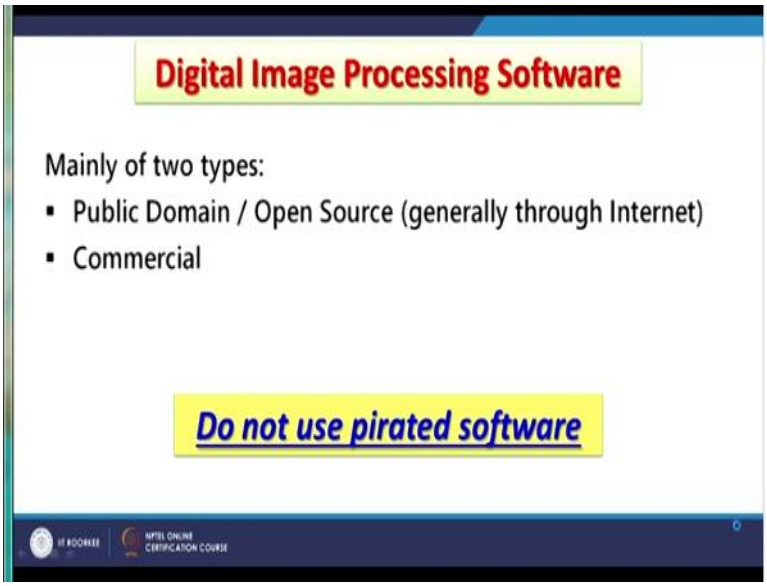
Remote Sensing essentials
Dr. Arun K. Saraf
Department of Earth Sciences
Indian Institute of Technology-Roorkee

Lecture-23
Digital Image Processing Software-Demonstration-1

Hello everyone and welcome to this demonstration of digital image processing software this is part 1. In this one we will be having demonstration of a very simple but very useful software to understand thus what basically goes behind the digital image processing softwares. Before that as you know that these slides I have already covered but very quickly I will go through because these are relevant here.

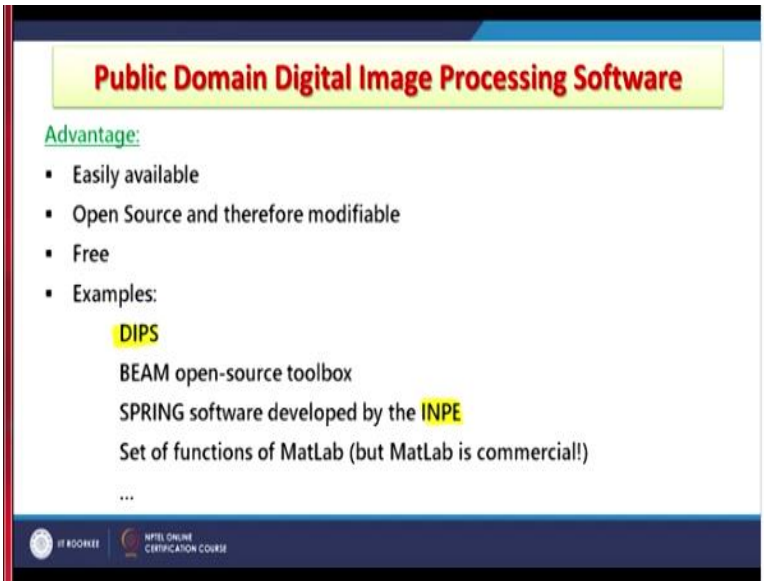
As you know that there are 2 types of softwares one is in public domain, so the software which we are going to use for the demonstration is purely in public domain.

(Refer Slide Time: 01:08)



And not really I would say open source but this is freely available on net and there are commercial software. So one day we will be also having demonstration on commercial softwares as well.

(Refer Slide Time: 01:21)



And what are the advantages because **e** easily available public domain software which you would see very quickly that how quickly these can be downloaded from net installed on your machine and start working quickly. They are also modifiable but this one which I am going to demonstrate is not that but if you write to the developer definitely he will incorporate your suggestions, of course these are free and examples DIPS.

