Computational Electromagnetics
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Radar Cross-Section
Lecture – 9.2
Computational Considerations

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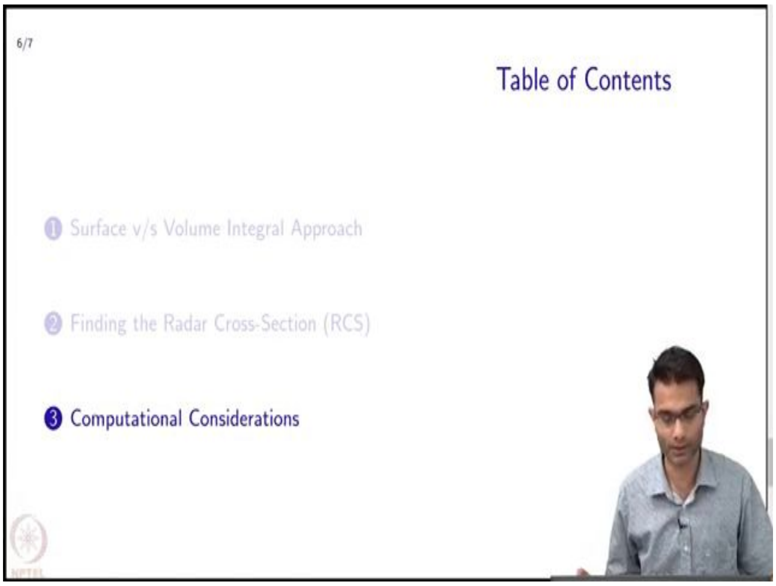

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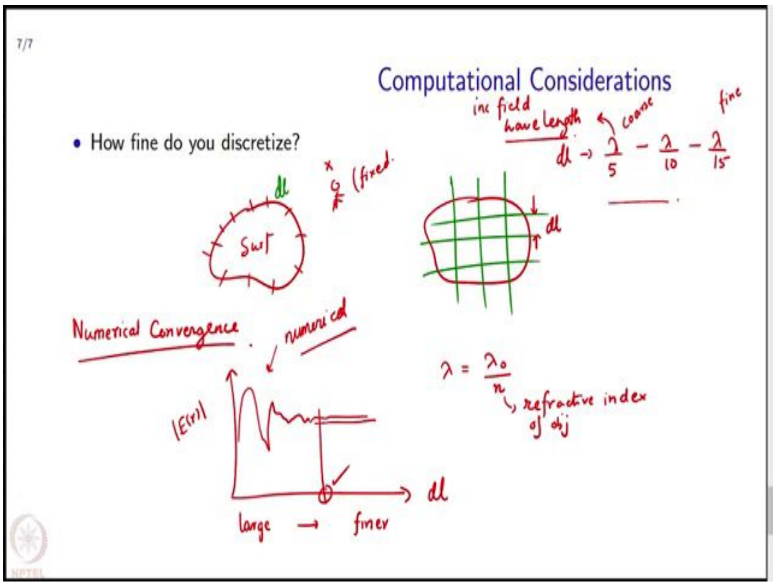

So, our final discussion on the Computational Considerations; so, this is the first question that will come to you right. So, whether you take the surface integral approach where you have to discretize finely over here or so this was surface or you take the volume, where you have this grid over here right. Now how do you know whether you have grid this you know whether how find should be make dl, how would you approach this problem?

So, let us say you have you know you studied these two methods you coded them up and you got some solution; how do you know whether you chose a dl to be fine enough or not? That seems to be an important question right because if you choose the wrong dl, if you choose it to be two coarse then you are not a you are not representing the fields correctly its two course. So, we will not get the right answer.

On the other hand, if I am make dl very very fine, I will get the correct answer, but it may take me 10 times more time on the computer, then I should have spent on it. So, how do we know whether we have reached the correct answer for dl? Think over it again this is the common sense question how would you figure out.

Student: And you keep running the code until you get a similar value.

Yeah. So, he is saying keep running the code until you get similar values.

Student: For ne equal to top of for ne equal to 400 equal to 500 similar one.

Yeah. So, that is the idea of numerical convergence that is the formal word for it; so, numerical convergence. So, what does that say? It says that let us say on this axis I have values of dl and what do I do? Let me take one position over here of where I am calculating the field. So, keep this fixed and keep changing. So, let us say I am plotting E at received point keep plotting it right. So, let us start with the large values and go to finer values right.

