Radio Astronomy

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Lec-17

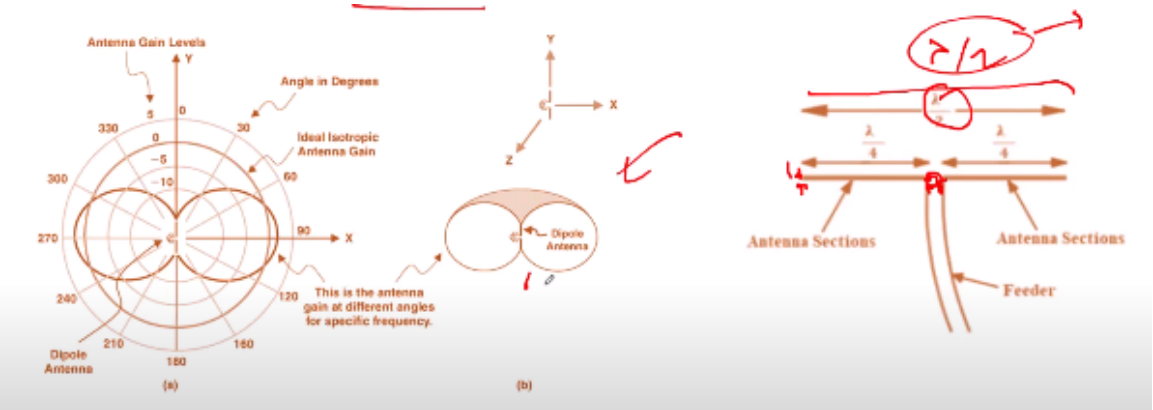
Demonstration of Antenna Design & Simulation Part 1

Hello everyone, I am Harsha Avinash Tanti and I am your TA for this course. Now lets begin with the overview of this session. What we will do in this session, we will try to see dipole antenna and Yagi Uda antenna from a design perspective. Say we are trying to design those antennas. You have already heard about it, what is dipole antenna, what are the equations related to it. But how do we design it? That we will see in this lecture series.

So this is basically a demonstration lecture series where we will try to demonstrate how you can use a antenna simulation software effectively to design an antenna. So in this we will talk about two specific software. There are several software's beside these two. But I am quite familiar with these two.

So we will talk about these two software which is 4NSE2 as well as CST studio suite. The 4NSE2 is I think free software and whereas studio suite is proprietary software. We will come reasonable to that in later in the lectures. And also we will discuss about the installation requirement in this particular lecture series. So lets first see what are the design parameter of a dipole antenna.

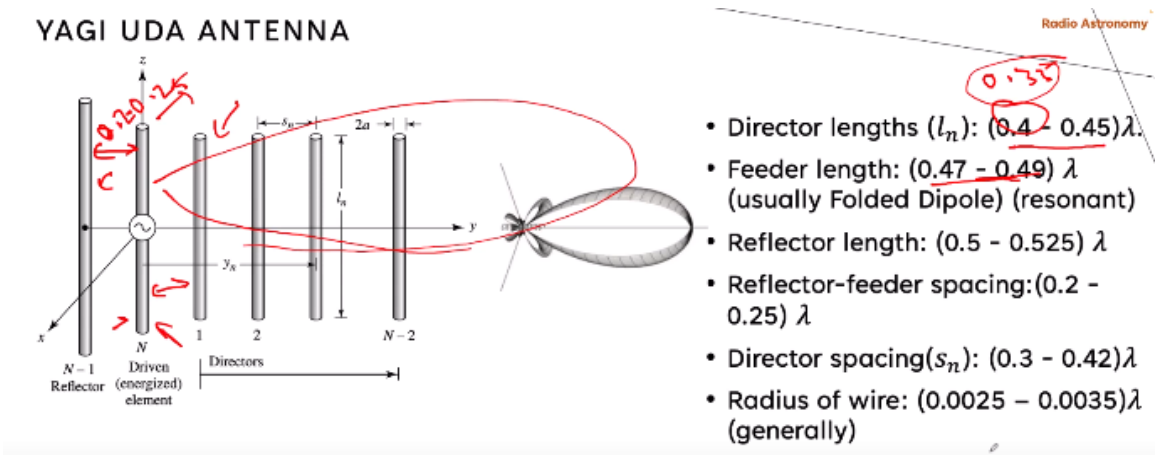
So what we have, we already know that dipole antenna is what the antenna length should be around lambda by 2. So this is what is called ideal situation. This is what is ideally. But it is researched and also observed that generally the range is around 4.5 to 4.8 lambda. Why is that so? Because antenna whatever the material you are using is not a perfect conductor. It has some intrinsic property of conductivity and all. So that will affect also whatever the joint you are making to send the signal here at the feed point that will also affect. So these all things are things affect the antenna's length.



