Computational Electromagentics and Applications
Professor Krish Sankaran
Indian Institute of Technology Bombay
Summary of Week 10

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We started this week's lecture building on the previous week's introduction to finite volume method

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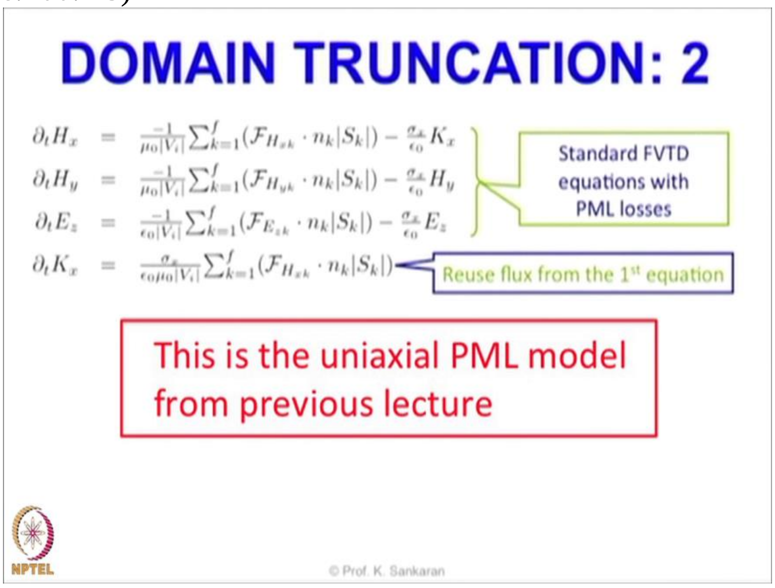

We further developed the idea of Perfectly Matched Layer technique introduced in the earlier lectures for advanced applications.

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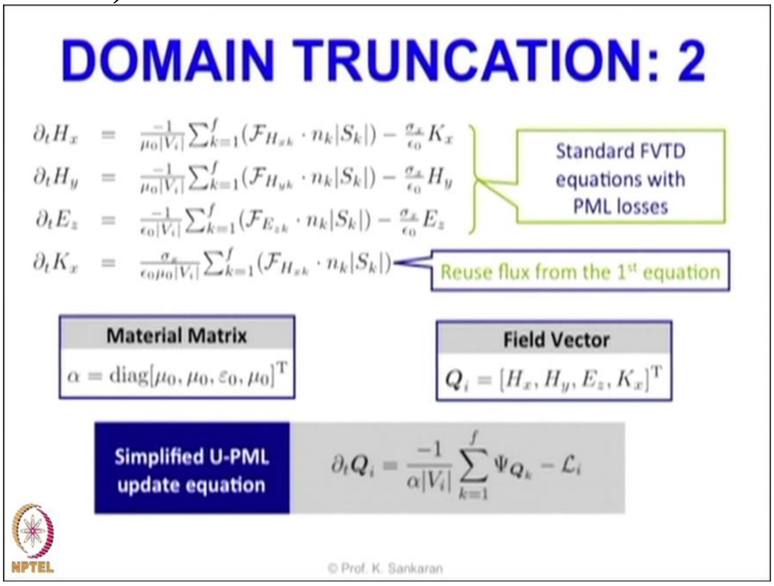

We looked into a simply kind uniaxial perfectly matched layer formulation for Finite Volume Time domain simulation.

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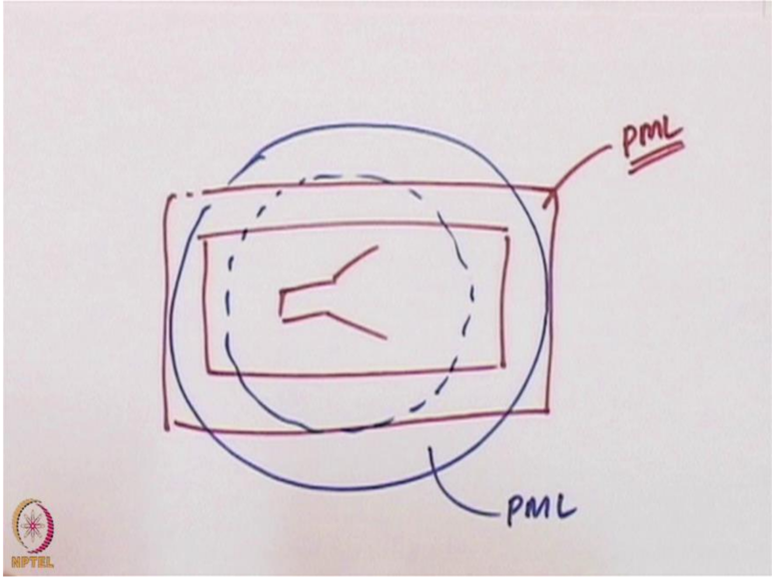

