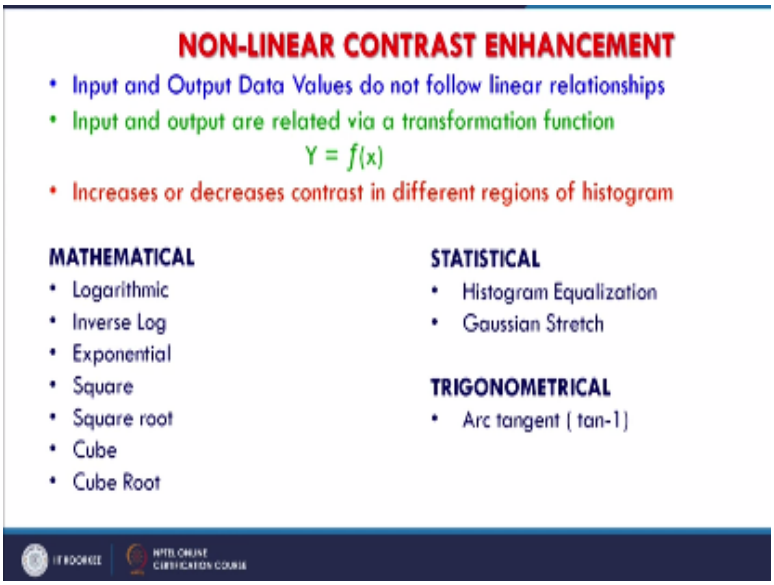


Are values are related by transformation function just y = function f x and a increases or decreases contrast in different regions of histogram. So depending on the requirements the may go for this one and that is there are various ways of involving that is mathematical logarithmic, inverse log, exponential square, square root, cube, cube root. And there are non linear contrast also based on in statistical most popular one is the histogram equalization maybe Gaussian stretch and trigonometrically also very rare to perform but it is available the arc tangent.

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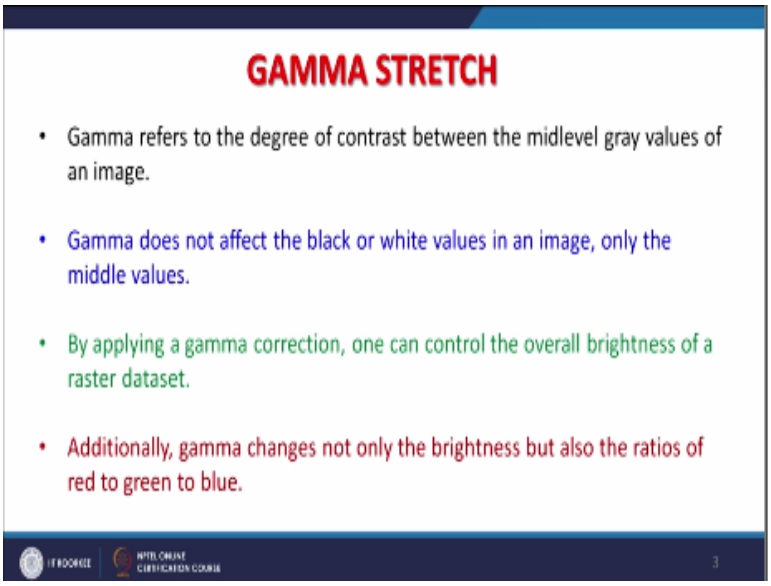


Gamma is stretch gamma refers to the degree of contrast between the middle level gray values of an image. And gamma does not alter the black or white value are affect the white values and an image only the middle values. And by applying a gamma correction because this is non linear stretch so you need not to follow the linear relationship. So where we apply this gamma correction we can control the overall brightness of a raster and dataset.

Very soon we would be seeing some examples of this stretches further the gamma change is not only the brightness and brightness but also ratios of red to green to blue of different bands which are being represented in our remote sensing data. Gamma stretch values less than 1decreasse the contrast in darker areas and in increase the contrast in the lighter areas.

