Course on Introduction to Medical Imaging and Analysis Softwares
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Module 01
Lecture 03: Magnetic Resonance Imaging

Welcome to our today's topic and this is on magnetic resonance imaging this is yet another interesting modality as well. So in the earlier one we had studied the first imaging modality which came up which was on x ray and from there we went on to how to look into 3d spaces and that using computed tomography. And the next one which we do over here is called as magnetic resonance imaging. And you might be curious as to why do we have these two words magnetic and resonance and like how do we even use it for imaging.

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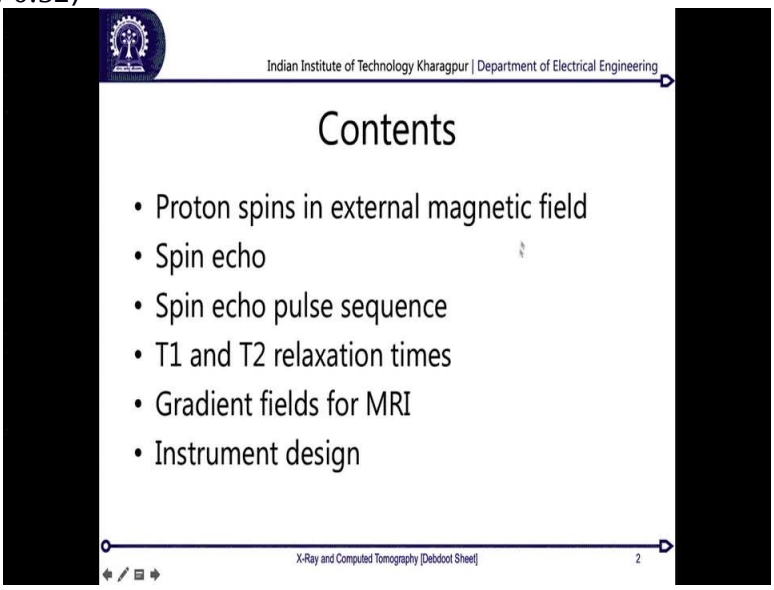

Now to making it even simpler let me just go through the contents what we are going to do. So basically first topic is on Proton spins in external magnetic field and this is where I will show you that basically your body is made out of multiple numbers of small magnets just because of the amount of water you are drinking. And that is what we make use into something called as nuclear magnetic resonance and from there this nuclear magnetic resonance is actually used into a imaging concept over here as well.

So from there I will enter into something called as this Spin echo and the Spin echo pulse sequences which actually helps us in doing two different very interesting kind of imaging modalities in T1 and T2 called as also called as fractional MRI. Now till over here there is nothing to do with imaging which comes out it is just with signals associated with resonance between with some sort of a resonance of the small magnets within your body which is caused again by the water itself.

Now in order to create an imaging you need to discriminate between small parts of your differently and that is where we enter into something called as a Gradient field in MRI which is quite an interesting topic of basically creating a spatially resolvable magnetic field inside a space such that I can look into different parts of your body in a different way. And from then, we will enter into the instrument design and once we have finished all of this we have small demonstration on how to look into a dicom image which is a continuation of the last lecture on CT as well but you can use all of those viewing principles for the rest of your images in 3d for any of these modalities as well.

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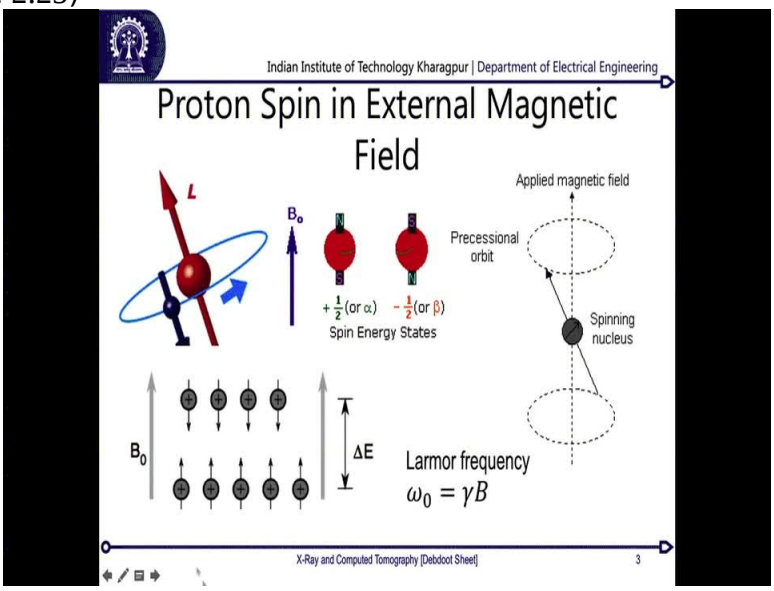

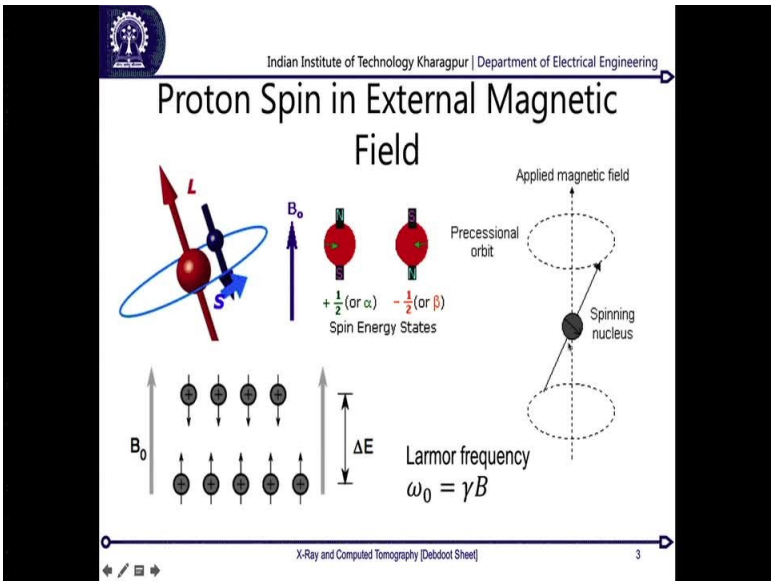

So without delaying much let us enter into what I wanted to say with this one over here. Now see that whenever you have a electron which is rotating around nucleus so this whole spinning electron over here, so you basically have a nucleus and you have an electron which is spinning around this one at a very faster rate.

Now, if you look at the total atom together so in this also needs to be in terms of its equilibrium. So the moment angular momentum caused by this spinning electron over there has to be somehow compensated by the nucleus by speeding in the opposite direction as well. And that is why your nucleus is also spinning in the direction which is opposite to the direction of spin of the electron and it is spinning at a much slower rate and that is because the angular momentum of the electron although it is spinning at a much higher rate higher speed but the mass of the electron is much lower.

Whereas the mass of the nucleus is much higher and that is why it can spin at a much lower phase in the opposite direction and still have a decent compensation of the whole momentum such that the total angular momentum of one of your atoms is always preserved. Now, look into hydrogen as the first atom where we are trying to look over there and the interesting fact is because you have just one electron which is spinning in one one electron which is spinning in one direction.

So you had something with two electrons over there then since the electrons are spinning in opposite direction my total nucleus does not need to spin in (())(3:49), there it is already compensated. So always whenever you have an odd number of electrons present in the valance band, only then you will see that the nucleus is also spinning in the opposite direction. Now as this nucleus keeps on spinning because of an hydrogen where you have one neutron and one proton present over so you generally have one proton if it is h1 if you have deuterium or h2 you would be seeing one proton and one neutron as well present over there.

So in either of this cases over there. Now since this charge positively charged particles which is the nucleus which is spinning around its own axis so that is obviously going to create some sort of a magnetic field as well, okay. The electron is spinning at a much higher speed so the magnetic field over there is very different from the magnetic field which this one is going to create and in total cumulative summation of the magnetic field of this electron and the magnetic field created by this proton will end up being as to an effective magnetic field of atom in one particular direction, okay.

So this is what will happen, say that it is spinning at one of these directions so we have a north-south and also the whole thing can be in a different form as well which is called as negative half spin over there and that is when it is spinning in the opposite direction. Now, say that we have an external magnetic field which is B not, okay then any kind of a magnetic dipole can align in two ways, either in a low energy configuration which is it aligns itself along the direction of the magnetic field or in a high energy configuration which is it align itself opposite to the direction of the magnetic field.

But in whenever whenever it needs to stay in some sort of a energy equilibrium, most of them will be aligned along the direction of the magnetic because they are supposed to stay in a low energy state. Sometimes there will be a few of them which will be aligned opposite to the direction of the magnetic field and this comes down from the fact that generally whenever everything is spinning in its own way the total net magnetic field effect produce by your human body is always 0.

So some of them are in low magnetic field, some of them at high magnetic field that is why they oppose each other and cancel out total magnetic field over there. But if I am putting down an

effective magnetic field over there, everything needs to realign itself and for that reason some of them which were at some haphazard orientation they will be aligning themselves with this orientation over here.

Now from haphazard orientation to this orientation when it comes it loses some energy which is passed on to some other ones which will align themselves opposite to this by taking down a higher energy state and there is a total difference which is called as delta E, okay. Now, along with that another interesting finding which comes out is that as you have a magnetic field B not which is applied over here or say some magnetic field B, these spinning nuclei they rotate at a particular frequency which is called as omega not or also called as a larmor frequency named after the inventor of this particular phenomenon.

So this is proportional to a ratio called as gamma which is also defined as the gyromagnetic ratio of any kind of a nucleus. Now for every single atom, each nucleus has its own gyromagnetic ratio, so if there is odd number of electrons present over there this will have some sort of a gyromagnetic ratio and if you can give down basically a particular magnetic field and just look into what are the frequencies of each of them you can actually find out which atom is present over there and this is the concept of nuclear magnetic resonance or NMR, okay.

