Computational Electromagnetics
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Applications of Computational Electromagnetics
Lecture – 14.05
Inverse Problems - Summary

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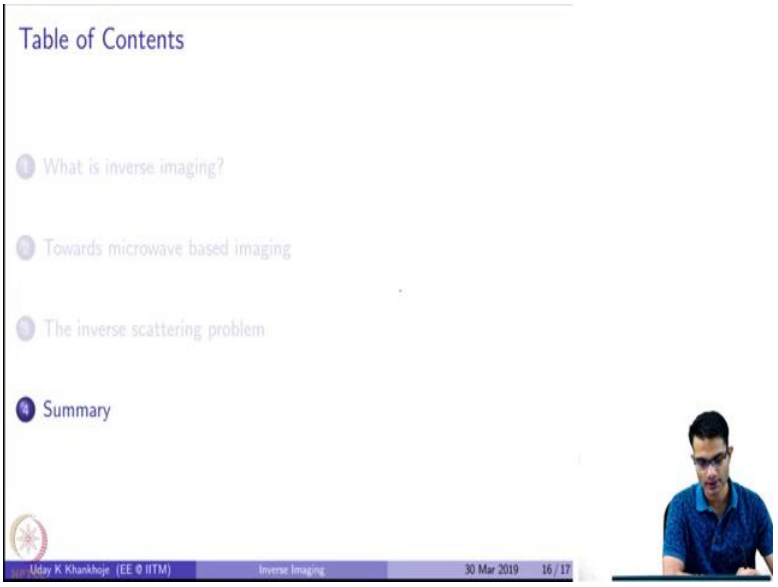

So, this is sort of brings us to a summary that right.

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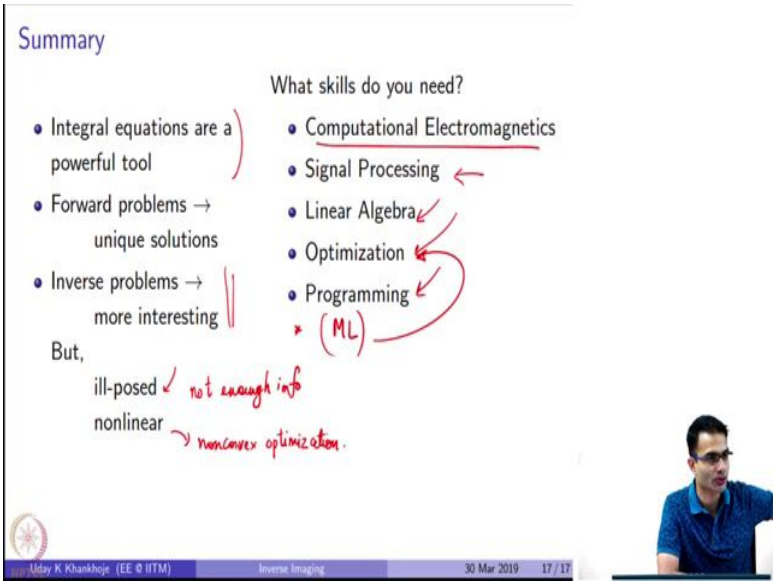

I mean integral equations, we thought we could just use them for forward problems, but it is given us a very nice language of linear algebra in which I could write down this inverse problem right and the main challenges that we saw in the case of inverse problem was ill-posed.

So, that was not enough info, it is just not there the fields are band limited, live with it and the second problem was non-linearity right. So, this gives me a non-convex optimization. So, these are I mean this problem is far from being solved right. So, all you know fancy data analytics and optimization machine learning whatever you can throw at it needs to be done to get a good solution with this and it also shows you that just CEM alone is not enough for this problem.

We of course, had to write it in the language of linear algebra we had to do programming and to get that ill posedness out of the way we looked at the wavelet domain for example, that is your signal processing and heavy duty optimization. Here all the techniques that come together you know and when you are doing signal processing there is probability hiding underneath also right.

So, these are all that I mean what I want to convey is that CEM is one of the tools like many others which together will be needed to solve a real world engineering problem right. The

days of just knowing one subject and using that alone. Everything has become so interdisciplinary these days right. So, if you want to add you can add ml over here also that is a part of optimization any.

Student: Sir can you.

Question?

Student: Use any other method other than integral equations.

Can you use any other method other than integral equations? So, you can use people have used FDTD also, but I do not think you get such a nice formulation over here you can use any.