We showed some applications using rectangular geometry using this PML formulation

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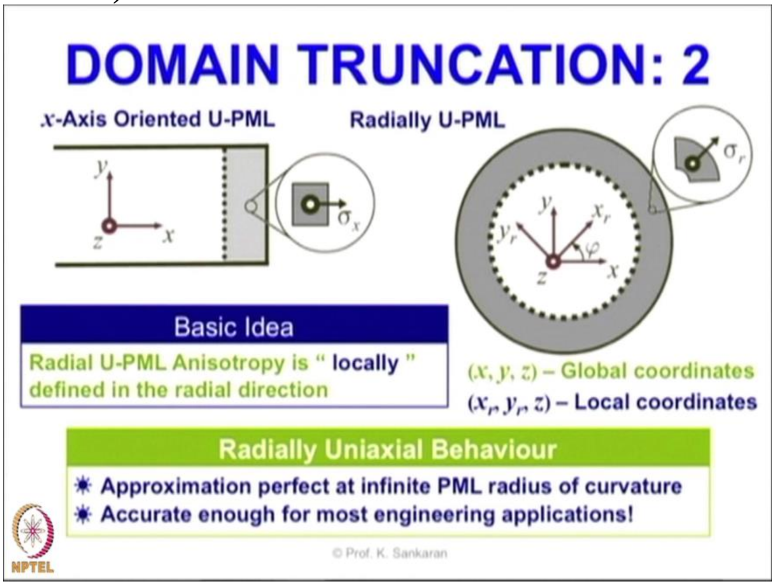

We further extended this idea to include a more general radial uniaxial PML

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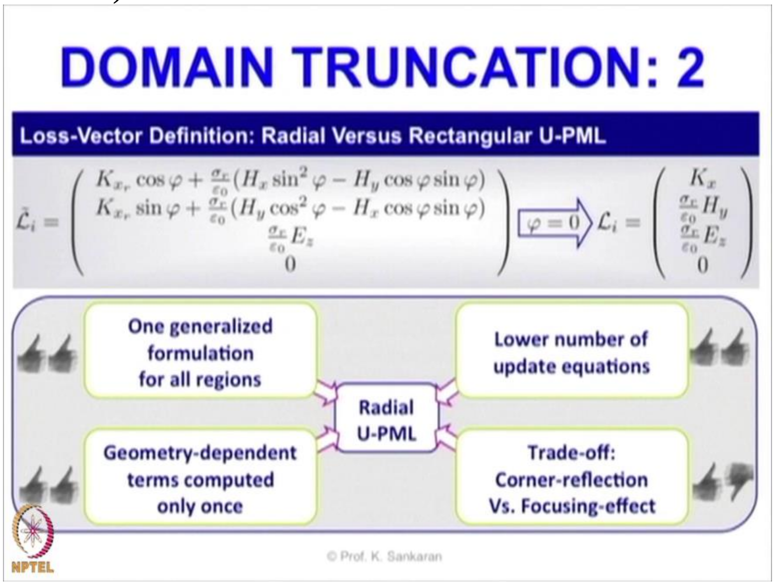

Showcasing pros and cons of this generalized formulation for 2D applications.