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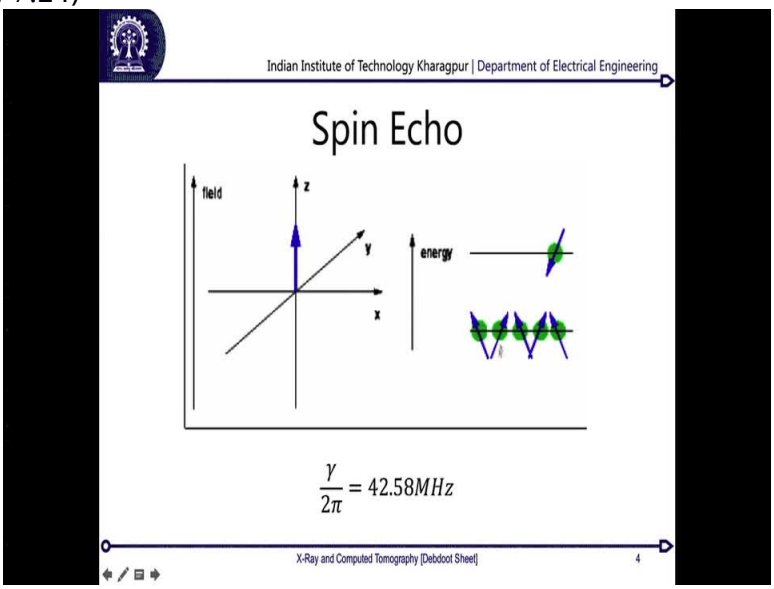

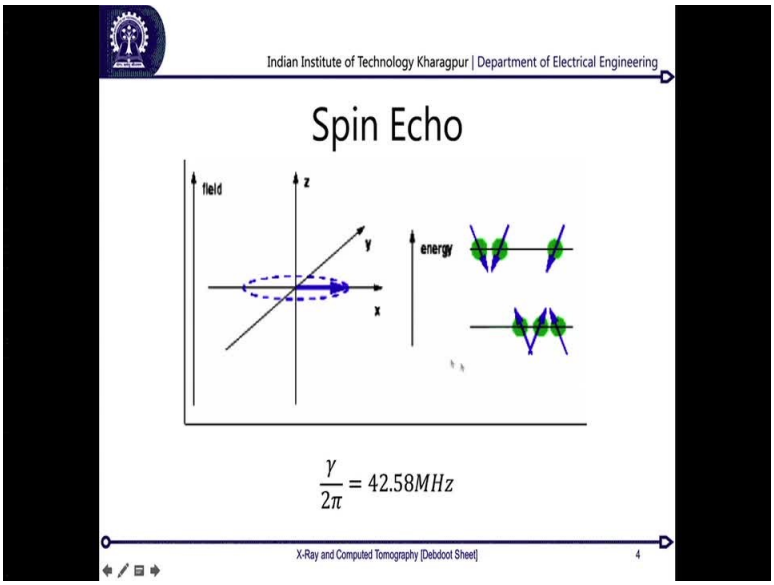

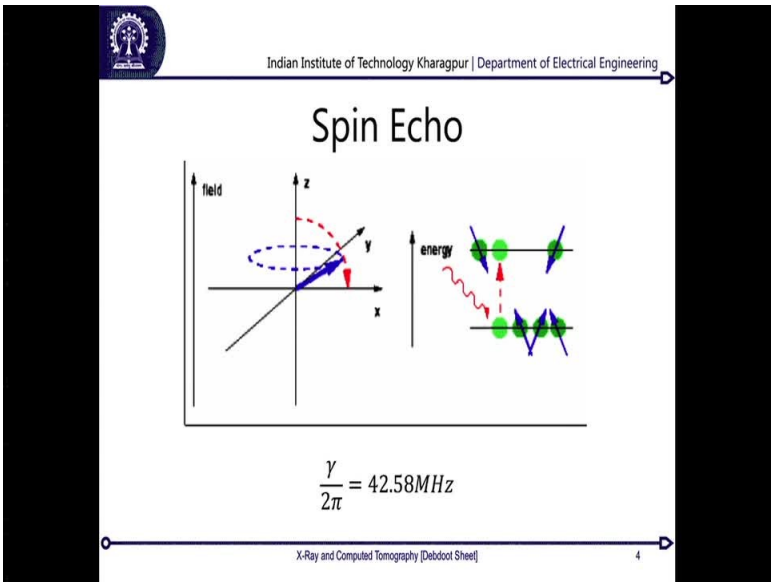

So from there we come into our first part of it which is called as a Spin Echo and this is what I was explaining you earlier. So if I want to basically align something from a lower energy state to a higher energy state, so I will have to provide some extra energies over there. So in general what would happen is that most of the things will be present in a lower energy state most of these is atoms whenever we are proving some magnetic field energy and keep in mind that this has to be given down in a so whenever you are giving this energy extra over there so this has to be resonate with the spin of the nucleus itself, otherwise the energy is not going to get absorbed.

So whenever we come down to a different concept called as RF coils we will come into the what comes in terms of a radio frequency over there. So as of now remember that we are going to give down certain energy and this energy is going to be in sort of a electromagnetic pulse where the electromagnetic pulse has a same frequency as the Larmor frequency of the atoms to which we want to excite over there.

And this is from where we say that all of this MRI imaging which we are going to do they are depended only on hydrogen atoms because we are going to stick down to frequencies specific to hydrogen atoms itself. So say that this gyromagnetic ratio (div) over here for a hydrogen is just 2 pi times of 42.58 megahertz, okay.

So if I give down 1 tesla of a magnetic field that is equal to basically sorry this will be megahertz for tesla, so it is 42.58 megahertz for tesla over here so then the whole frequency will be 42.58 megahertz into 2 pi times over there which is the total frequency at 1 megahertz at 1 tesla of field.

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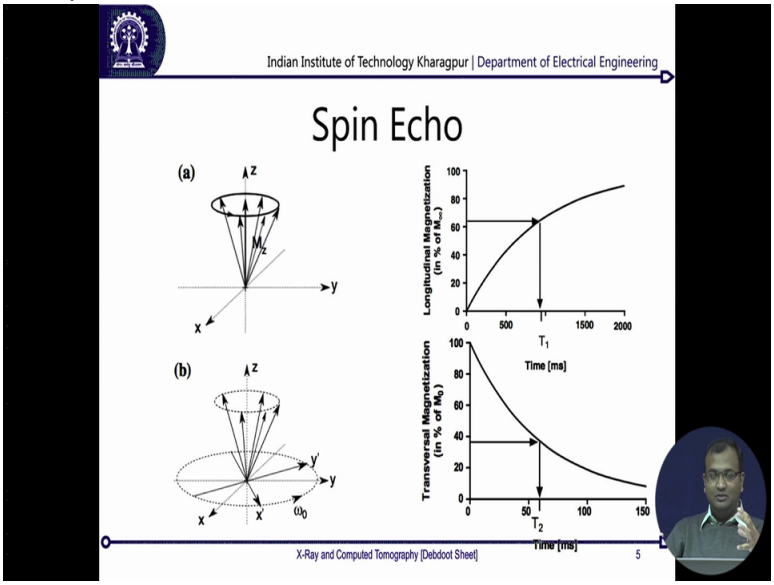

Now from there let us enter into what happens if we put down the energy and then we observe it over a period of time. So once you have all the energies given down to all of them and say we put down so much of energy that all the protons over there went down to a higher energy configuration, okay. So they are all aligned say opposite to this magnetic field over here.

Now after some time it is just because of your thermal motion between them they are going to lose some energy to other atoms over there and once they keep on losing energies they are eventually going to fall down to this particular plane over here and then again some of them will go opposite to each other so is that the net magnetic field over here is going to be 0.

Now, initially when we look into two different magnetic field directions one of them is longitudinal which is along this direction and so yes along this direction and the other one is called as a transverse which is along opposite direction, okay. So now as you see initially you have everything pushed down over here and then some of them are going to fall to this particular line over there. So as they keep on falling over here you would see that there is a difference of energy which is being created over here and you will have this longitudinal one which is growing.

And similarly if you look at this particular plane xy plain you would see that the transverse one is falling down and eventually when they enter into opposite modes you would see that there is distinct rise over there in a longitudinal magnification, whereas in the transverse one it is not there. So now if there is a change in magnetic field which is happening over time, you put down two antenna coils in two opposite directions.

So these antenna coils will be sensing a change in energy as well and from these antenna readings you will be getting a what is the amount of time it is taking so if you are looking over period of time, then after sometime you will be looking into this sort of curves.

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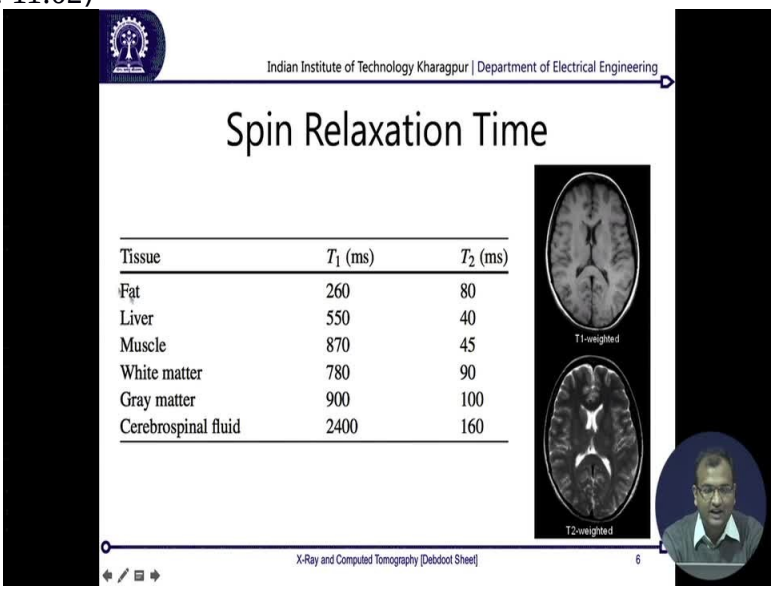

Now from there we come into what happens with different kind of materials, so with fat generally you would see that the T1 relaxation time or which is by the time it goes down to half of its value half of the maximum value is about 260 milliseconds. Whereas for T2, when it comes down from the half of to its maximum value is 80 millisecond. Now go down from this one you would see that the highest values are actually for Cerebrospinal fluids.

Now another interesting fact that it does not always mean that if you if your T1 is increasing, then your T2 also is also increasing for them because just look at liver. Your T1 is higher than fat, whereas your T2 is lower than fat, look into muscle your T1 is higher than liver as well, whereas your T2 although being higher than liver is not higher than fat, right? So there is a distinct difference between T1 and T2 and this is the cue which we use.

So over here if you look into these two images the first one is a T1 weighted image, the second one is called as a T2 weighted image. So we are just looking at a particular after a particular interval of time we are just looking at what is the total amount of intensities at different regions. So those regions which have a much higher T1 relaxation time will which have a much higher energy over there whereas the other ones which have a much lower relaxation time they will have it in the same way.

Now if you look over here typically so this is my lining of the meninges around the brain and since that is made out of a lot of fats so this still remains white, whereas if I look into my grey matter and white matter over here, so they also make down a difference in the sense that white matter over here which is lower and grey matter which is higher they are inverted over here. Now look into correspondences between T1 and T2 you would see that my white matter and grey matter actually appears opposite to each other because of their kind of relation between T1 and T2 together.

Whereas in T2 you would see that it is not so easy to make up between them because their relaxation times are almost of the same order and that is why you just see some sort of gyrations present over there but you do not see a very distinct difference as you can see in these ones. And compare that with the CSA which fills up this intermediate cavity over here in the brain. Now this CSA which has a much higher value for both T1 and T2 you would be seeing out these differences.

But T1 weighted since this is a difference image between my T1 time and T2 time that is why it comes as dark over there.