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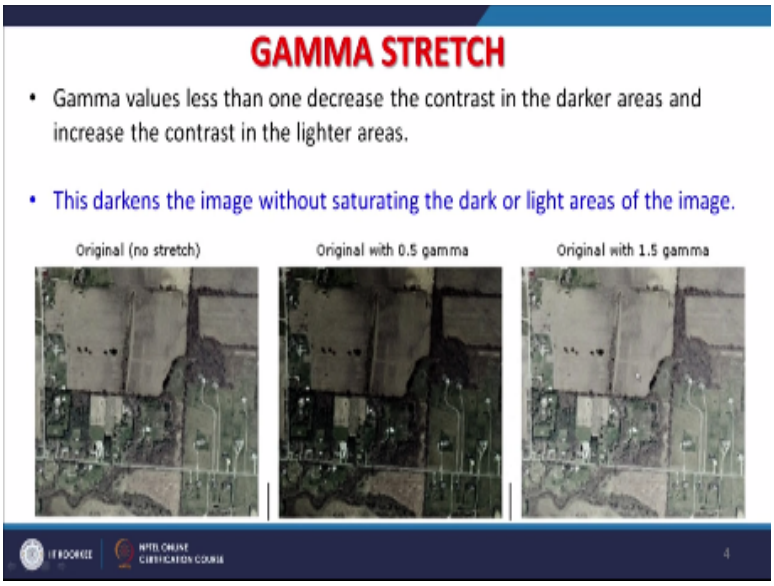


And the this dark and darkens the image without saturating the dark or light areas of the image in linear contrast stretch this was a problem so here three images are shown the same image with different gamma stretch the first one without any stretch and the second one the original with the 0.5 gamma and then you are having the original image with i.5 gamma and you can compare the quality of image like point gamma is has become very dark but whereas if we go for higher gamma then we can have a much better contrast in the image.

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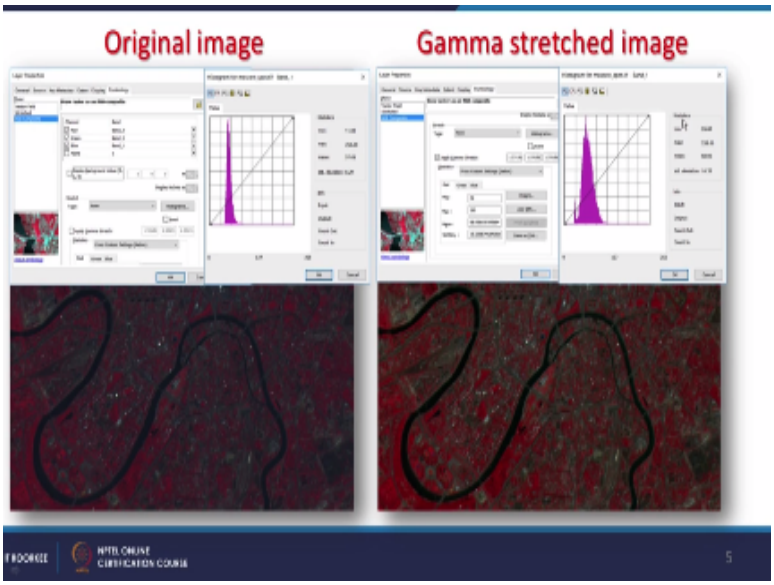


And similarly there is one image which is suffering because of low contrast if we bring ABC say this is the example which I have taken from RGIs and if you see that we are not using any type of stretch the type is none is mentioned here. And when we go for histogram then the distribution of histogram in a very limited drain. Instead of occupant the full range which is available between 0 to 255 it is occupant a very small range minimum value and maximum values are also mention maximum values are only little bit are there but minimum values is just 41.

So most of the data is distributed between 41 to maybe 80 or 90 and there is that is why this image is suffering for very poor contrast so the our aim should be to improve the contrast and we go for this gamma stretch image this is how we have choosing here the stretch accordingly and the quality of image as improved as well as the distribution of the data. After the stretch is also can also been seen here.

So now instead of occupying what is starting over minimum value at 41 now we are having at 26 and the maximum value of course 255 which we is there. So on the right side of the histogram because values where already there so no changes but the contrast as improved on the lower side of the image or the pixel values. And in the next one is the logarithmic contrast stretch which is again non linear contrast stretch.

