Computational Electromagnetics
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Applications of Computational Electromagnetics
Lecture - 14.10
Antennas - Motivation for CEM

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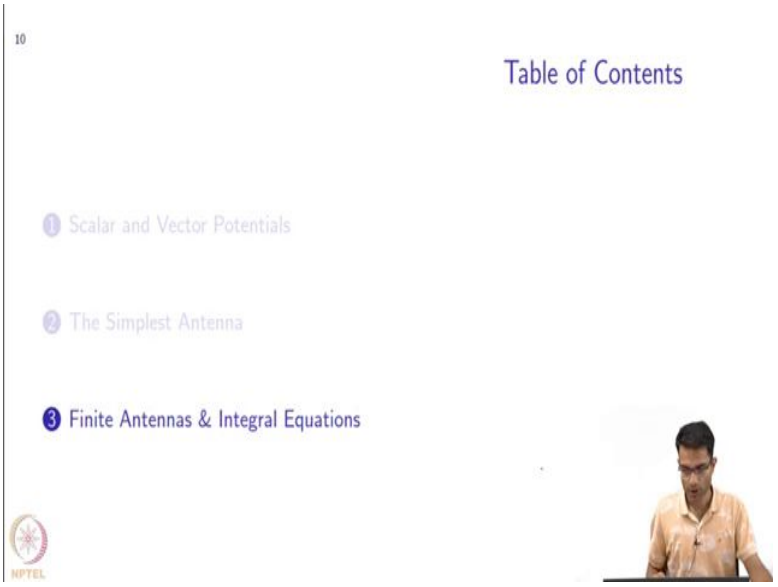

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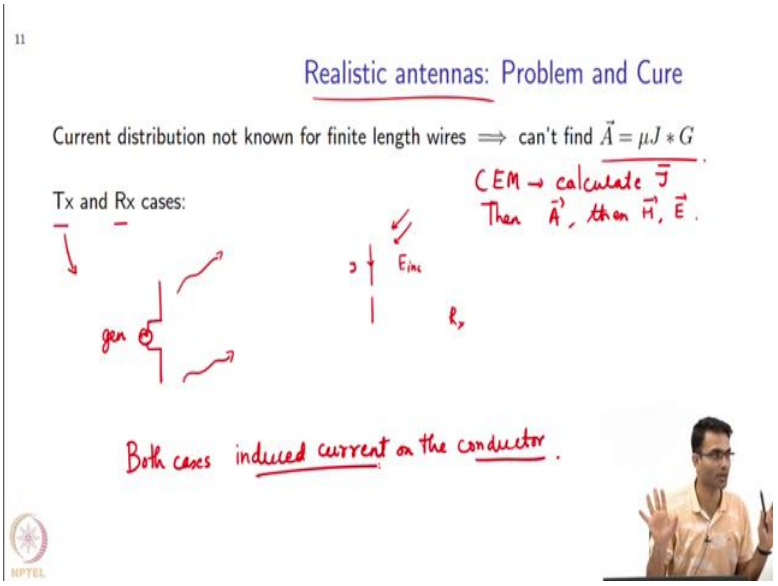

Let us see what is the problem in a realistic antenna ok. So, realistic antenna is; obviously, some an antenna where the length is finite ok. Now in a finite length antenna what current distribution will you assume? No idea right so, you might assume, for example, take a transmission line if I take if I give you a transmission line and I keep it open circuited at the end and if I bend the two ends that is one very crude form of an antenna ok. So, what is the current distribution on a transmission line? Sinusoidal.

Student: (Refer Time: 01:00).

Standing waves right; so, sinusoidal particularly if it is open circuited at the end. So, at the end of the antenna sort of wires the field is going to the current is going to be 0 and depending on whatever length is I will have some kind of sinusoidal distribution over I mean that is.

Student: (Refer Time: 01:19).

Yeah, I am hypothetical like doing a mental experiment to construct an antenna right, but this is not going to be realistically once you bend it is no longer exactly a transmission lines. So, that current distribution will no longer be a sinusoidal distribution. So, actually I do not know the current distribution in a realistic antenna. If I do not know the realistic current distribution I can no longer use this expression right; if I do not know $\vec{J}$ how can I find out $\vec{A}$, the convolution. So, I do not know $\vec{J}$. So, this is where CEM comes to our rescue. So, computational electromagnetics helps us to calculate what should be the J be given boundary conditions, I get $\vec{J}$ then I go back plug it into this get $\vec{A}$, get $\vec{H}$ get $\vec{E}$. So, that is where CEM comes to the rescue right so, CEM - we calculate $\vec{J}$.

Student: So, may be found that (Refer Time: 02:17).

Yes, like our very initial example in the integral equation methods where we wanted to find out the charge distribution right. So, calculate $\vec{J}$, then $\vec{A}$, then $\vec{H}$ and $\vec{E}$ that is the general philosophy that we follow right. Now, there are two different cases that we will talk about: one is transmission and the other is the antenna operating in receiving mode. So, when the antenna is operating in transmitting mode right. So, this is typically how you will show it, some generator is over here. This generator is producing a current and this current is radiating

I mean this current in turn produces a field ok. So, that is transmitting case, in the receiving case what happens if this is my antenna what is happening some $\vec{E}_{inc}$ is falling on it on this antenna, what will that $\vec{E}_{inc}$ do?

Student: (Refer Time: 03:36).

It will generate, it will induce a current in this metallic structure right. So, this is going to induce a current over here and that current I can take it and drop it across the resistor calculate the voltage and basically get this thing right. So, this is what is happening in the receiving case and this is in the transmitting case over here. So, in both cases what is common is that there is an induced current right.

In one case the generator induces the current on the surface of the wire and then that current radiates and in the receiving case incident field comes excites a current on the surface and that current which has been excited is what we decode in some sense. So, in both cases there is an induced current and for now we are going to be talking about conductors. In fact, very good conductors ok. So, just think of a wire.

Student: (Refer Time: 04:40).

That is a matter of interpretation you can also think of it as a current that is being induced on the surface.

Student: (Refer Time: 04:46).

That current I mean when there is volt when there is current flowing through a wire and a resistor there would do you say that the voltage came first and then the current or current came first and then the voltage does not matter right. So, one and the same thing although; if you ask a pure physicist then there are some.

Student: (Refer Time: 05:03).

Yeah, from an engineering point of view does not matter there is induced the reason why we will go with the interpretation of induced current is because we know a way of relating field to current right. If I know $\vec{J}$, I can calculate $\vec{E}$ right. So, that is the philosophy that we are

going to use, but if you give me voltage then I suddenly do not know what to do with Maxwell's equations; why do I put voltage in that that is electrostatics right gradient of electric field or whatever or gradient of voltage is electric field yeah thats. So, we follow the induced current philosophy over here ok.

So, when we continue we will go more into detail, but the basic point is that we should talk about an induced current in addition to induce current is there any other field like quantity here. Yes, in the case of receiving antenna there is an incident field right. There is a field that is coming in inducing a current that current itself is also going to radiate. Similarly, in the generating case there is going to be an induced voltage or induced current by the generator and something on the wire. So, there are two things that I have to worry about alright.