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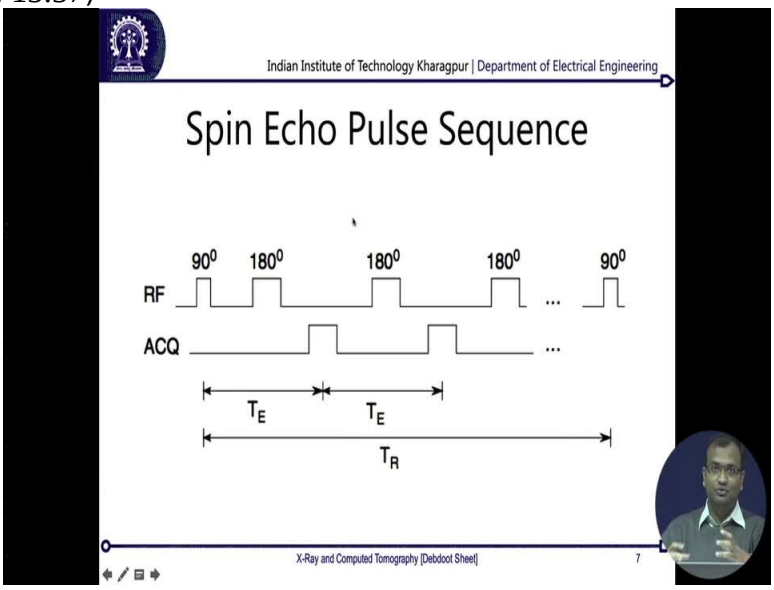

So cumulatively let us enter into the next of the explanation which is how to if you I want to generate both the T1 and T2, then I will have to generate some sort of a pulse repetition rate over there and how this one is generated. So now initially I said that whenever I want to give some sort of an energy in order to turn the magnets on to one direction so I have to give an energy in the frequency which aligns with the frequency of the rotation of those protons over there, okay.

So for that reason, we have an RF coil which is going to give the now whenever we are putting down an RF coils over there, this one does have its own phase constraints as well. So it can either be in phase, outer phase or in a particular phase alignment. So if I give down a pulse which is 90 degree oriented to the actual pulse which is being received because of the magnetic field over there initially and then we give down a T2.

Now this whole combination of a 90 degree pulse is called as the initial pulse and the T2 is and these secondary pulse is coming at 180 degree they are all the reset pulse is which keep on going down over there. Now as we keep on doing it we will see that initially there is a relaxation there is an excitation time in which so first I will have few of my protons which are in a high energy state and a lot of them in a lower energy state.

So after this giving of first excitation I basically turn all of my low energy states into a neutral state, okay next I give down some more energy such that all of them bend down and go to a high energy state and then I leave it. Now as I leave it over here from here then it will start falling down into initially this minimal energy state and then go down initially into a 0 energy state and then go down to my low energy state over there.

So from here it keeps on decaying like this together and we observe this whole time which is called as my relaxation time and the total duration taken down over here. So once I finish off my relaxation time, I again give a reset pulse which is at 90 degree and then again start with this coming of reset pulse we will be aligning them to this 0 energy configuration and again doing the same thing. So this is done over a period of time, so now if you think as your whole body together now I am giving down the same kind of and excitation and everything.

So I am basically looking into the whole body as one single object on whose magnetization properties I am looking at, I cannot look into different voxels over there in any, okay.

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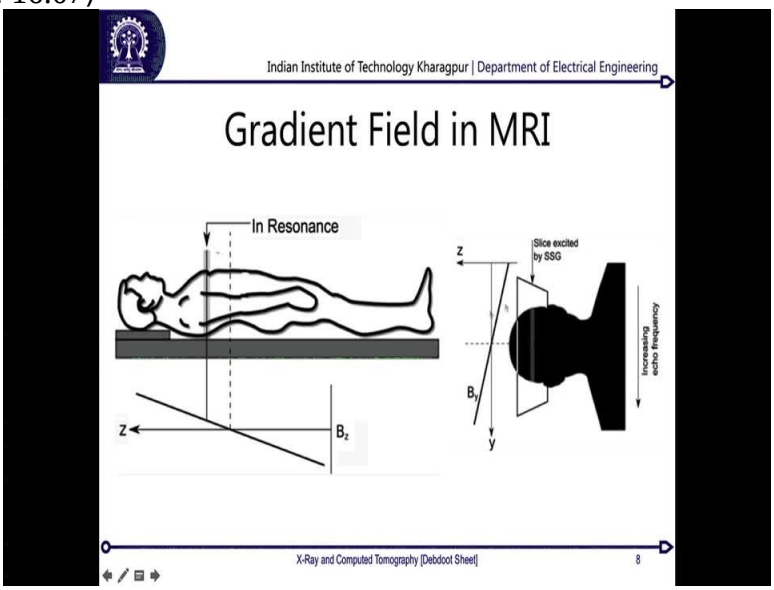

So for that what we do is, we apply a trick and this is where the engineering comes into play. So what we do? Instead of exposing the whole body to a constant magnetic field of 1 tesla we actually create a gradient, say I create a gradient from 0.5 tesla to 1.5 tesla so my average magnetic field within over there is 1 tesla. But somewhere around my head is 1.5 tesla, somewhere around my leg is basically 0.5 tesla. So now each slice of my there will now I can divide my body into different slices and each slice of my body is now going to have a different frequency over there because my effective resonant frequency is of the proton is depended on what magnetic field I am applying.

So now if I have a RF coil which is sensing and then I put down an array of band pass filters so for a specific band pass filter I am going to get the information along one slice of by body. This is how it is going to come down. Now from there, the other point is that I will have to do an xy discrimination as well over there. And in order to do that we again apply the same trick. So we apply another gradient field along this y direction, so first I had this gradient field along the z direction which helped me in creating these slices.

Now I apply a gradient filed along the y direction which will help me in discriminating along this y direction. Now the other point which remains is my x direction and for this what we do is so we had initially given down this reset pulse of 90 degree, now 90 degree to 180 degree is the next pulse which is going down. So what I would do is I will send the immediate next energies

will be instead of sending a directly 180 degree I will send it down at different phase angles over there such that along the x direction I have a phase based separation.

Now if I put down a frequency filter and a phased filter together coupled down over there I will be able to discriminate on the 2d space as well. So this gives me voxels creation along the whole volume of my body which is used for 3d imaging in an MRI.

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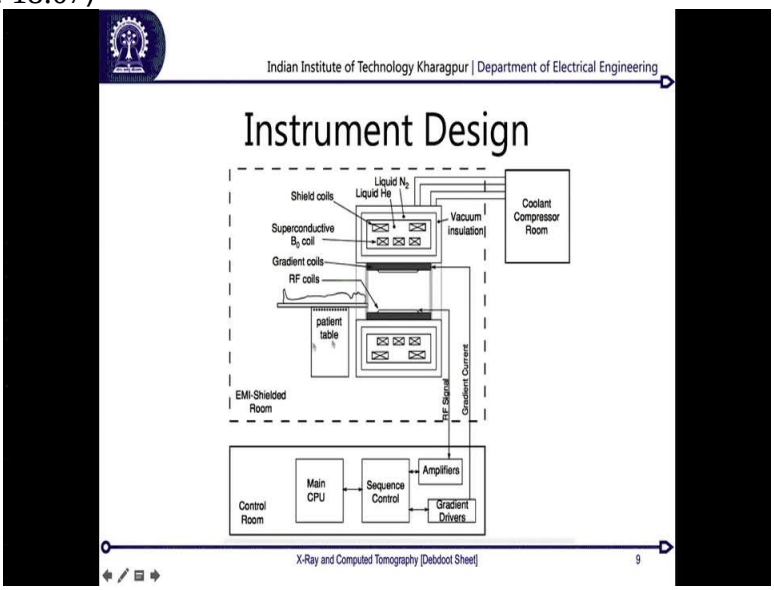

So cumulatively the instrument looks something like this. so you have a whole cylinder in which the body over here enters and you have a series of these RF coils over there. So these RF coils together produce a gradient along this direction which is the z direction, they will also produce a gradient along this direction which is the y direction and then they will encode along the x direction in using phase. So since these RF coils are operating at a much higher frequency and the magnetic field which you need to create over there is in the order of few tesla, so imagine the amount of amperes of current which is going to pass down that generates a super amount of heat.

So you do need a good amount of cooling and that comes down by using liquid helium and liquid nitrogen together in a shielding apparatus and there is another like coolant compressor room which uses it. So majority of the instrumentation is basically cooling down this high amount of current passing down through this whole circuit in order to create that heavy amount of magnetic field. And then the rest of it is basically a control sequence generator for the gradient pulses and

the magnetic field gradients and then a processing unit which just has these bank pass filters and their acquisition from each of these and created stack on to a 3d volume to do it. That is how an MR room looks like.

So one field of caution generally in an MR room, you cannot carry down metal objects so scissors and everything or metal objects on your body are not allowed because image it is a 1 tesla magnetic field so that is almost 10 power 6 times the magnetic field of earth. So something metallic over there basically keeps flying down. So even if you have a metallic ring over there it will just come out of your finger and fly down to the coil.

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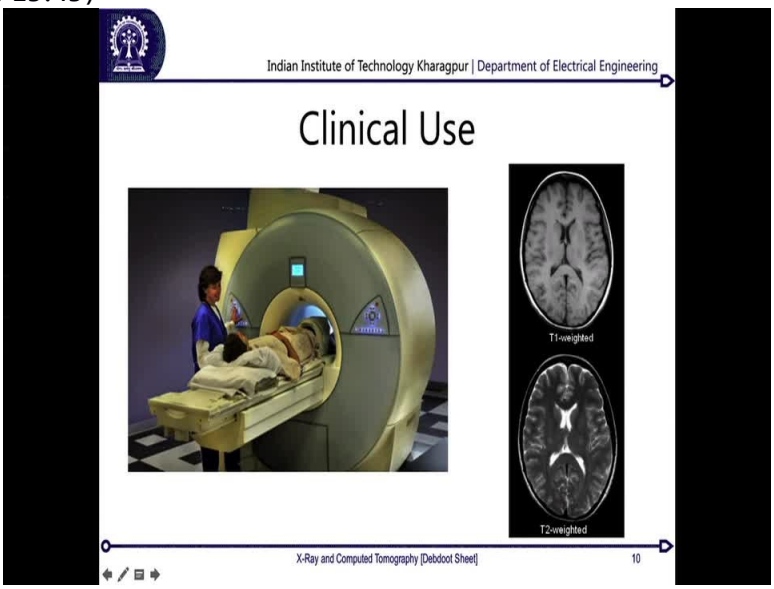

So this is a particle setting of a particular MRI machine. So you would see that this patient is being lied down on the bed and then the eventually the bed would move inside this whole gantry over here which is the cylinder which has all the coils and the cooling arrangement together over there and then you can get down this T1 and T2 images coming down.

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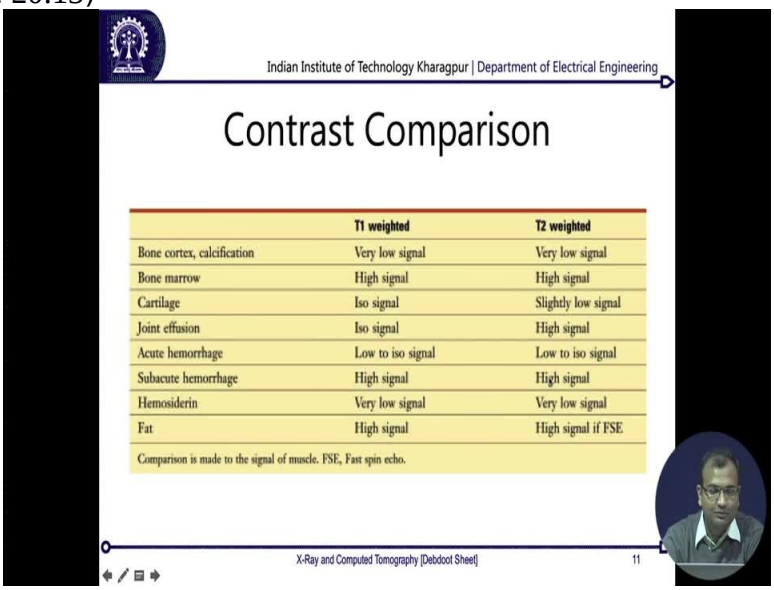

Now I have another slide in order to help you segregate between how images, how different matters in the body look like in T1 and T2 and this can be a very rapid reference for you. So if you look into a T1 weighted and a T2 weighted image for bones or bonny like structures which also include calcifications, so you would see that the T1 has a very low signal and the T2 has a very low signal and this gives you an indicator that MRI is something which is quite contrary to what a CT image gives you.