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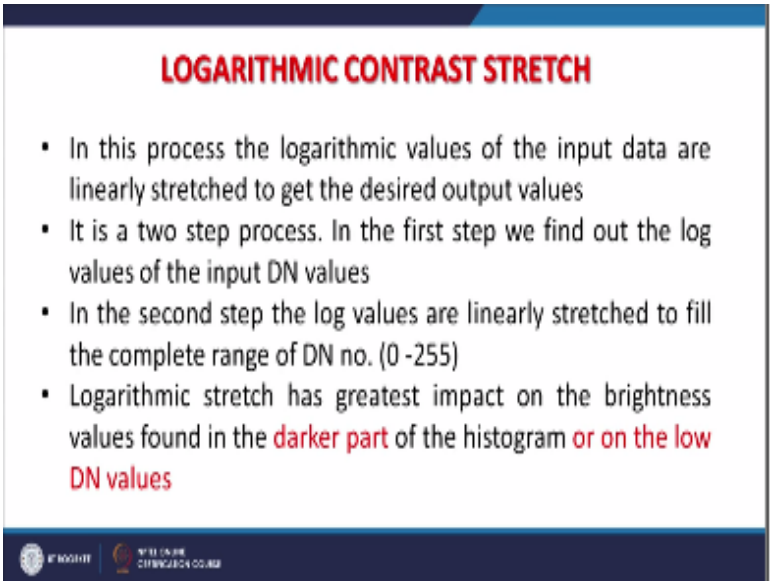


In this process the logarithmic value of input data are linearly stretched to get the desired output values. And a it is a two step process in the first step we find out the log value of the input pixel values and then second step log values are linearly stretch to fill the complete range which is between 0 to 255, in case of eight bit image generally and the image process systems which we are using based on the eight bit image processing system.

Logarithmic stretch is greatest impact on brightness values which are formed in the darker part of the histogram and on the low DN values. And generally the distorsons are coming only mainly on this side here the example of both non linear and linear contrast stretch is giving that logarithmic will come on this side.

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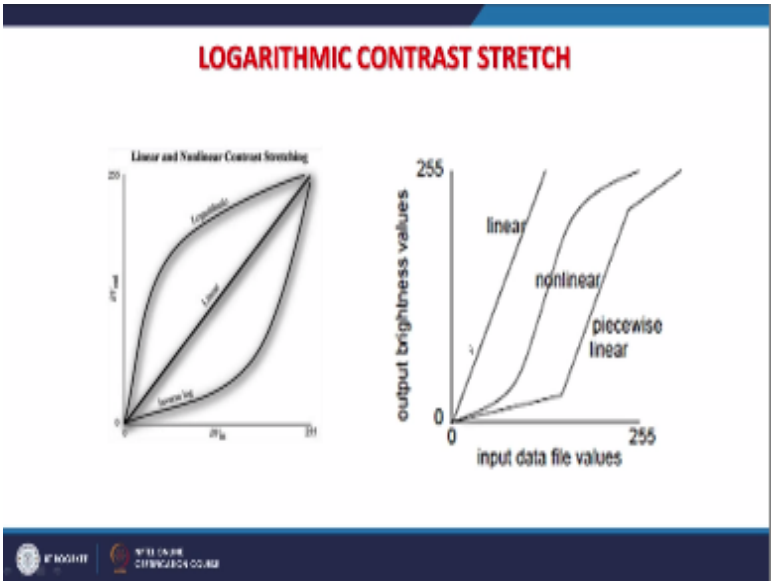


And where is a inverse log will come like this, and this is how this is the sort of LUT these are the brightness values input brightness values these are the output brightness values. If we go for different type of stretch like instead of linear we go for nonlinear then we can go for this kind of chip or piece wise linear contrast stretch is also possible. So input values are between this range and output are coming generally between 0 to 255.