Also there is another factor which is the radius of the antenna. As you know that this is a wire antenna. So the radius means the radius of the antenna also affects the frequency band of operation. So it has been noted and studied that if we increase the radius, the bandwidth of operation will increase. We will see that also in the demonstrations.

But it is to be noted that, see the antenna here, whatever the dipole antenna, we know the radiation pattern. So basically by simulation we will see whether that kind of radiation pattern we are able to observe or not. So that is the basic idea means if a dipole, we will design a dipole and try to see what is its radiation pattern, impedance, then reflection coefficient, all these parameters which we studied in the antenna fundamentals. Now there is another type of antenna which we will try to design which is Yagi-Uda antenna which is a directive antenna. This is, we are doing this because we are dealing with lots of reflector antenna concept and antennas with a high directivity like Parabolic Dish.

This is a simple wire antenna which is very directive. So we will try to see how we can design this also. So essentially in Yagi-Uda antenna you will have a driven element as we discussed earlier. So you will have a driven element which is essentially a half wave dipole or which the feeder or which length varies from 0.47 to 0.49 lambda. And then we have a reflector which is kept around 2 to 2.5, 0.2 to 0.25 lambda distance from the driven element.



And then we have different driven element which is a parasitic element which catches the field and oscillates and again forwards that field to the next driven element. So causing the beam of the dipole to go in only one direction. So now this is there. So these are the few important things. Director lengths are between this 0.

4 to 0.45, feeder length is 0.47 to 0.49 and this director length sometimes you can find it going from 0.352. So this all depends upon simulation.

There is mathematics behind it but that is very complicated to solve for. So the best way for that is to simulate and understand where you are getting the maximum directivity, maximum resonance, resonance means in terms of frequency, where you are getting all those things maximum such that you can use that for your application. And the design metric for any antenna depends upon your application. Say you require antenna for Wi-Fi frequency then you won't design it for 700 megahertz. You will design it either for 2.

4 gigahertz or 5 gigahertz. So those and also the range you are talking about. Say you want to have a Wi-Fi which can go up to 10 meter. So you need to give gain accordingly. And based on your link budget of your receiving mobile or laptop or anything means receiving device.

So now let's come to the point when we are doing antenna design and simulation what we are trying to do, we are trying to skip this step of trying to solve it analytically using equations which will become very cumbersome if you add different kind of losses and parasitic values of the conductor or any material, parasitic values of the material. So that is very difficult to account for when you are deriving it analytically. So for this we require softwares. So now generally in the simulation software what happens say if you have a frame or this kind of box where you want to design say test this dipole antenna. What it will do, it will divide the entire cubical box into small small grids.

Those are also called meshes. We will learn later also this what is that. But to get an idea what it does, it divides into small small grids and evaluates the electric field and magnetic field in that small grid based on the boundary condition as well as the field values at a point if the source is at your driven element. So this way they kind of calculates each grid, grid values or the meshes. Each meshes is evaluated then those are combined to form the actual solution.