In CT you would get down bones as brighter structure, in MR you will always get bones as darker structures, be it T1 or T2. The other one is bone marrow, so bone marrow will always give a much higher signal both in T1 and T2 which is contrary to again CT. In CT generally you will get a low signal corresponding to bone marrow because x rays do not get attenuated within the bone marrow in any way. So from there we go on to fat as well, so fat is both in T1 and T2 you will get down a very high value whereas if you are looking into acute hemorrhage or whereas yes if you are looking into joint effusion or you are looking into cartilage you would see this kind of a difference coming down.

So in case of cartilage, the T1 weighted gives you Iso signal which is just a base line signal coming down over there not a negative value but just a standard base average value. And for a T2 it will be just lower than that base value over there. For a joint effusion which is wherever you have a bony joints over there and there is some sort of a fluid transfer taking place around

those bony joints over there. So if there is a effusion which is there is a crack over there and fluids are effusing out you will be seeing in a T1 image a very flat one, whereas in a T2 image it gives you a very high signal.

And now look into a bone and a bony effusion you would now able be able to see that, whereas in a bone it will always give a low signal in T2 in case of a effusion it is going to give you an high signal. And these are all those diagnostic markers which clinicians regularly used when showing these images and when trying to make an inference out of using MR images as well.

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So you can read more in details in this particular book on chapter 5 by Haidekker or you can also have a look into this tutorial video over there, so just click onto this particular link on you tube and you have a much details. So it is about one and a half hours of tutorial only on magnetic resonance imaging explaining the concepts and how it is done. So if you are much interested into the imaging instrumentation aspects of it do definitely make a note of this video.

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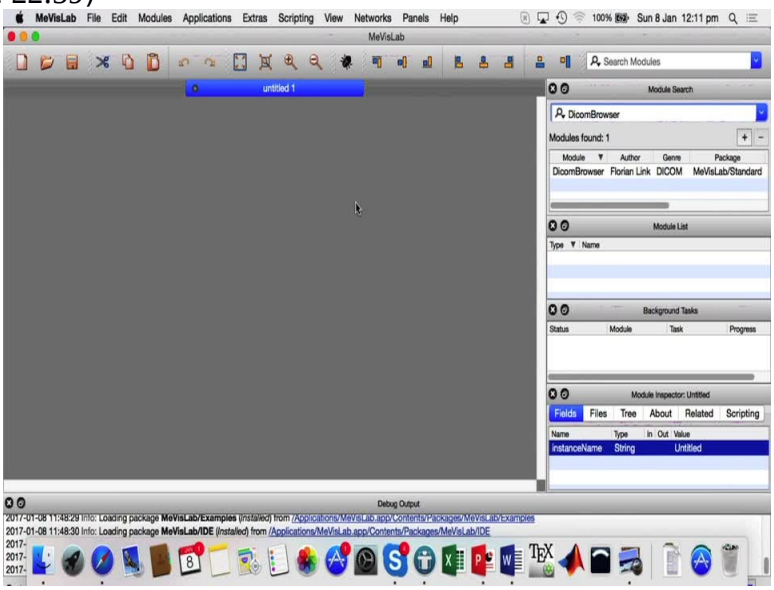

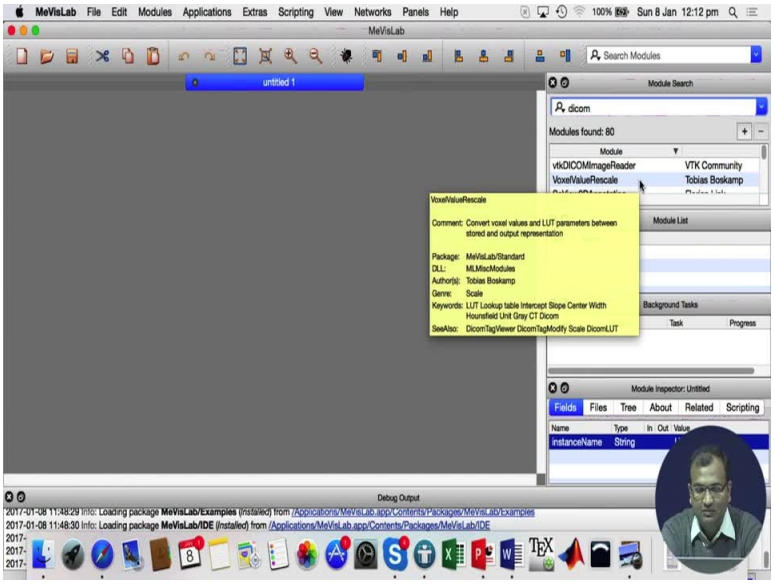

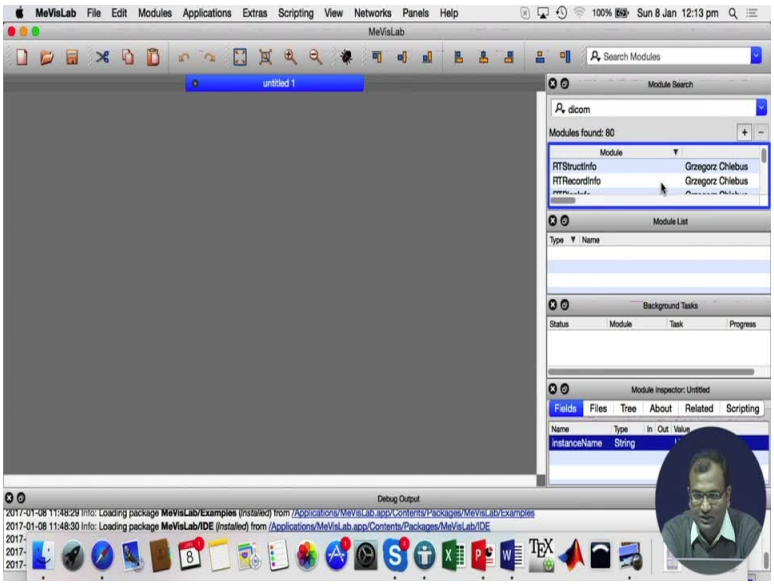
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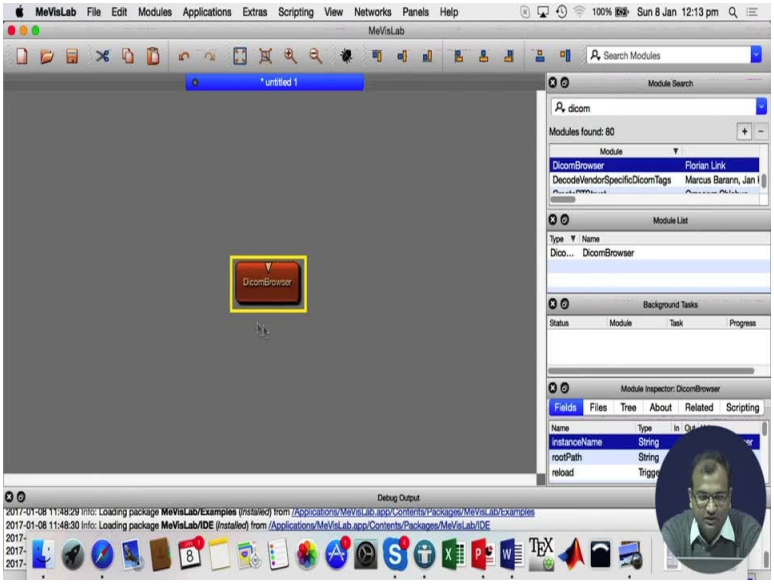
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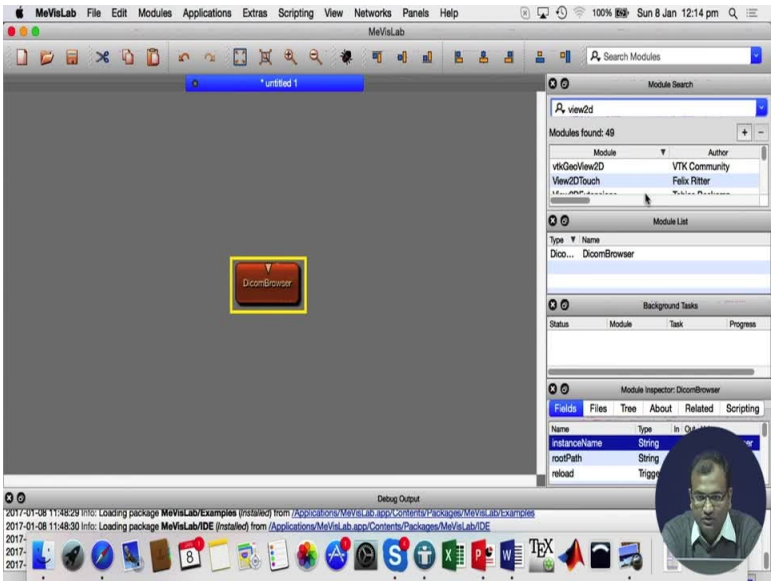
MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
MeVisLab
Search Modules
* untitled 1
DicomBrowser
Module Search
view2d
Modules found: 49
Module
Author
vtkGeoView2D
VTK Community
View2DTouch
Felix Ritter
Module List
Type
Name
Dico...
DicomBrowser
Background Tasks
Status
Module
Task
Progress
Module Inspector: DicomBrowser
Fields
Files
Tree
About
Related
Scripting
Name
Type
instanceName
String
rootPath
String
reload
Debug Output
2017-01-08 11:48:29 Info: Loading package MeVisLab/Examples (installed) from /Applications/MeVisLab.app/Contents/Packages/MeVisLab/Examples
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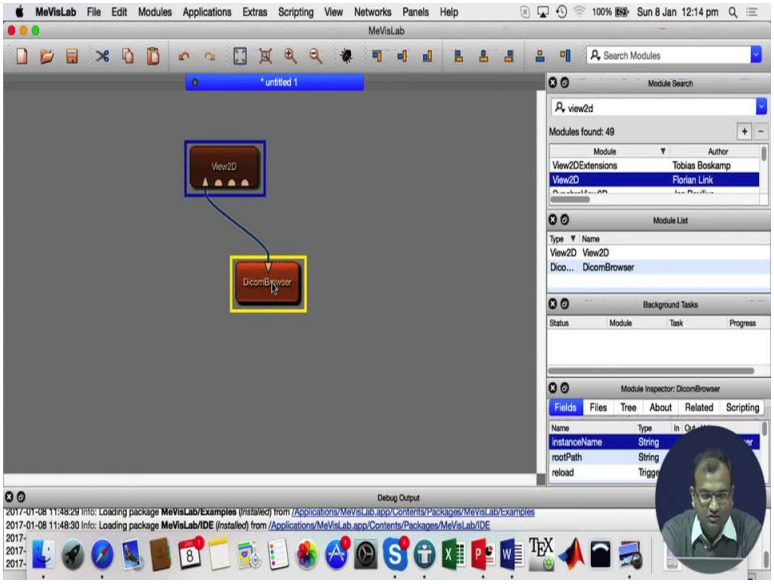
MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
MeVisLab
Search Modules
* untitled 1
View2D
DicomBrowser
Module Search
view2d
Modules found: 49
Module
Author
View2DExtensions
Tobias Boskamp
View2D
Florian Link
Module List
Type
Name
View2D
View2D
Dico...
DicomBrowser
Background Tasks
Status
Module
Task
Progress
Module Inspector: DicomBrowser
Fields
Files
Tree
About
Related
Scripting
Name
Type
instanceName
String
rootPath
String
reload
Debug Output
2017-01-08 11:48:29 Info: Loading package MeVisLab/Examples (installed) from /Applications/MeVisLab.app/Contents/Packages/MeVisLab/Examples
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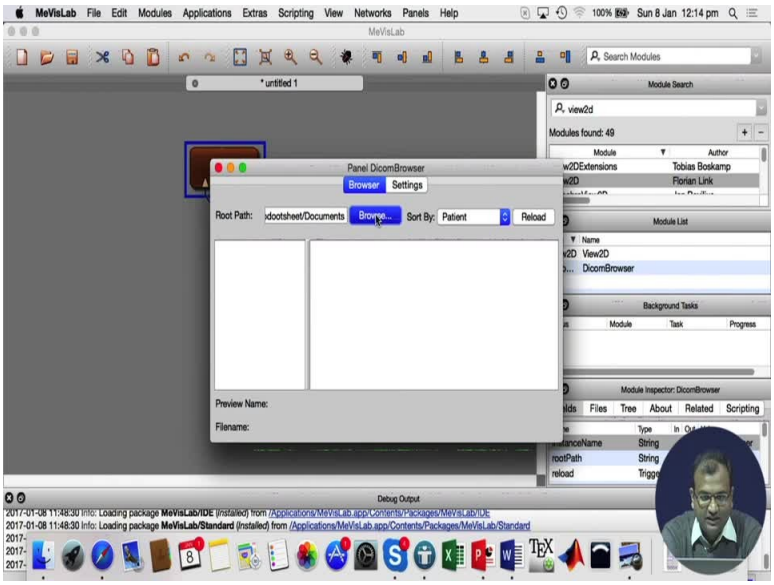
MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:14 pm
MeVisLab
Search Modules
* untitled 1
Module Search
view2d
Modules found: 49
Module
Author
w2DExtensions
Tobias Boskamp
w2D
Florian Link
Panel DicomBrowser
Browser
Settings
Root Path:
Browse...
Sort By:
Patient
Reload
Module List
Name
View2D
DicomBrowser
Background Tasks
Module
Task
Progress
Module Inspector: DicomBrowser
Files
Tree
About
Related
Scripting
Preview Name:
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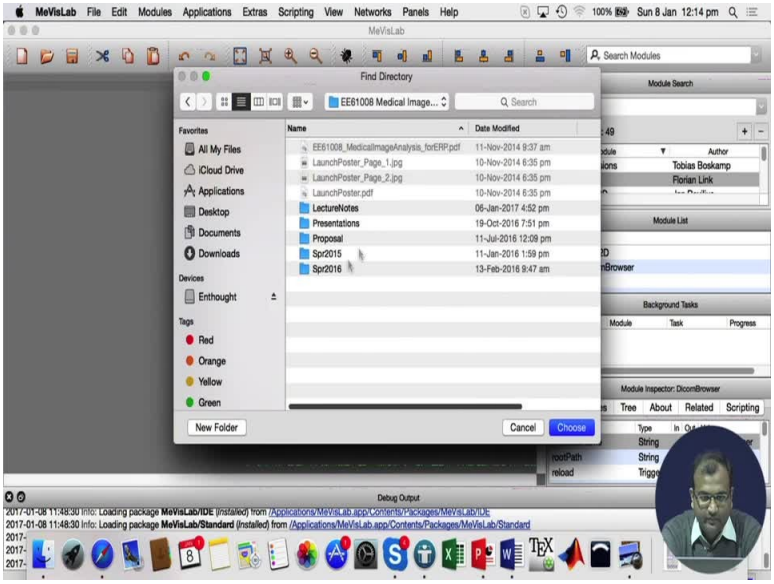
Debug Output
2017-01-08 11:48:30 Info: Loading package MeVisLab/Standard (Installed) from /Applications/MeVisLab.app/Contents/Packages/MeVisLab/Standard


MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:14 pm
MeVisLab
Search Modules
Find Directory
EE61008 Medical Image...
Search
Favorites
All My Files
iCloud Drive
Applications
Desktop
Documents
Downloads
Devices
Enthought
Tags
Red
Orange
Yellow
Green
Name
Date Modified
EE61008_MedicalImageAnalysis_forERP.pdf
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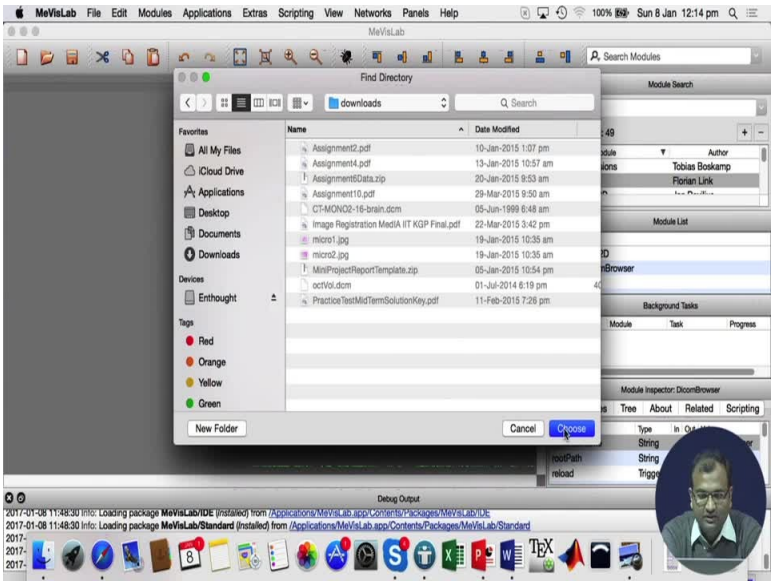
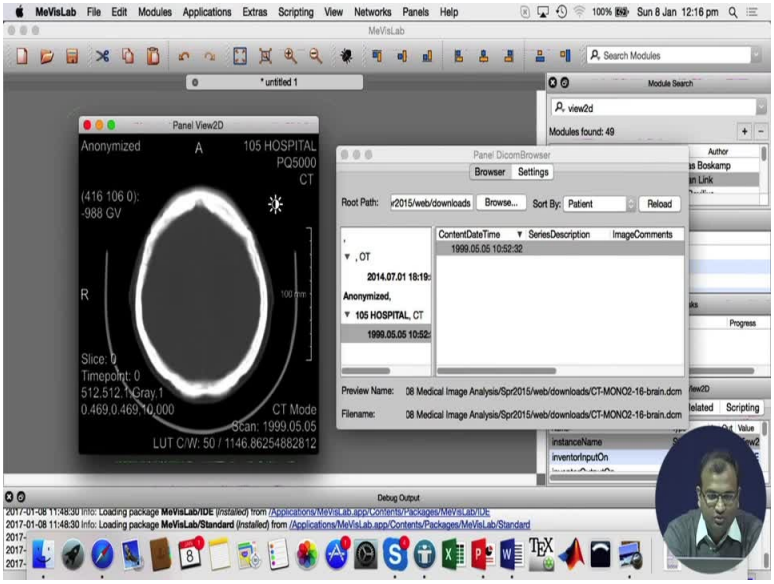
LectureNotes
06-Jan-2017 4:52 pm
Presentations
19-Oct-2016 7:51 pm
Proposal
11-Jul-2016 12:09 pm
Spr2015
11-Jan-2016 1:59 pm
Spr2016
13-Feb-2016 9:47 am
New Folder
Cancel
Choose
Module Search
Module List
Background Tasks
Module Inspector: DicomBrowser
Debug Output
2017-01-08 11:48:30 Info: Loading package MeVisLab/Standard (Installed) from /Applications/MeVisLab.app/Contents/Packages/MeVisLab/Standard





Now as we end this one I would be showing you a demonstration of using a MeVisLab as one of the key tools you can for doing it. So in the first lecture I had actually told you about different tools and techniques and over there I had introduced you into MeVisLab. So this is a standard interface when you open up MeVisLab and you have a you have a module searcher over here and you can basically write down name of any particular module and then it will go down.

So generally for medical images which are packed down into a format called as dicom digital image communication format, so we are going to read one of those images over here. So initially what I would start is first is in order to read a dicom I would need a dicom browser so I just

type in dicom. So in case you do not remember names it is not so hard you can type some part of it over here say you are supposed to do it with dicom. So it will need to have something called as dicom, now the first entry which comes out over here is VTK dicom image reader and it tells out like what is an input to it what are the outputs over there.

Now you can again search down on the community for this particular MeVisLab as well you can make use of help in order to find out much more details into what they mean. Or if you are once you become expert then most of the names are quite intuitive in that sense. So I need to get access to a dicom browser over there. So I am just looking down I just scroll and look down for that, so I see a dicom tag browser everything, yeah so here is my dicom browser.

So I just double click on this one I get my module over here, now this is a graphical programming equivalent. Now once I am able to open my dicom image the next thing is I want to see that one, so for that I need some sort of a viewer, so over here we have a different sort of viewers. So there are 2d viewers and 3d viewers so I am just going to use a 2d viewer over here we just called as view 2d, okay.

So next the signal has to be connected so I click and just drag and drop it over there good. So now on my dicom browser I need to select out my directory. So I can just click on this browse and wherever you have downloaded your dicom files you can just go over there so mine are somewhere over here, so I have multiple dicoms over here so there is one this is a dcm file, there is another ocd valt dot dcmm that is another volumetric file, so I will just open one of them which is a CT dicom.

So it just fetches out all the dicom files which you have over there I know that this is the one which I am supposed to read. So I click on this one and then I need to invoke this viewer over there. So this is when I invoke the viewer this is what I see. Now this is not a 3d one which I have over here, if you have a 3d then you will have to invoke a 3d view 3d as well, so I will open up the other one and show you on a view 3d how it looks like.