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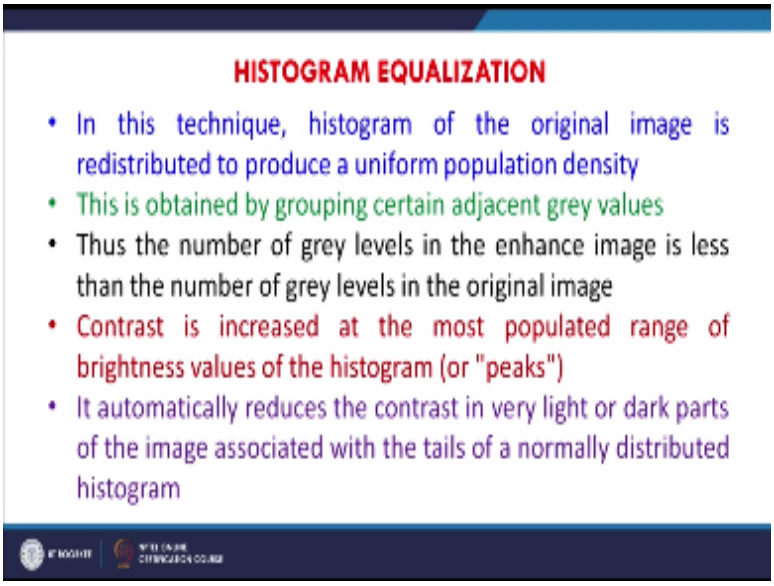


Another very popular one contrast stretching which is non linear of category is histogram equalization, and this is based on basically the frequency of pixel so in this technique the histogram of original image is redistributed to produce a uniform population density as I mentioned that the bars you can take or you can think like this the bars which are original histograms are having a small height will be redistributed in manner should be all bars having the same height.

And that is why it is called as to the gram equalization, so this obtain by grouping certain adjacent and gray values and thus the number of gray values in the enhance image is less than the number of gray value levels or values in the original image. And contrast increased at the most populated range or the brightness values, so wherever the most of the values are there pixel value are in histogram there the contrast would be the maximum and there is the real target actually the teal end if been improve the contrast of the teal values then it does not improve the contrast of the image much.

But if we improve the contrast of the where the maximum values or the highest frequency pixel values are present then definitely contrast is going to improve we will see the example through the image is as well. So it automatically reduces the contrast at the both ends that is very light or dark parts of the image associated with the tails of a normally distributed histogram.

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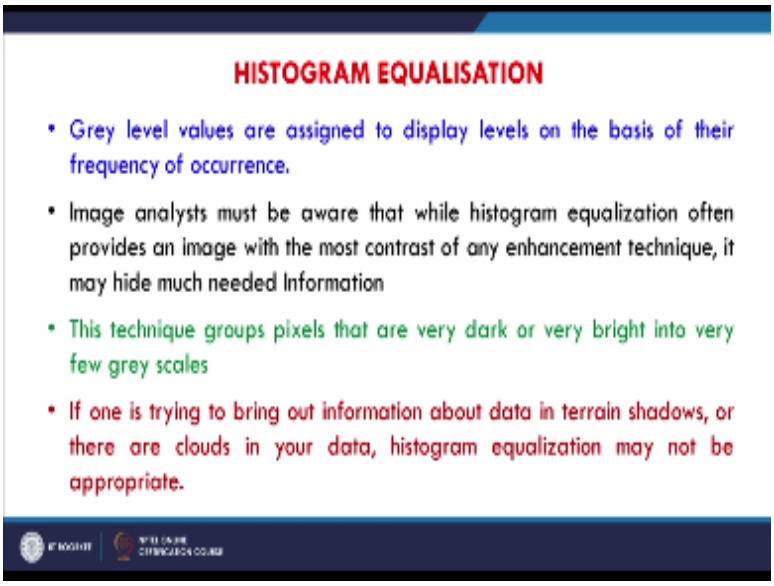


And in histogram equalization the gray values are assign to display levels on the basis of their frequency of occurrence and image analyst must be aware that while histogram equalization often provides an image with the most contrast of any enhancement technique it may height much needed information. So whenever one is going for this kind of enhancement one should take care that it is improving some time too much contrast within the image.

And if you are going making interpretation based on histogram equalization contrast stretch one as to be careful and this technique groups pixel that are very dark or very bright into very few gray scales. And if one is trying to bring out information about data in terrain shadows, or there are clouds in your data then histogram equalization should not be applied.