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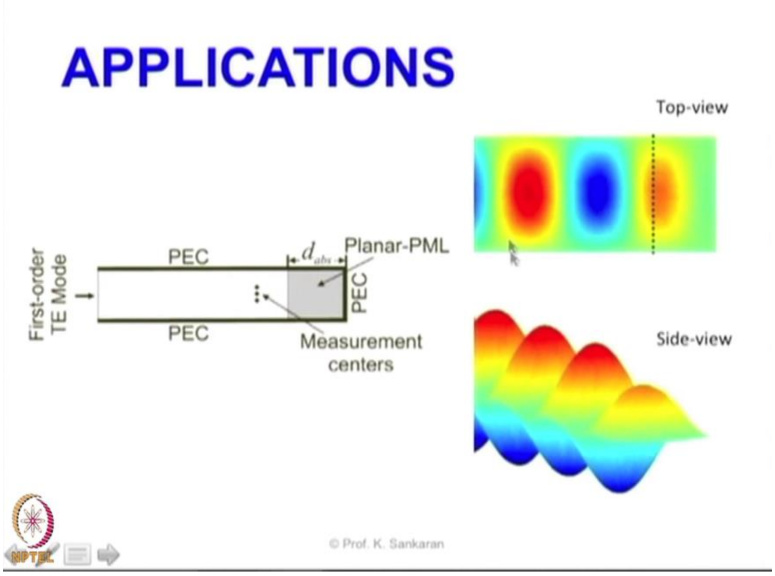

We later studied using a simple wave guide problem. The epicacy of radial uniaxial PML for finite volume time domain applications

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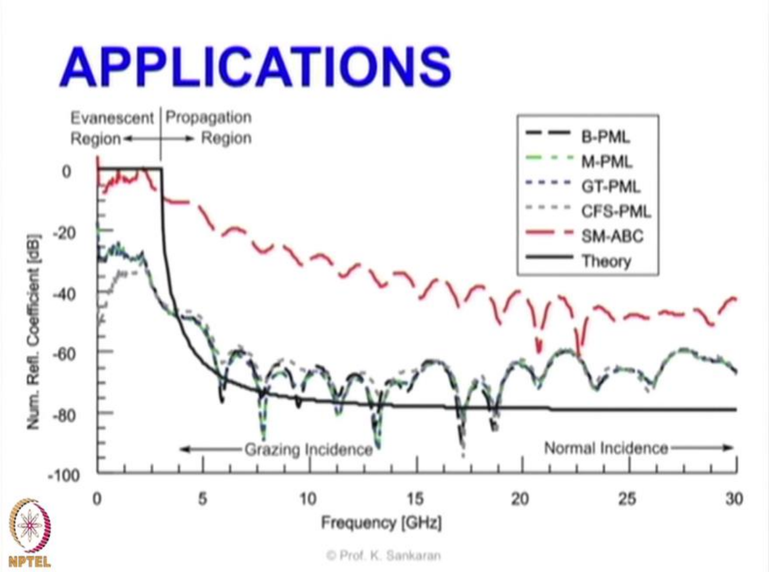

We also compared the performances of a standard silver Muller absorbing Boundary condition and uniaxial radial PML in the finite volume framework.

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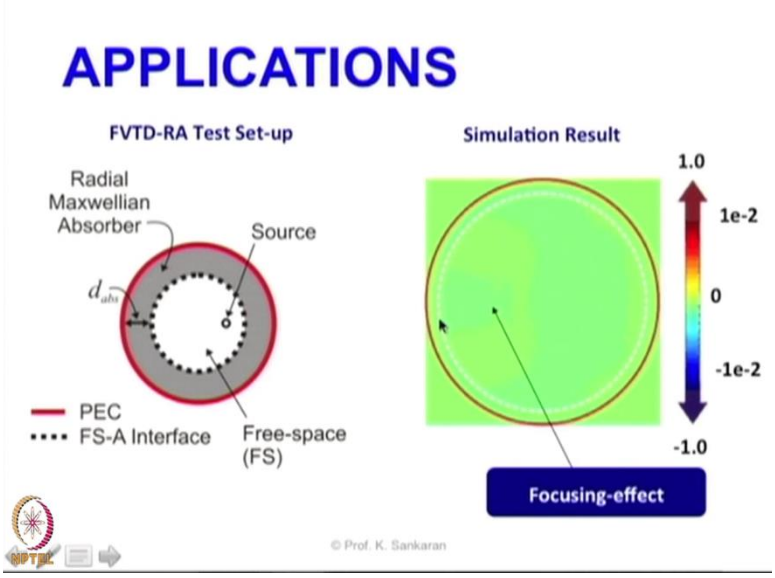