So when you look over here you would see all of these are in terms of your Hounsfield unit, so as I go in hair it gives me a negative which is this grey value GV over here, in my bone it is

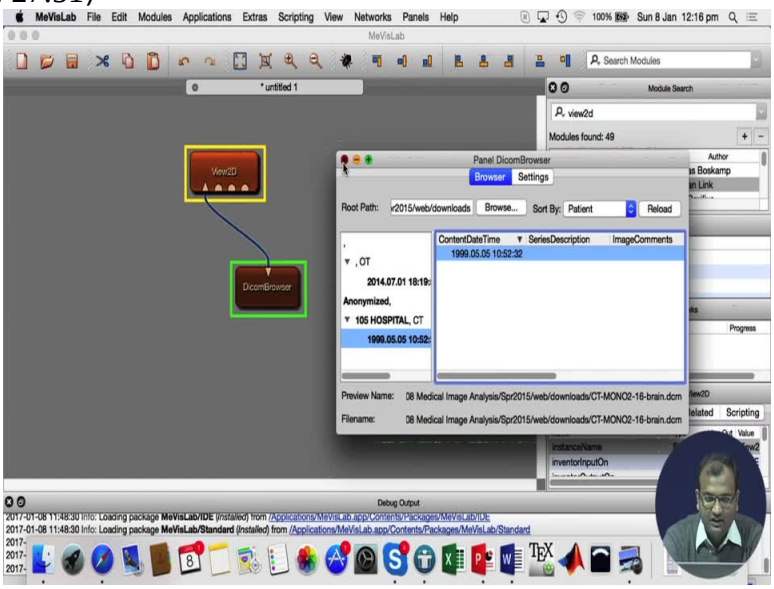
somewhere around 500 in this grey matter and white matter around 33 around 30's and 30's what I am getting down over there.

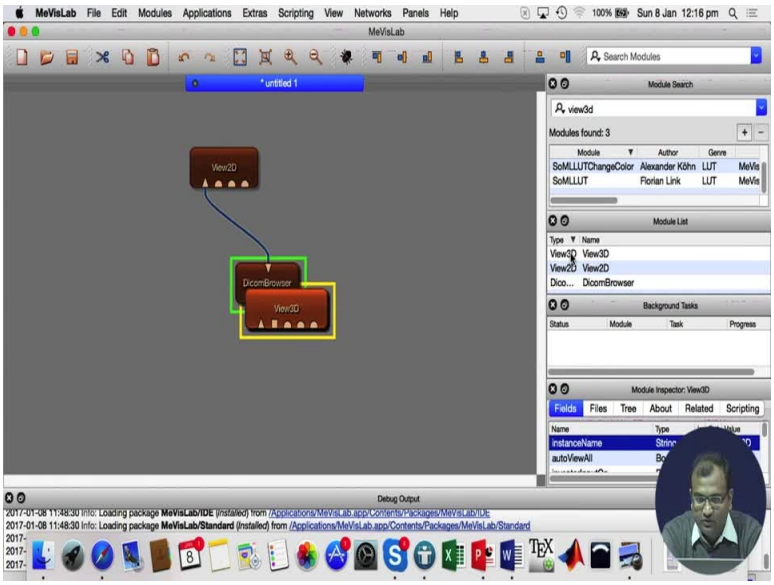
So this is basically the metallic lining of the cup on which the patients head was resting that is why this u shaped kind of a thing comes down over there. Now I can do a right click which gives me this kind of a sun like icon coming down and then I can do a left and right drag and that will be changing my window functions on my grey values. And these window functions which are changed over there are basically going relook into how you are going to modify the total behavior. So it is a 16-bit image you need to map it down into a 8-bit. So this is how you change it.

So up and down is another kind of a so you basically play around the width of the window and the range of the windows for doing up and down slice movements. So based on whether I want to look into the bones or I want to look into the brain over here I will be adjusting my one. So I wanted to look more into the contrast between the bones over there. So that is why I was doing it like this.

So this is one very intuitive way of actually looking into 2d and 3d kind of images which you can really make use of.

(Refer Slide Time: 27:51)




MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:16 pm
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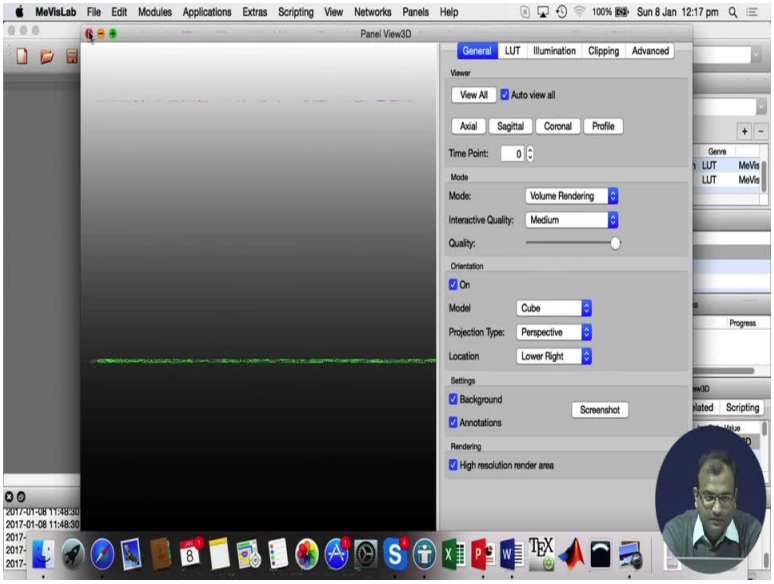
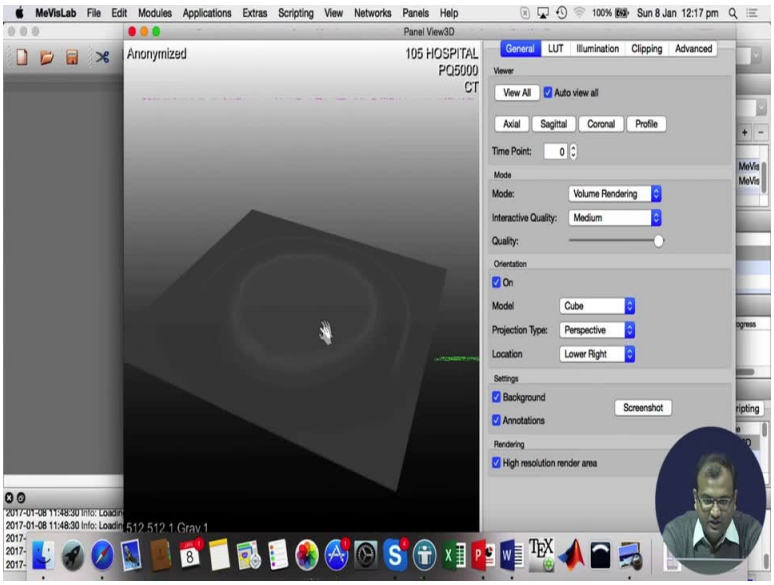
Search Modules
* untitled 1
View2D
DicomBrowser
View3D
Module Search
view3d
Modules found: 3
Module Author Genre
SoMLLUTChangeColor Alexander Köhn LUT
SoMLLUT Florian Link LUT
Module List
Type Name
View3D View3D
View2D View2D
Dico... DicomBrowser
Background Tasks
Status Module Task Progress
Module Inspector: View3D
Fields Files Tree About Related Scripting
Name Type
instanceName
autoViewAll
Debug Output
2017-01-08 11:48:30 Info: Loading package MeVisLab/Standard (installed) from /Applications/MeVisLab.app/Contents/Packages/MeVisLab/Standard


MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:17 pm
Panel View3D
General LUT Illumination Clipping Advanced
Viewer
View All
Auto view all
Axial Sagittal Coronal Profile
Time Point: 0
Mode
Mode: Volume Rendering
Interactive Quality: Medium
Quality:
Orientation
On
Model Cube
Projection Type: Perspective
Location Lower Right
Settings
Background
Annotations
Screenshot
Rendering
High resolution render area


MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:17 pm
Panel View3D
Anonymized
105 HOSPITAL
PQ5000
CT
General LUT Illumination Clipping Advanced
Viewer
View All
Auto view all
Axial Sagittal Coronal Profile
Time Point: 0
Mode
Mode: Volume Rendering
Interactive Quality: Medium
Quality:
Orientation
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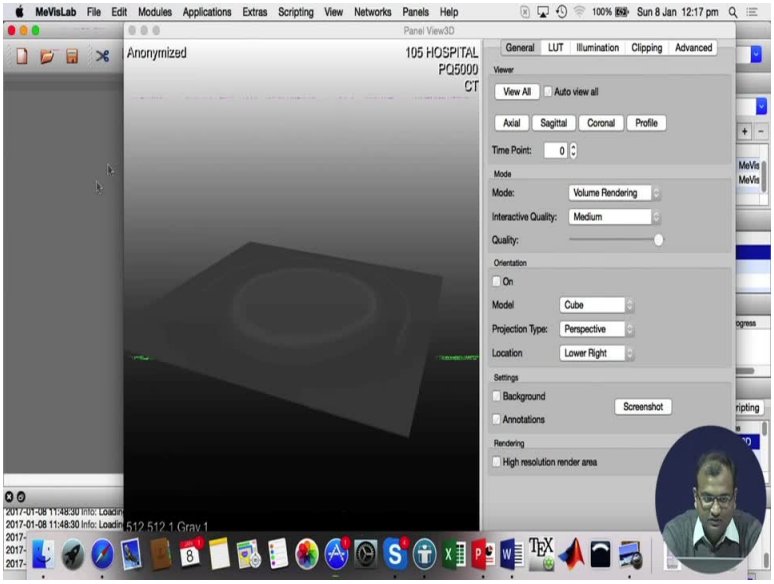
Model Cube
Projection Type: Perspective
Location Lower Right
Settings
Background
Annotations
Screenshot
Rendering
High resolution render area
512 512 1 Grav 1


MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:17 pm
Panel View3D
Anonymized
105 HOSPITAL
PQ5000
CT
General LUT Illumination Clipping Advanced
Viewer
View All
Auto view all
Axial Sagittal Coronal Profile
Time Point: 0
Mode
Mode: Volume Rendering
Interactive Quality: Medium
Quality:
Orientation
On
Model Cube
Projection Type: Perspective
Location Lower Right
Settings
Background
Annotations
Screenshot
Rendering
High resolution render area
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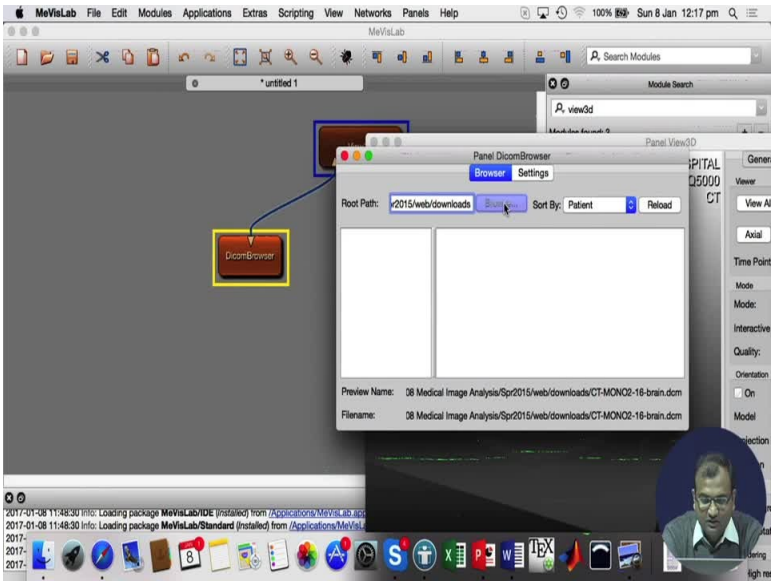
MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:17 pm
MeVisLab
Search Modules
* untitled 1
Module Search
view3d
Panel View3D
Panel DicomBrowser
Browser Settings
Root Path:
Sort By: Patient
Reload
DicomBrowser
Preview Name: 08 Medical Image Analysis/Spr2015/web/downloads/CT-MONO2-16-brain.dcm
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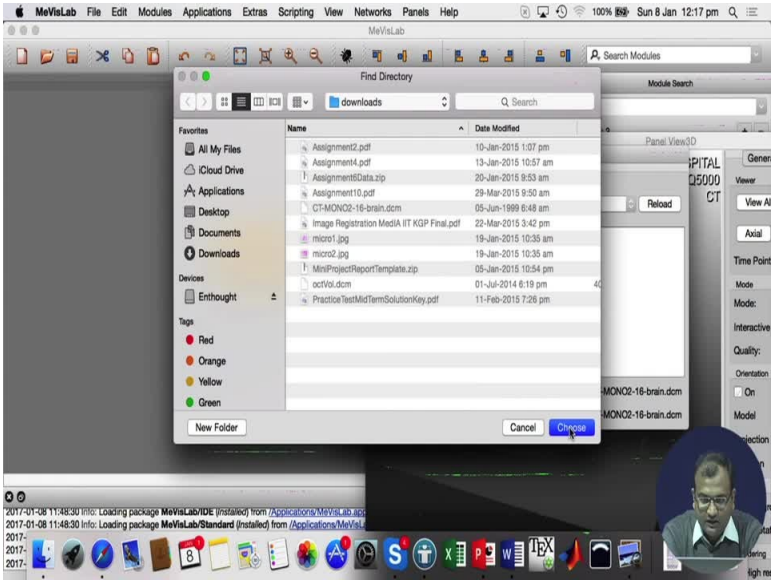
Axial
Time Point
Mode:
Quality:
Orientation
Model


MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:17 pm
MeVisLab
Search Modules
Find Directory
downloads
Search
Favorites
All My Files
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Applications
Desktop
Documents
Downloads
Devices
Enthought
Tags
Red
Orange
Yellow
Green
Name
Date Modified
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Assignment4.pdf 13-Jan-2015 10:57 am
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Assignment10.pdf 29-Mar-2015 9:50 am
CT-MONO2-16-brain.dcm 05-Jun-1999 6:48 am
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micro2.jpg 19-Jan-2015 10:35 am
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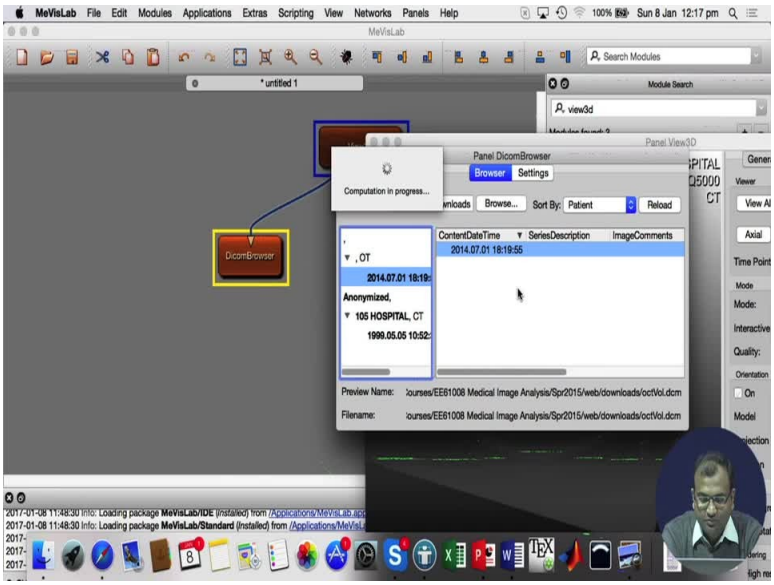
MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:17 pm
MeVisLab
Search Modules
* untitled 1
Module Search
view3d
Panel View3D
Panel DicomBrowser
Browser Settings
Computation in progress...
Browse...
Sort By: Patient
Reload
DicomBrowser
ContentDateTime
SeriesDescription
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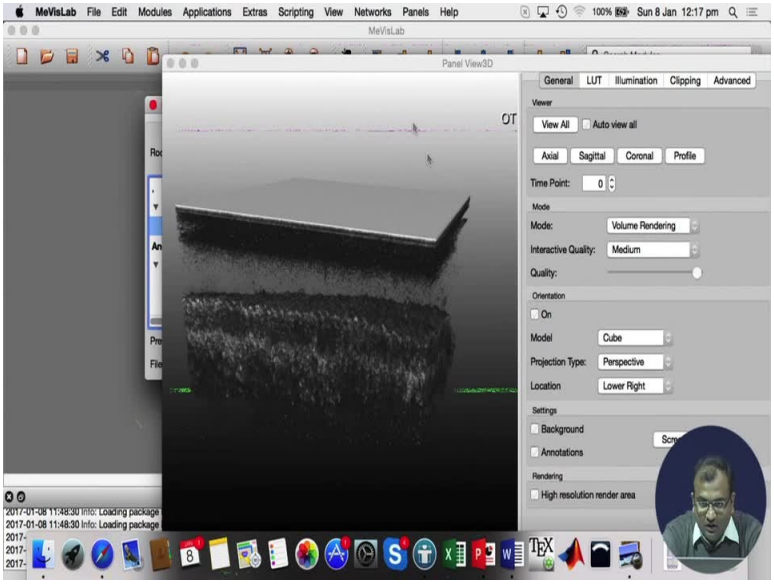
MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:17 pm
MeVisLab
Panel View3D
OT
General LUT Illumination Clipping Advanced
Viewer
View All
Auto view all
Axial Sagittal Coronal Profile
Time Point: 0
Mode
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Quality:
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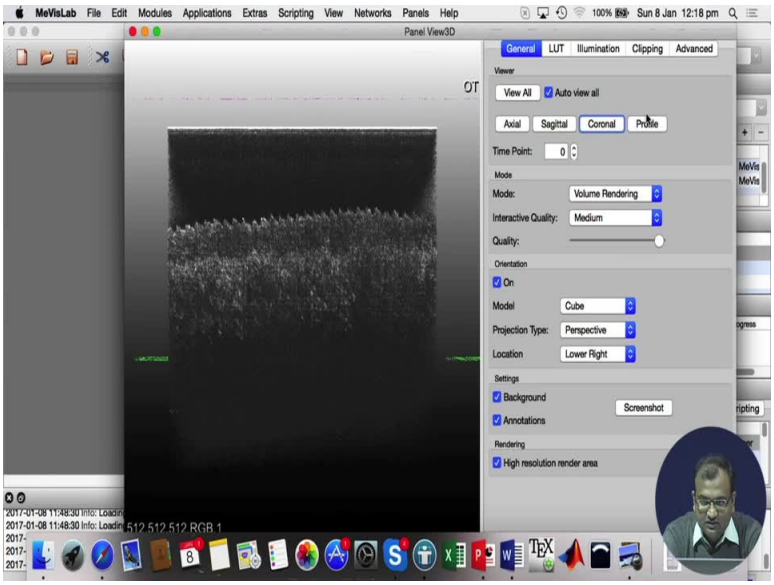
Model Cube
Projection Type: Perspective
Location Lower Right
Settings
Background
Annotations
Rendering
High resolution render area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Sun 8 Jan 12:18 pm
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General LUT Illumination Clipping Advanced
Viewer
View All
Auto view all
Axial Sagittal Coronal Profile
Time Point:
Mode
Mode:
Volume Rendering
Interactive Quality:
Medium
Quality:
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Projection Type:
Perspective
Location
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Settings
Background
Annotations
Screenshot
Rendering
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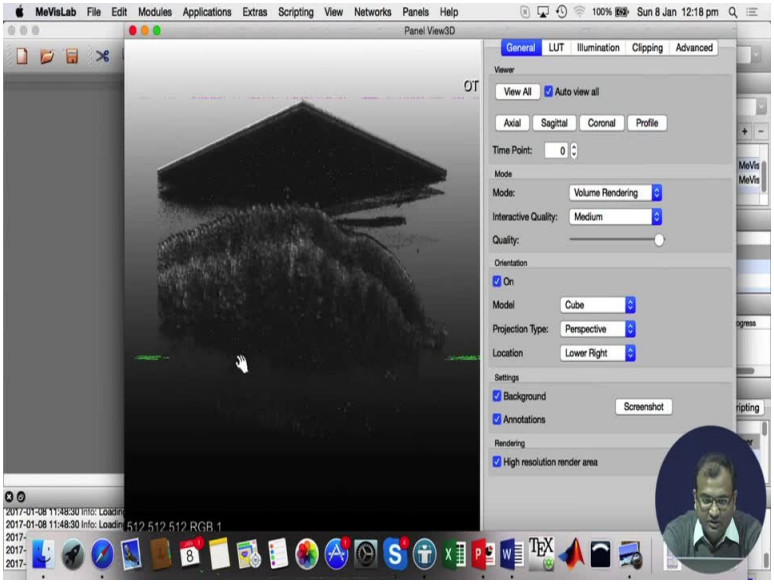
MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:18 pm
Panel View3D
General LUT Illumination Clipping Advanced
Viewer
View All
Auto view all
Axial Sagittal Coronal Profile
Time Point:
Mode
Mode:
Volume Rendering
Interactive Quality:
Medium
Quality:
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Location
Lower Right
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Annotations
Screenshot
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High resolution render area
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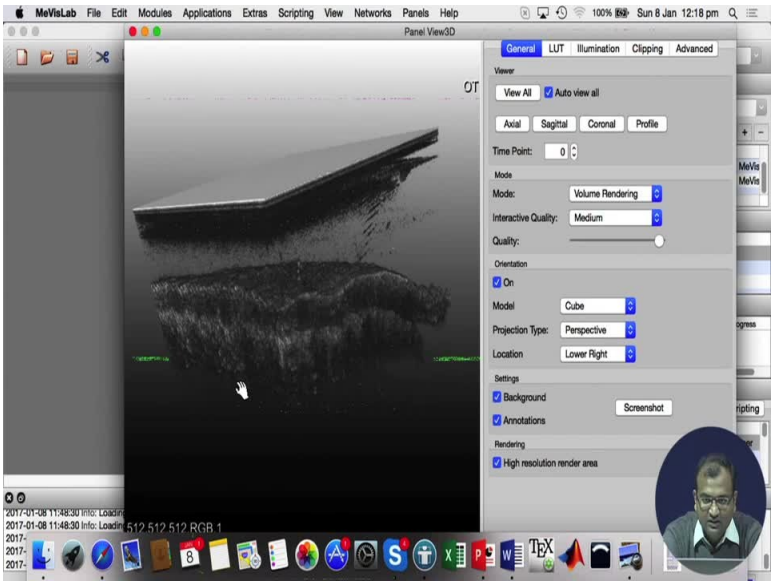
MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:18 pm
Panel View3D
General LUT Illumination Clipping Advanced
Viewer
View All
Auto view all
Axial Sagittal Coronal Profile
Time Point:
Mode
Mode:
Volume Rendering
Interactive Quality:
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Quality:
Orientation
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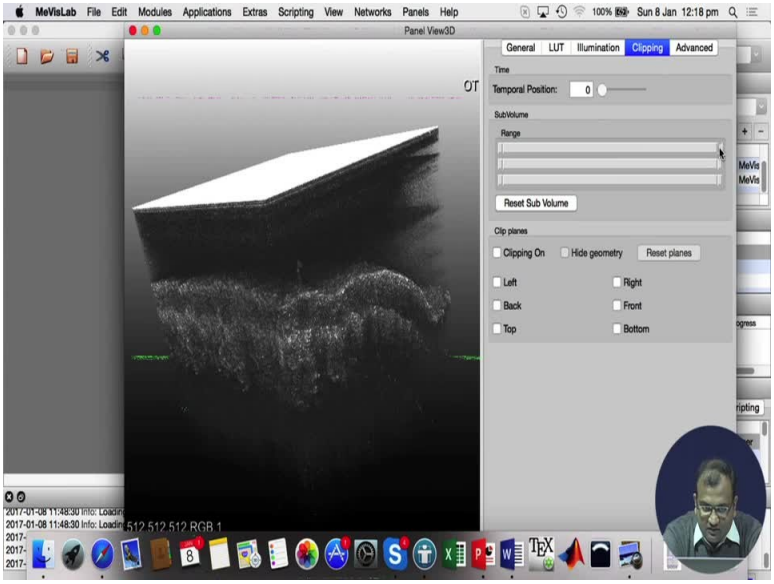
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Sun 8 Jan 12:18 pm
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General LUT Illumination Clipping Advanced
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Temporal Position:
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Reset Sub Volume
Clip planes
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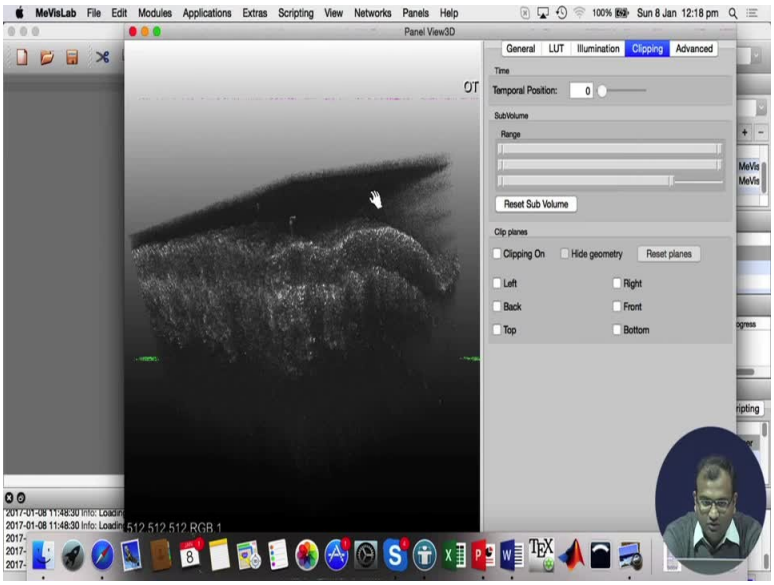
Hide geometry
Reset planes
Left
Right
Back
Front
Top
Bottom
OT
512 512 512 RGB 1


MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
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General LUT Illumination Clipping Advanced
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Temporal Position: 0
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Range
Reset Sub Volume
Clip planes
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Top
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OT
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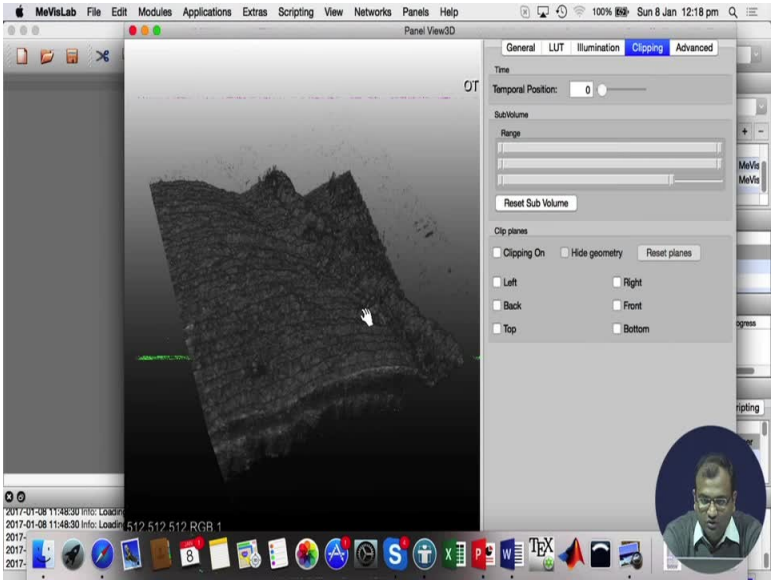
MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
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General LUT Illumination Clipping Advanced
Time
Temporal Position: 0
SubVolume
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Reset Sub Volume
Clip planes
Clipping On
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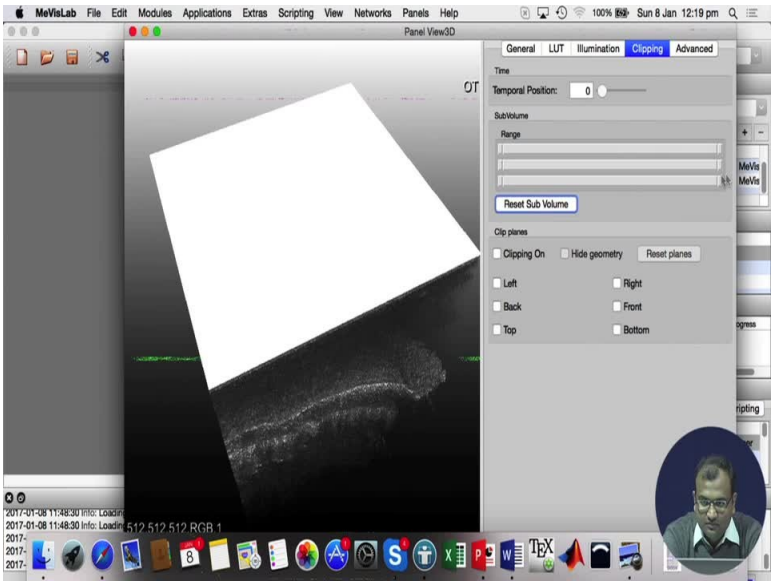
Reset planes
Left
Right
Back
Front
Top
Bottom
OT
512 512 512 RGB 1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General LUT Illumination Clipping Advanced
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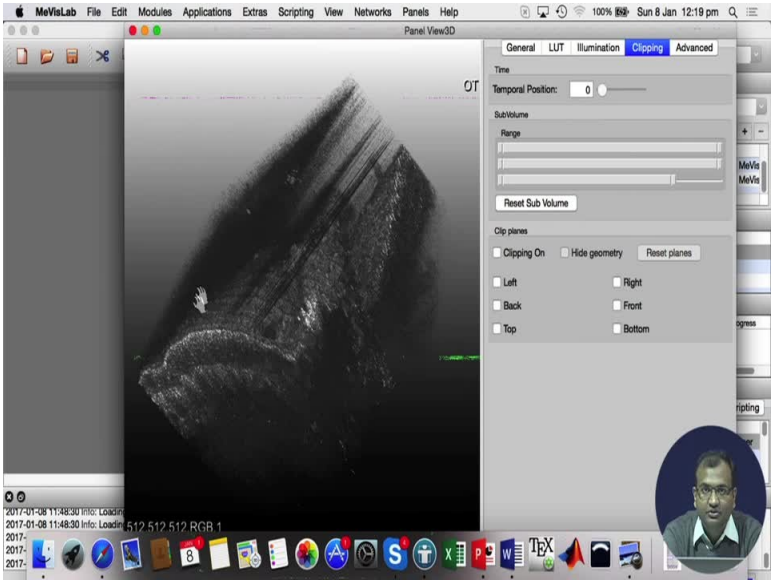
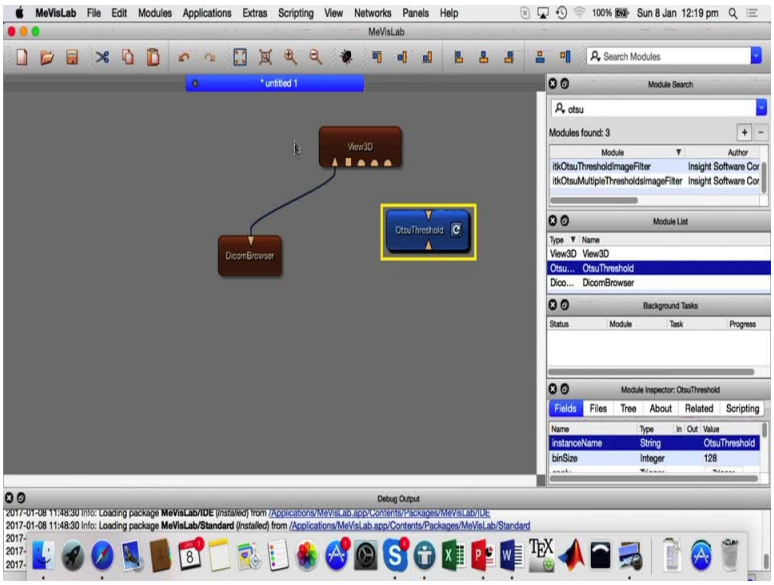
Range
Reset Sub Volume
Clip planes
Clipping On
Hide geometry
Reset planes
Left
Right
Back
Front
Top
Bottom
OT
512 512 512 RGB 1


MeVisLab File Edit Modules Applications Extras Scripting View Networks Panels Help
Sun 8 Jan 12:19 pm
Panel View3D
General LUT Illumination Clipping Advanced
Time
Temporal Position: 0
SubVolume
Range
Reset Sub Volume
Clip planes
Clipping On
Hide geometry
Reset planes
Left
Right
Back
Front
Top
Bottom
OT
512 512 512 RGB 1



And say I want to look into a 3d and the other dicom which I have so I would replace this 2d with view 3d kind of module. So this is where it gives me a view 3d. Now what I do is instead of my 2d module which I am going to delete I put down my 3d module over here and this is what it shows to me on the 3d because that image was actually just a one single slice. Now say I change this one and I use my 3d over here, okay. So this is just trying to compute out the plane geometry and the rendering over there initially.

So once that get computed we will be able to see down the 3d one as well, yeah. So this is the whole image which comes on the 3d. Now you can make some movements or motions about over there as to how it looks like now it does take a bit of time based on what orientation and what kind of modules you are going to render down. You can look into an actual orientation, sagittal orientation, coronal orientation, any of them, our profile is basically any intermediate orientation and you can again rotate and look over there, you can do clipping of the ranges.

Say I want to click along that side or here is something which would possibly along it, I wanted to basically clip along the z axis, yeah. So if I am able to clip along the z axis so my total volume which I want to see I just want to change that whole thing over there and then we will look into it. So you can make use of these kind of tools very intuitively to look into your 3d data which clinicians also do and obviously MeVisLab has more of processing modules over there.

So if you want to just do an otsu thresholding in order to find out so you can use these otsu's filters as well. And they can be very useful for so say there is an otsu's browser. So input is basically an image and output again you can view through it and some of these very intuitive prototyping you can do on a much faster scale using MeVisLab as well.

So with that we come to an end on the micro imaging module with MRI and just a simple demonstration of the software use. So just have fun with using more of them and the lot of public data sets which also are available for your fun. So with that thank you.