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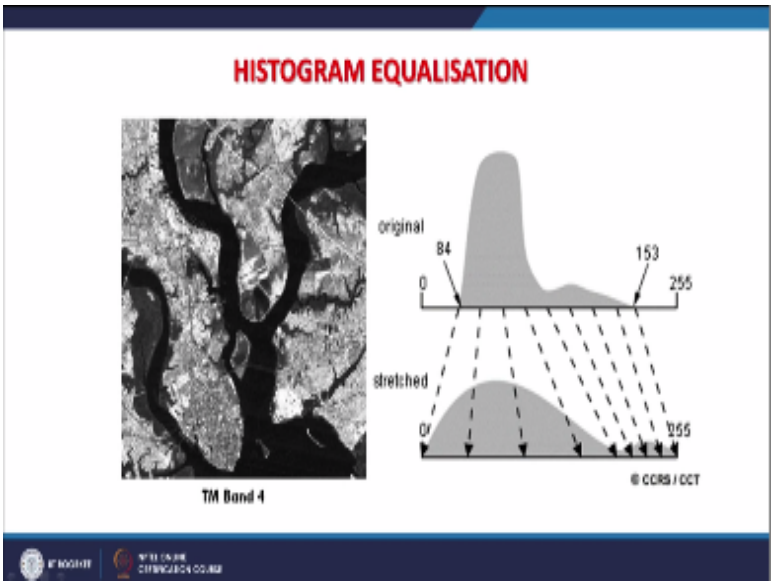


This is the example of histogram equalization that here the data is distributed like this when histogram equalization is perform this high frequency values where the maximum values where there I have been redistributed like this and a image contrast has improved very significantly.

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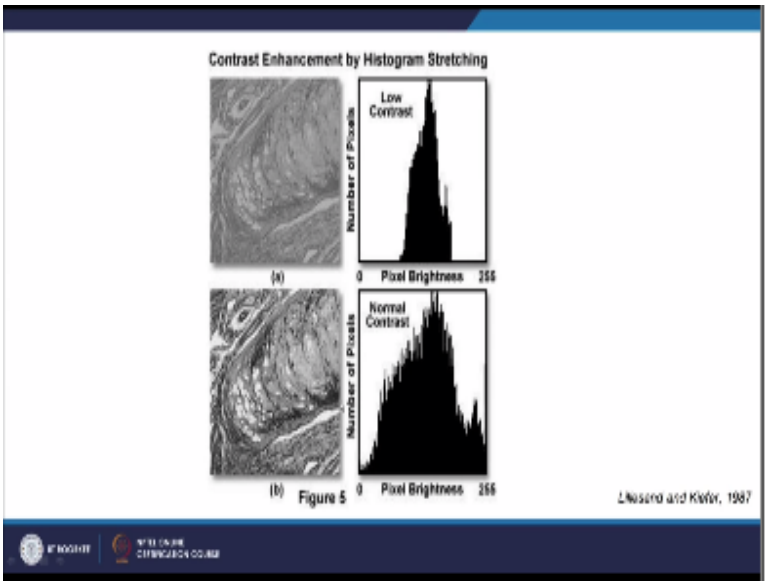


Similarly here one example this is the original image and this is the original histogram of the image but once it is histogram equalize stretch is perform then this is how the distribution in the histogram. So it occupies almost full range but the middle range values are stretch maximum where you are having high frequency of that. Here also one example is through this RGIs is that this is the distribution of the data.

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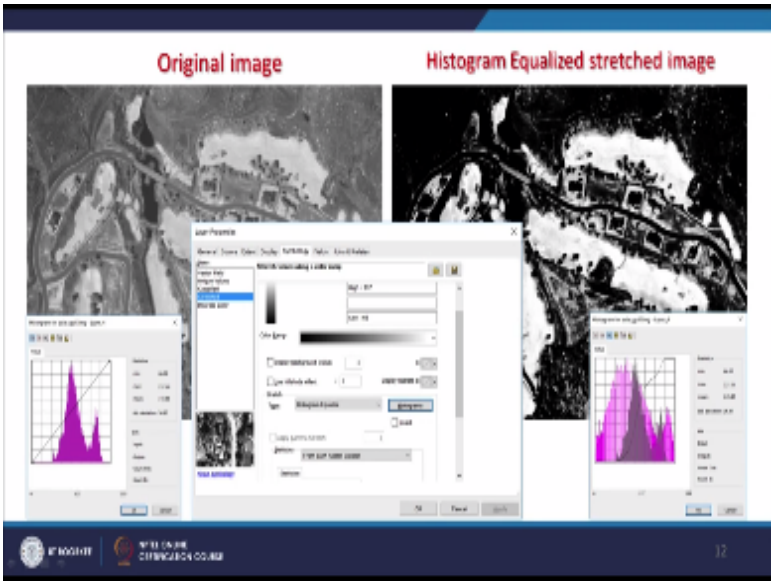