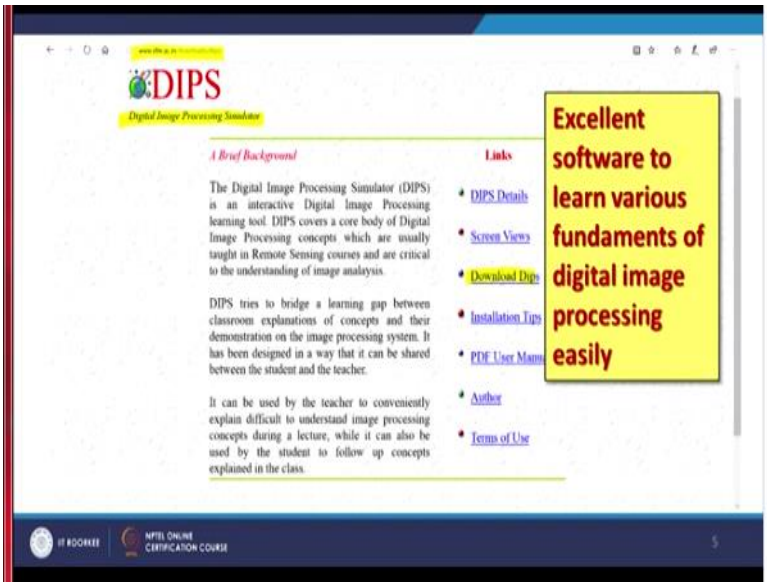
So this is the software which I am going to demonstrate which stands for digital image processing simulator. Basically it shows how in the background what kind of processing or what kind of calculation for individual pixels goes on, so very useful for understanding the things. There are some other softwares like BEAM and SPRING software developed by other organization INPE is the Italian organization.

Of course MatLab as discuss earlier, the MatLab is though commercial but there are lot of functions which are available free of cost on MatLab. And the list which I have shown is not really exhaustible there can be many such softwares. But are the disadvantages very quickly, generally no support is available. This is the main problem with the public domain or open source software basically nobody owns them, so that is the problem.

A QGIS is a very popular GIS software is also been public domain software but it is open source one can modify. There are communities associated with the softwares, so they keep informing

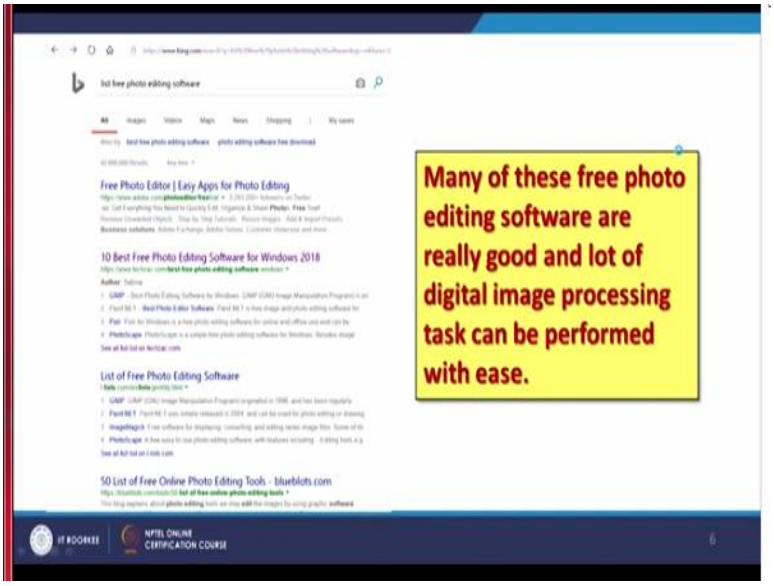
people this is the software, which I am going to demonstrate it says the digital image processing simulator.

(Refer Slide Time: 03:16)



And if you go on this web page just type on Google that DIPS download, you would get the access to this page. And while going here, you will have a file and just install that one and you get that one it is as I have mention, it is excellent software to learn various fundamentals of digital image processing and that to very easily .

(Refer Slide Time: 03:44)



There are some other softwares are also, so no need for going in detail about those softwares and now I will be showing the demonstration of that software.

(Refer Slide Time: 03:59)

Then you will install the software this is how you would see on your screen.

(Video Starts: 04:05)

So first I will go for this one which is RGB viewer. Because when we go for false colour composite images we use 3 channels and how individual pixels, how they are arranged and how the values are calculated, this is what I am going to show you. So if I choose a blue band here and green here and red here and give some values here.

Like I am giving some value for blue and which would be very visible soon also something like this and I say ok, so. Now what it is saying that since top is the minimum value and bottom is the maximum value and since green is having maximum value that is 146. And whereas you know red is having 55 and 90s this is having 37 and therefore the overall presentation in false colour composite for this kind of combination of bands for that particular pixel is going to be this green one.

If a infrared channel is there and say it is giving large value and high reflectance in infrared channel and low reflectance in green and low reflectance in blue, then I say ok and it gives the red colour. So likewise you can really see understand that how in a colour composite whether is a false colour or true colour or you know near true colour whatever, how these combinations of

different bands and their corresponding values in different bands will create a new colour in the false colour or colour composite.

So this clearly demonstrate you can change these values also and you know keep changing and see that if I say here infrared. I declare that this is the infrared channel and it is having high reflectance immediately I get. So you can have pseudo colour, you can have infrared colour and so, and if you play with this one I am sure you will be able to understand this colour combination thing, which we have discussed just in before geo referencing lecture. We have discussed colour space, so those concept now are being implemented.