We demonstrated the impact of source locations in the PML absorption behaviour

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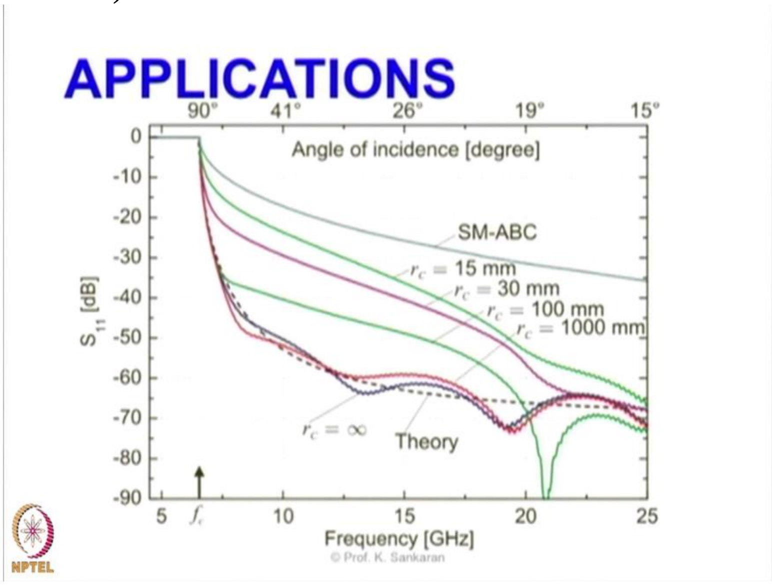

Later we discussed a critical role where radius of curvature of radial PML placed in the PML absorption performance.

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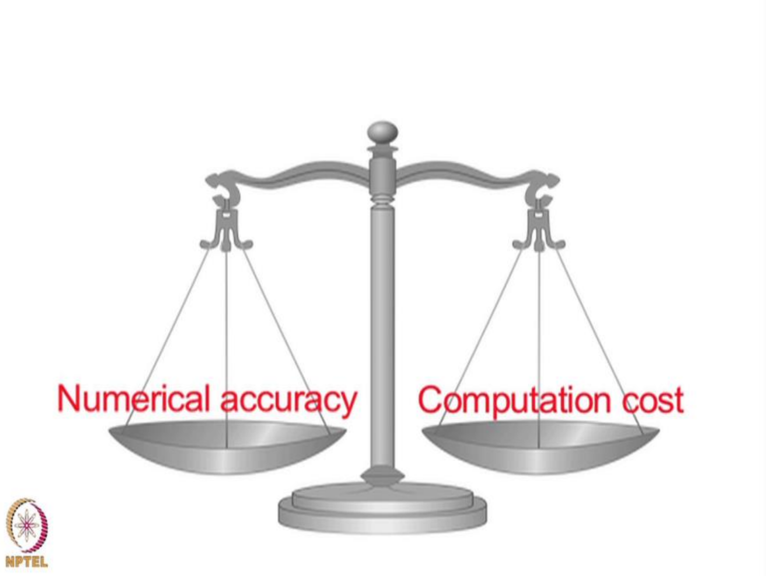

We later discussed some practical tips for making some trade off between accuracy and computation cost while using these advanced methods.

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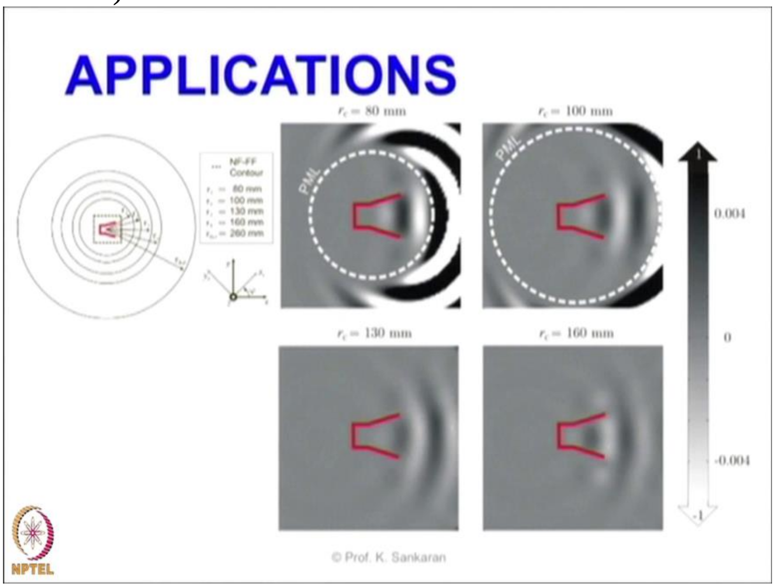

We also simulated some advance applications like a horn antenna.