Through histogram and histogram equalize image this is the one as you can visualize here with while comparing original image with histogram equalize image that you are having very high contrast. Sometimes for a better image interpretation one do not need very high contrast so one can avoid for that in that case but otherwise it is a very good technique the original histogram in the re distribute histogram through after the histogram equalization stretch is a both are shown together here.

Which you can realize that how this has been redistributed. Here also the histogram equalization of some in RGIs as I bring in choosing and the image has been enhance.

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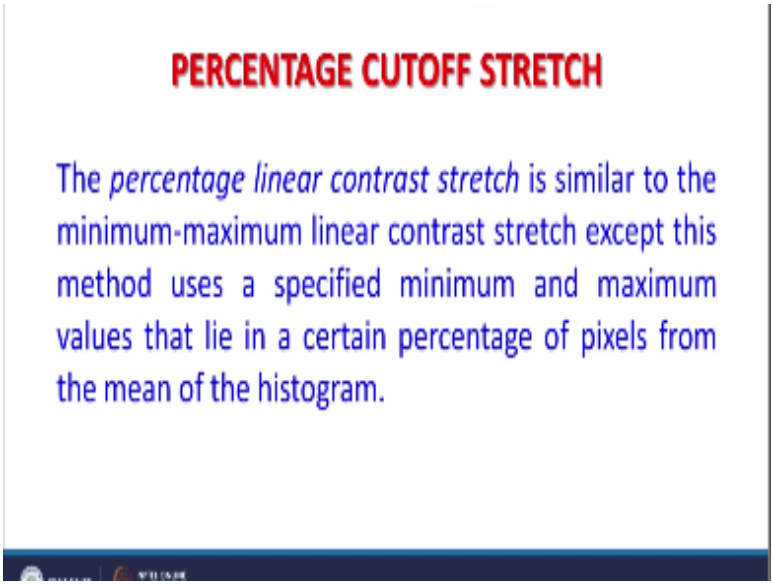


There is say percentage cut of a stretch so that you cutter that this much data I do not need on the tail values and then in between the values are stretch so the percentage can linear contrast stretch is similar to the minimum maximum linear contrast stretch which is most common except this method the uses a specified minimum and maximum values. User will define or decide which are the minimum values or maximum values.

Rather than the original minimum and maximum values of the image there are you can also involve the statistical data or techniques so like standard duration contrast stretch or linear stretch can also be performed which is more or less similar to minimum maximum linear stretch.

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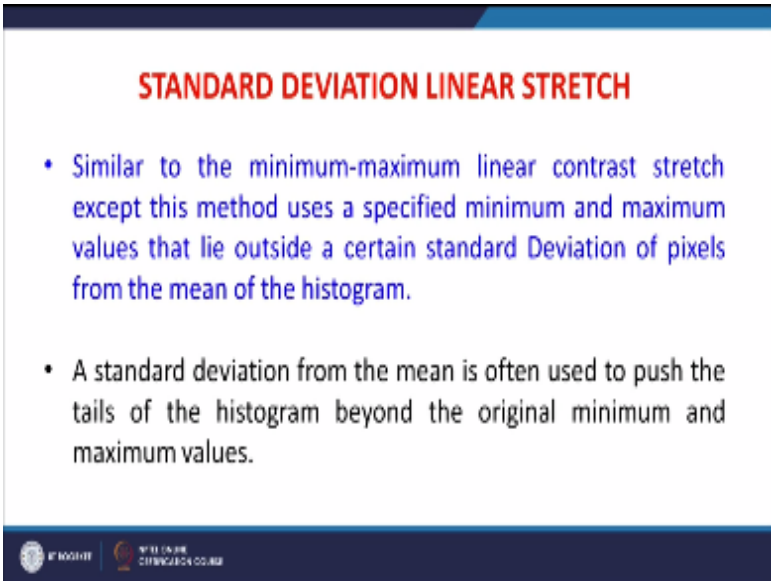