This is done by different kind of numerical techniques and also in fact there is an entire topic or subject about it which is called computational electromagnetics in which there are different kind of methods to evaluate such kind of problems. Now as I said we will discuss two softwares here. One is 4NSE2 which is a free software which is mostly used for wire antenna design and a surface antenna design is not possible, is very difficult to do in 4NSE2 or next to impossible. Now another one is the CST studio suite. It's a proprietary software but the solar systems it requires license but there is student license available so that you can test it and have an idea how to design an antenna.

So there are few limitations in software like the numbers of mesh or the grading you can do is up to I think 10 lakh or 1 lakh grids or some mesh. So there are some limitations to that but including I mean with that limitation also we can do some kind of simulations on that and you can get an hang of how these simulation methods work and gives results in what what forms. Now let's talk about installation requirements if you are trying to say you have to install it so both will require a windows machine 4NSE2 can work on any configuration which you have but for running the CST studio suite you will require at least of 8GB RAM and 2 core processor on your PC and also if you are running a full version of that you will require much more processing power. So personally in our department we use 94GB machine with 12 core processor with 2 threads that means virtual core of 64 cores and also this whatever type of machine computing node or machine you require depends upon what kind of design you will do. If it's about low frequency and simple designs then not that much processing power is required.

So let's begin with how to install 4NSE2 on your desktop or laptop. So when you search for 4NSE2 on your computer what you will get you will get the first set qsl.net it is the authentic site where you can download 4NSE2 so you go on that then what you can go down and then you can just download the latest version. So when you do that just click on that you just have to go to the downloaded folder where you have downloaded so downloads you have to go to downloads and there you will find a zip file setup file and then you can go to install it and just do next next next and next and install. So this is how you install 4NSE2 very simple.

Now and then next and there you will get a finish option you don't have to launch it finish it and when you go to the desktop you will find this kind of antenna logo here 4NSE2 so this is actually software so just to look at it if you see it looks like this. Now and you can design it we will go through the design also but first let's install the software and make our machine ready for the simulations we will be doing. So this is that and for another thing the another one software that is CST that is what we have to do CST studio suite you can search for that then you can you have this Dassault link here okay so what you can go you can go there and you can and the learning edition okay so here you can see that learning edition they give out learning edition but for that what you have to do you have to register in this okay so register for download for free it's given here so you have to go to that and click that link and if you click for download for free you will have to register to the Dassault system okay preferably if you have a college ID that will be much better otherwise normal email ID can also do so you can you can you have to create your 3d experience ID so here you have to give your name email ID and all and you will be registered to the Dassault system and Dassault system 3d experience forum kind of thing and then you can go and download download this okay so how to download it I have already my account here so I will just log into it okay so I am just logged in here so here what you can find you can go to below and you can find studio suite version so you can try the latest version no issue or the earlier version both both will work fine so you can download it from here say if you download this and now go to the downloads folder after the after that open the file okay so here the installation is almost similar but there is one extra process okay so so wherein you have to log in with your email registered email ID to get retrieve the license of the CST okay let it extract and then we will see how to install CST studio so after extraction is completed you will be redirected to the folder where it is extracted now click on the application okay when you click on the application this sim a similar window to the similar window like when you installed for an AC to will come somewhere you have to say that directly where you have to install and all with for for the for now we can just install it wherever it suggests just like clicking next next okay so this kind of window will come you have to just press on next so you have to just like you you can keep this empty also no issue so go to next and then you can change that folder but just proceed next then you you will just click install and it will install so after finishing you will get this finishing installation you will get this window okay so you you need to launch this one okay because it requires license activation okay so when you launch it you will get kind of pop-up okay see see like this pop-up so here you have to type in your email ID just like mine is being okay here it is and then I will just press on ok and it will retrieve student version license here ok educational license here now you can design and go now the environment is set so in the next lecture we will have we will we will go through how to design dipole and also gag you die antenna using for an AC to ok and after that we will in the following

demonstration again we will go go go through CST software how to design in that also so thank you for paying attention