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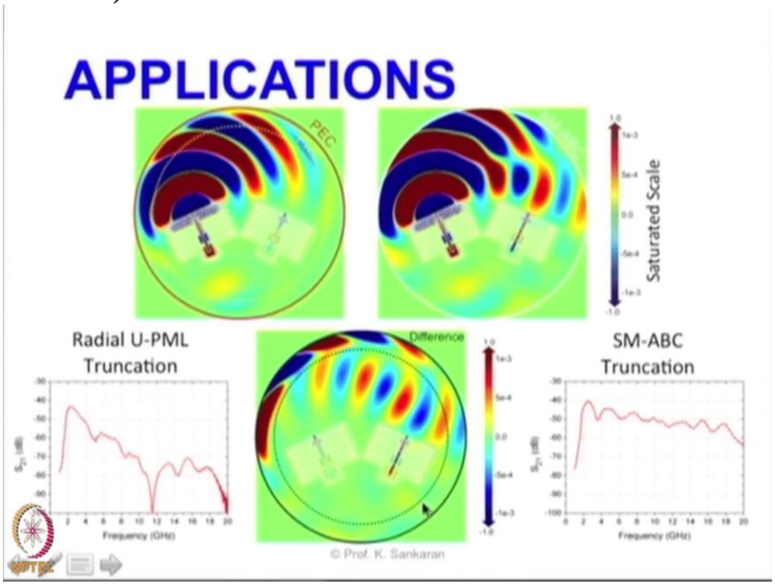

And coupling between 2 Archimedean spiral antennas using radial PML and Silver Muller absorbing boundary condition in the finite volume framework.

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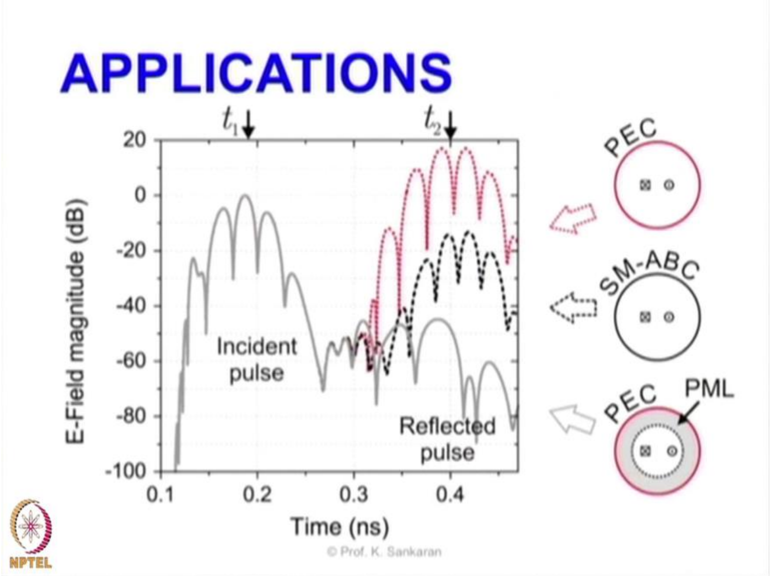

We compared the computed radiation pattern and;