Except this method uses a specified minimum and maximum values that lie outside a certain standard division of pixels from the mean of the histogram, and the standard division from mean is often use to push the tails of the histogram or values low and high pixel values beyond the original minimum and maximum value.

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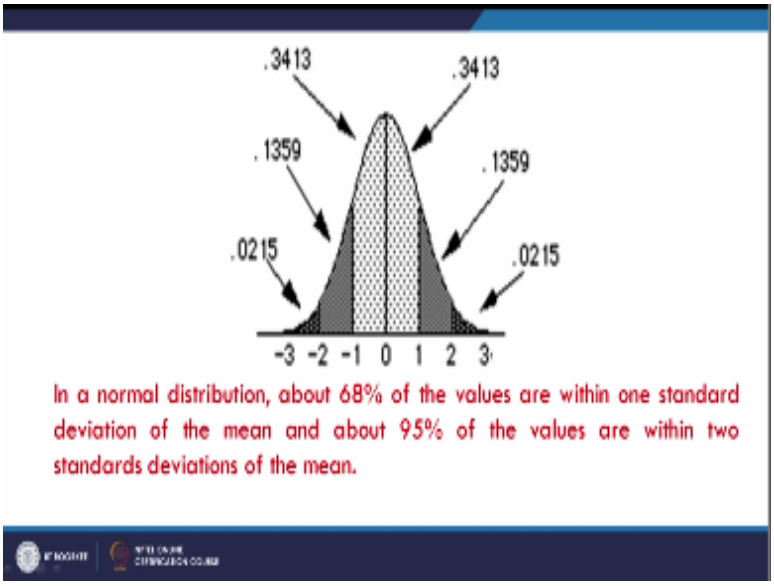


So like in version distribution schematic it is shown that one standard division and then two standard division three standard division how so in a normal distribution about 68% of the values are within one standard division of mean and about 95% or within the two standard division as you one can. So there are only 5% of the data remain and the tail.

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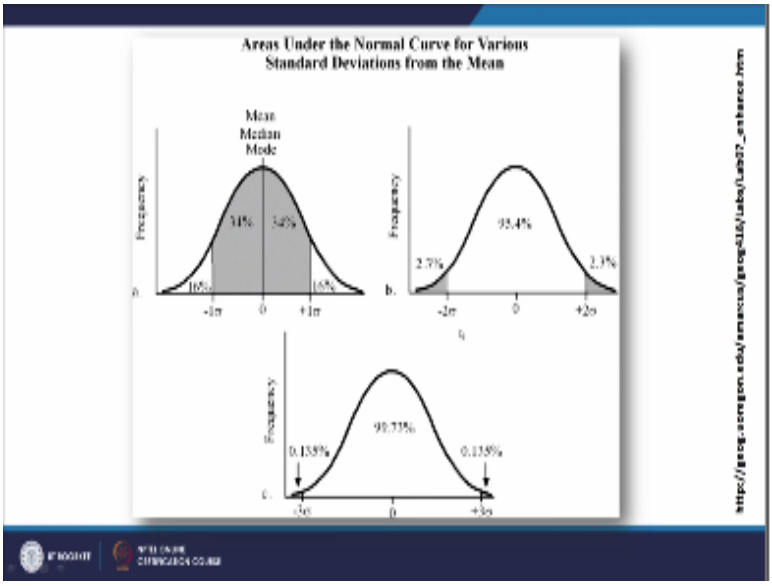


So areas once we do not take that much area so areas under normal curve for various standard divisions from the mean are shown here, which we can see that in when we go for two standard division roughly only 5% or less than 5% area is left.