In the commercial softwares which we use like radar or RGIS or other softwares or NV, for digital image processing. The things which goes in the background are not visible to us directly, we just see the results. Sometimes we do not have controls or we do not see what kind of calculation is going on, we just depend on assuming that software is doing right calculation.

But in this particular software, we can understand how calculations are going on, even for a simple colour composite. So you keep you spend some time on this and I am sure that in few minutes time, you would be able to appreciate the application of this software, basically for understanding. Then we are having another routine which is a pixel animator, what we are going to do that when we say I want to create composites, 3 bands band 1, band 2, band 3 are shown red, green and blue.

And when I say create composite one by one pixels will keep coming, so as you see here the top most top left corner pixel of all 3 bands is picked up. And when I say ok render that one now in this blank image it will be rendered there and it goes there. Then next pixel, and now the colours depending on the values of those pixels are coming in this image. So in the previous simple exercise which we did, where we were able to change the values, here 3 bands means the 4 by 4 matrix 4 by 3 matrix of 3 bands were provided. And when we go for 1 by 1, we can create these colour composites.

So I will do it again that when I say create composite now see that input values are this 87 45 and 95. And when once I accept that the colour which will be created because of band contribution of band this band 1 that is red band, green band and blue band. Because if there the blue band had a very high value 95, green has 45, where a red also had 87, so that is why that colour in the first pixel you are seeing.

Now in the next band it is going to be the very much blue because blue value is 98 rest values are 10 and 11 respectively and therefore it is going to be blue. Now here, the next pixel that is the third pixel in first row is going to be more red this is what we see. So likewise as you can see, it will be doing this thing, if I apply a stretch, linear stretch on this one then see what happens I apply linear stretch and see that values.

Now it is a doing a linear stretch at the same time for all input pixels. So once I have selected these 3, 4 by 3 bands images are still there, the same images. For the first pixel that the top left pixel again at 87, 45 95 and I have now asked to stretch it. And when I choose this option see the calculation on the right side, how it is going on, as you can see here, that now for band 1.

The value is coming for 245 instead of 87 because it is a linear straight how this value is coming, that 87 is the input value - 10 that is the minimum value within that band. And the minimum value in red band is 10, which you can see also then divided by 90 that is the highest value within that band minus again minimum value. So the formula is for new value for a stretch linear stretch the formula is that new value equal to DN that is digital number of pixel value - minimum value within that band divided by maximum value - minimum value.

And these values have to be rescaled up to between this 8 bits between 0 to 255 therefore multiply by 255. So when we go for this kind of calculations, we see the linear stretch on our images. This is what exactly happens in case of commercial or other softwares but in background, what kind of calculation for each pixel each band is going on, we generally do not see in front.

But this software, the simulator is really in that way very good to know how this calculation is being done which formula is being applied for which kind of a stretch. So now I accept this one see the previous image which I was getting without a stretch was completely different then now this one. So as you can see here when I go to apply the stretch, so let me repeat this exercise and that create.

And now what I am creating is the original image without a stretch. And now when I apply it stretch and then refresh it and again I go for a stretch, this is still unstretched and now I go for a stretched one and create composite. So see what will happen pixel by pixel will stretched here and this is what you are, you see in a, so if the previous display had the raw image without any stretch.

Now, the current image in the bottom is having stretched image, simple linear contrast stretch and the formula which has gone is very simple one that new value equal to DN - minimum value divided by maximum value - minimum value. And rescaling has to be done for entire pixel value and therefore, multiply by 255, so this is 8 bit scenario. And likewise, we will be seeing some other tools available with this software for better understanding.

So 2 RGB viewer and pixel animator we have now demonstrated. Now I will go for a recall that when data is acquired by some agencies, that data might be in BSQ format, might be in BILL format or might be in BIP format. As you can see in the bottom that I can this is the data I can tell that this read this data in BIP format or in BILL format and that. So of course, we know beforehand that the data has come in the BSQ format suppose.

So suppose the data has come in the BSQ format. Now, how it is stored that it will be shown to us, so now I will ask this software to you know slowly bring the data you know in BSQ format. So, what is, it is constructing the image and from BSQ format band in sequence. So first it has created the band 1, now it has also created band 2, for next pixel now is reading for band 3 and likewise it is now reading for band 3, so this is 3 band scenario.

Because the green line which is showing the pixel values or in a one single you know sequence and generally when we used to have data in magnetic tapes, cassettes, CCTs or then we used to have data like this only. So if we know the data is in the BSQ format and this image is going to be form is 3 pixels by 3 pixel in this scenario at least in this example. Then how it will be red, so I will again do it with the same thing the top one initially you would have header information.