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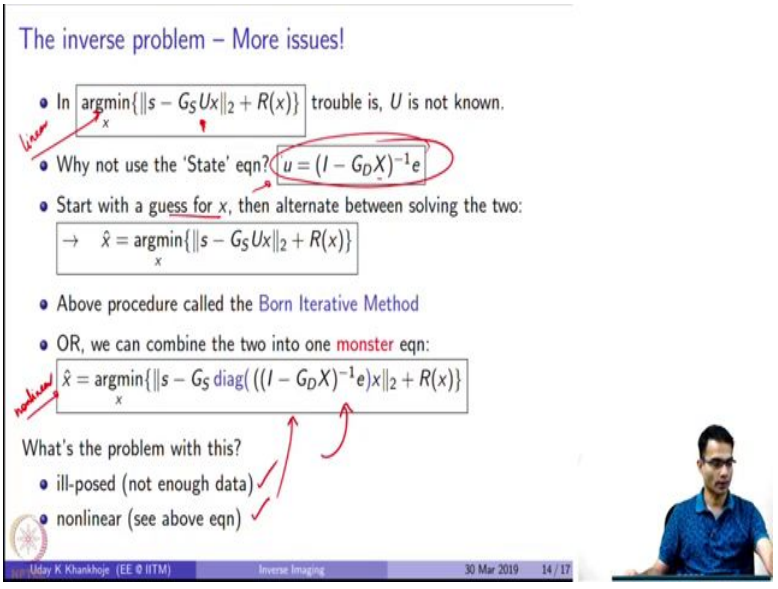

So, if you go back over here in this method over here where I am I start with some guess for x then I calculate u using this right. So, getting u is what solving the forward problem solving the forward problem could be done from any of the methods, the inverse problem I have written I got the formulation from the integral equation formulation. So, it is yeah if you think if you feel that you know computational time is your most important thing, then you should not run the forward problem in integral equation because, it takes much more time then let us say FEM. So, you could do forward problem in FEM inverse problem like this right and.

Student: We are looking at the inverse problem.

Right now we are looking at inverse problem.

Student: Imaging.

Real time microwave imaging? I do not, well for very simple where I know the contrast is going to be very very low then as long as this algorithm works very quickly you could do it in real time.

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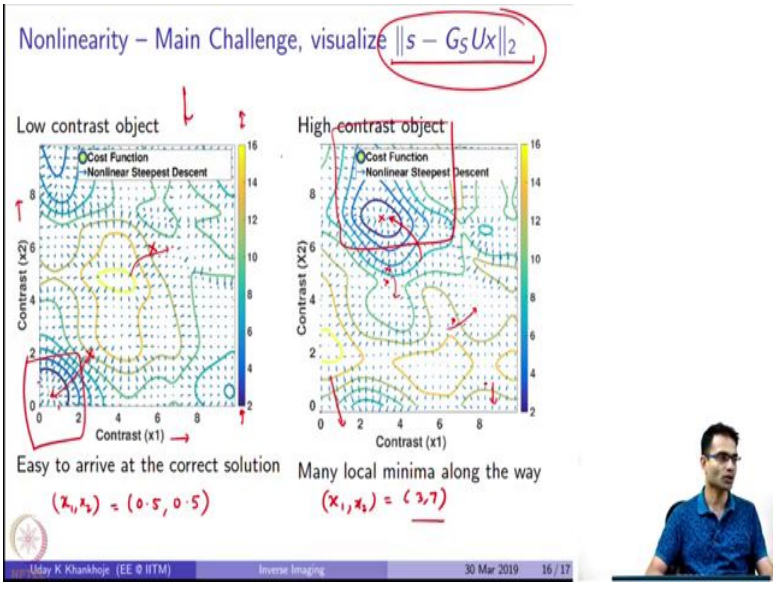

But if it is you know a problem like this one [3, 7] right then it is an iterative process it may it may not work in real time you.

Student: (Refer Time: 03:39).

So, through the wall imaging and moving targets and all of that; so, if you allow for some approximation so through the wall detection for example: is that you have a wall and you have some objects behind it and let us say a terrorist or something you want to visualize it. Now, there you may not care that the permittivity is 3 or 3.5 who cares whether or not there is an object or not. So, if I reduce my expectations from the problem as long as I get a fuzzy shape for the object I am happy right.

So, I have if I change my problem I can relax my requirements on the accuracy of solution. So, these kinds of tradeoffs have to be made you have to say what you are interested in, if I am interested in breast cancer detection I had better be able to tell the difference between healthy tissue and cancerous tissue and that is not a fuzzy thing right because, if you give the wrong information to the doctor he will cut out the wrong part so, right.

So, getting the permittivity correct is what is a quantitative problem and what you know through the wall imaging these kinds of applications are qualitative problems; give me some solution which is more or less it is also problem there you can possibly get real time solution and so on.