So, dl is starting from a large number and decreasing. So, it sort of inverse you can think of this is 1 by dl or whatever or basically start from a large thing right. So, you might actually observe some fluctuating behavior like this eventually what will happen is that, you get a stable answer over here right. So, this fluctuation is purely numerical; why because you are not actually solving a real physics problem because you are not representing the fields with sufficient resolution.

So, you are you are solving some system of equations you are getting some solution it has no real physical meaning. So, you might find sometimes the fields are increasing sometimes the decreasing. As you begin to approach the required fidelity for representing the solution, you will find that the fields stabilize like this. So, what should you do? You should look for this point which has where it has stabilized and say that this is the correct value. So, any code that you write in computational em, you should have done one numerical convergence test and typically not just for one point, but for a few points why because it could happen that by mistake you chose a point which is actually a field node.

Where the field value goes to 0, then you will keep thinking that how is whether my code is giving I mean that is also valid, but you might wonder if there is something entirely wrong with your code that is giving you 0 right. So, pick a few points and it should converge and then that is your value of dl ok. Now people have done these tests a lot right. So, there is also a rule of thumb over here that you pick your dl to be in the range of $\lambda/5$ to $\lambda/10$ all right. So, this is dl in this case.

Picking it in this range gives you it is a rule of thumb; it may be wrong or right it depends on the object, but in general if you have it sort of well behaved object choosing it between $\lambda/5$ and $\lambda/10$.

Student: What will have?

λ is the wavelength of the incident field right. So, λ is incident field wavelength. This is sufficient to give you a reasonable answer you can even go all the way to $\lambda/15$ depending on the problem ok. So, this is fine and this is coarse all right. But I mean just use this as a rule of thumb it may be wrong also for your problem you should check ok. This is just to tell you to not start from d l equal to two λ or some ridiculously large number.

That is for sure not going to work and choosing $\lambda/100$ for sure is not is an overkill you know like.

Student: Inside the medium

Inside the medium yes that is a good point right. So, there are values of lambda which are inside the medium right. So, what do I mean by inside the medium? So, lambda is equal to lambda naught by.

Student: (Refer Time: 05:46) depending upon omega naught.

The object typically V_2; so, n is the refractive index of object right ok. So, what is so, what is the sort of conclusion of this is that, if I have an object with a very large dielectric constant very high refractive index I need to grid it finer compared to let us say a very shallow refractive index ok.

So, you are computing. So, the same object may need a better discretization; if it had a higher refractive index ok. So, that is something to keep in mind.

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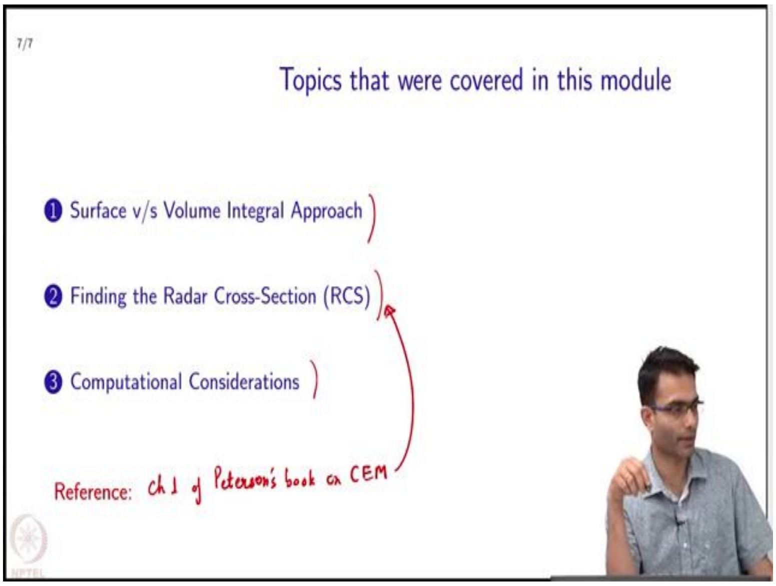

So that is so, summarize over here let us what we did we looked at. So, differences between surface and volume found of the RCS and spoke a little about computational considerations. So, for reference I think chapter 1 of Peterson's book on CEM, he gives you this radar cross section and the approximations required quite nicely.