That in header information, which comes along with these tapes in the first few you know bytes will have the header information also you are having trailer information. So these 2 information in between these 2 sets of information you are now having the real data that is the pixel values. And it will also tell you header information that you are going to have 3 bands and in this example 3 by 3 in pixel terms 3 by 3 pixels. So again I will say that, so you know now I will go for fast read, so I say like this or I may go for slow read just for slow demonstration.

So now it is constructing, reading now it is using third pixel see the when it is read the fourth pixel it has gone on the next line because it is already declared that my image is going to be 3 by 3. So band 1 is now complete now for next band like this, next band is now being red and for the last band third band as the third line is being red and finally everything is over. So when data is in the BSQ format, this is how we will be retrieving the data.

Similarly when data in the BIL format that vent interleaved by line, so the first line of band 1 then you know first line of band 2 then first line of band 3 and likewise. So when I go for a reading of that one so, now it is reading and see what happens that now it is jumping and it is reading that creating this one. Now when I go for the next band, it is now reading the another one see it is has jumped after this one and as soon as I press here.

For the next read it will jump to fourth place and then again likewise because band interleaved by line here this is how it will read. All 4 have been all 3 bands have been read, if the data has come in the BIL format. If the data has come BIP format that is you know band interlude by pixel, then how it will be read by the software or by the tools which you are having. So here you see the it is jumping in the top green layer and now first one, now next likewise it will be band interleaved by pixel.

So the first one was the band sequential format, one band then next band. In BIL, the first line of band 1, first line of band 2, first line band 3 likewise and in BIP format, first pixel of band 1 first pixel of band 2 then likewise. So this way we can understand very easily that how the data in these 3 popular formats are written for raw images, once the image is there, then rest of the things will follow.

Now similarly if you are having we also discuss that sometimes there are errors in the data, the very common error is the drop line, you may suddenly there is no data for a particular line. So how we can remove this error by averaging this one, putting the average value against this pixels from. In this particular example, I will be showing that from top line and bottom line. So one line up and one line down these 2 values will be read their average will be put against the 0 values on this line drop out image which you see on the left side and then see what happens.

So now I go one by one and I say corrected drop out, so as soon as I say how it is being done see 135 that is the top line pixel and 102 divided by 2 that is 118. So then average of 1 **1** pixel top and 1 pixel bottom up and bottom down, that is average value has been assigned to this value and that has been put against that 0 is 180. And likewise, the entire line which was dropped out and if I display in my image, as you can see here, then I saw a completely blank line.

So I will do this one again by refreshing the things see this image which is being shown in grey colours, black and white and a line is completely blank here because corresponding values are 0. So when I you know correct this line dropout by a very simple formula using 1 pixel up and 1 pixel down average value and putting and assigning that value to the 0 value then see that what happens to the output image that blank line which you are seeing of 4 pixels is disappear.

So now it is correcting as can be seen here that this value is being replaced by 118 and again. And by this is the values have been replaced and you do not see now the dropout line and image is corrected. But is such you know if these are the regular you know, systematic errors in your image. Then it is easy to correct it but when it is not systematic then individually pixels have to be handled like this.

So, dropout issues or stripes issues in the images can be handled like this by just taking the average of surrounding pixels one up and one down and putting that value against that 0 value. Because remember these are taking the example here is 8 bit scenario and we have only integer values. So if no signal has been received by the sensor due to some reason, maybe natural reason or unnatural reason.

Then it will assign 0 value, though 0 is a value there might be some features which will have in real sense they may have even 0 value might be like, absolutely pure water in a very clear atmospheric conditions may have value 0. But when along a line all values are 0 then we can say or recognize that this is a line drop scenario, it is not a natural phenomena. And when that object is not natural, it is a line because of some errors in the sensor due to some collaborations or might be some other issues, then this can be corrected like this.

Also we can see like there are you know other way salt and pepper way of doing this thing like instead of continuous. You may have a scenario something like, that one value is 0, another value is the maximum that is 255, another pixel value is 0 then again the value is 255. If salt and pepper kind of noise that is also sometimes seen in the sensors, so how we will correct it, again the same way that we go for this one and we try to correct that one like this scenario.

So if I correct this pixel likewise, so I get these values. So, now here 255 will be dropped and that will be replaced by 80 which is 1 pixel up and 92 again 1 pixel up average of that one 80 pixel like this. So when once I go for this correction this is more manual correction but ultimately I get rid of these pixel values. Same here, so I can get this type of corrections as well. But these are really if errors as I have been saying earlier, I will repeat again once more that if errors are systematic it is rather easy to remove them.

But if errors are non systematic then sometimes it becomes very challenging ok. Now here there are some other useful things are there but since we have not covered in theory part. So we will stop here and I hope that you would download this software and try to run at least these top 4 tools and see how things happens.

(Video Ends: 25:31)

So this brings to the end of this discussion thank you very much.