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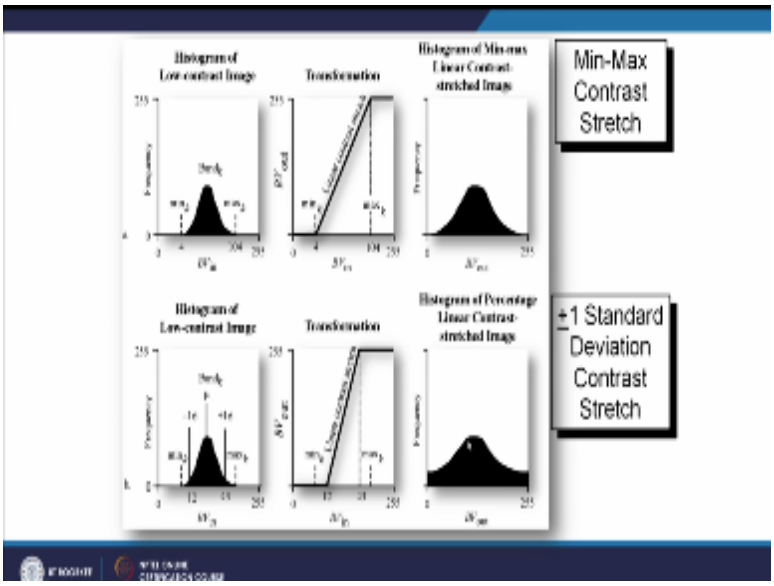


So here the LOT is for different like in histogram of low contrast image when we go for this then this has how LOT will look and the minimum and maximum values are stretch here so this is the minimum maximum contrast stretch when we got for this standard division one standard division contrast stretch so one standard division value no lower 68% of the values. This is the LOT of the same and this is how the distribution of the values in histogram will look.

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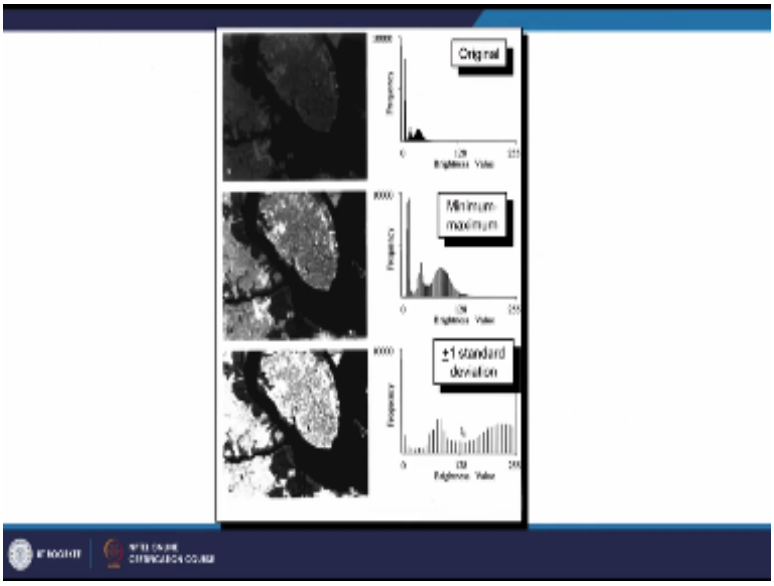


Now we see in case real image this is the original image and the corresponding histogram which you can see and not much distribution is there are therefore image is completely dark hardly one can make any kind of interpretation except can see to measure areas but a simple minimum maximum stretch we can do that performance but it maximum values goes up to say 140 or 50, and therefore you do not have even much contrast as one would like to have.

If I go for one standard division then I am occupying the entire range which is available for us between 0 to 55 and then contrast of the let us say satellite image improves very significantly. So original image one more example here the same image which we have been taken in previous example in case of gamma stretch and other stretch is that this is the original image.

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Originally image is not that bad but if you go for standard division stretch it improves further very significant improvement has been made in this image and after this standard division stretch and we can our interpretation will definitely improve this is how the distribution or histograms both original which is in darker or black area and then the stretch bun is also shown and ion the example of RGIs this is what you would chose standard division and this area going for 2.5kind of thing.

So this brings to the end of and this enhancement part which is the second part of a digital image processing technique. Thank you very much.

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