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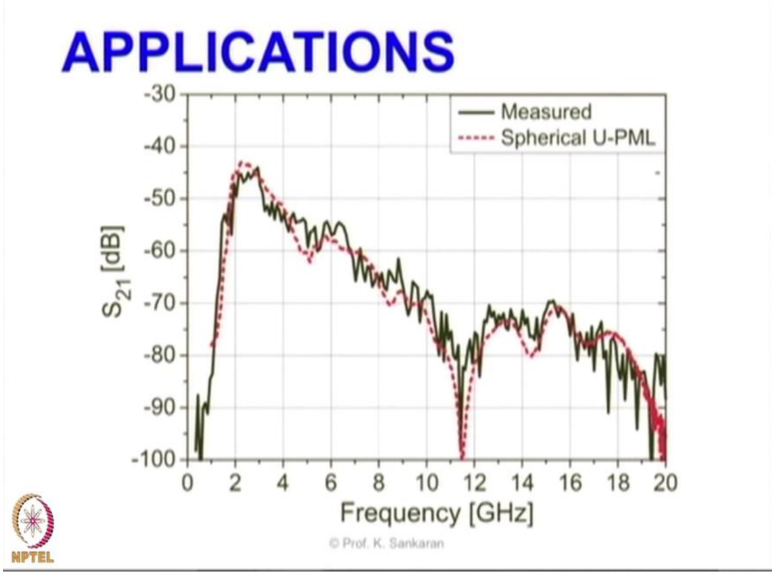

Cross coupling to discuss the performance of different domain truncation techniques in the finite volume time domain method

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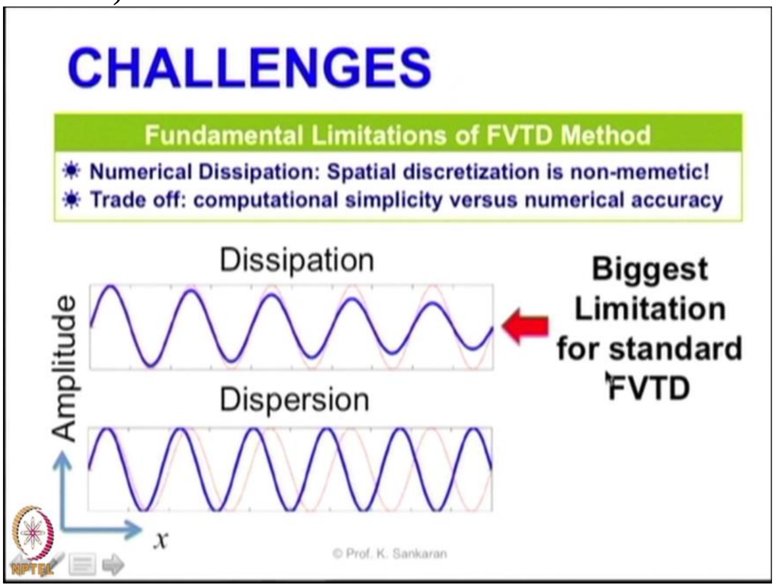

Finally we also discussed one of the biggest challenges while using Finite difference time domain method namely the numerical dissipation.

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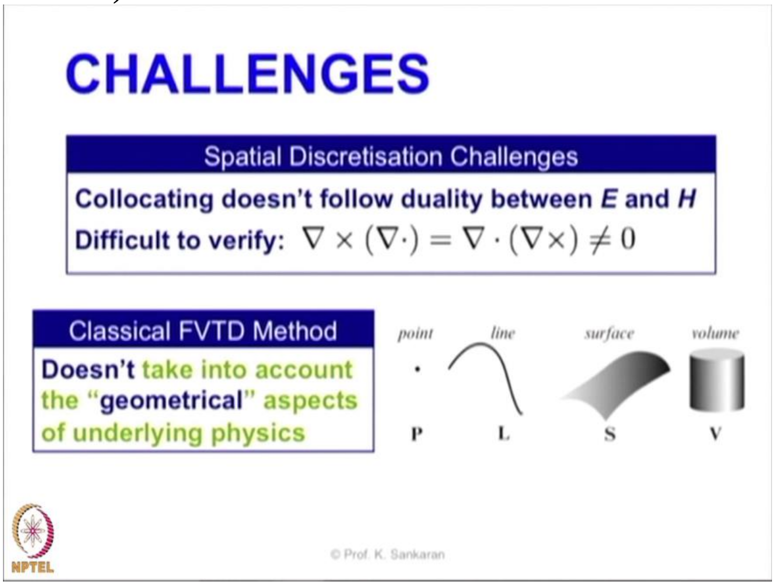

We also discussed source of such dissipation while computing the flux function and how it is inherently timed to the manner in which we do the spatial discretisation and compute the flux function.

We also briefly alluded how and why co locating electric and magnetic fields in space and time affect the duality relationships that exists between them. We mentioned the coefficient between space and time while using the finite volume formulation does it consider the underlined topological aspect of the electromagnetic quantities

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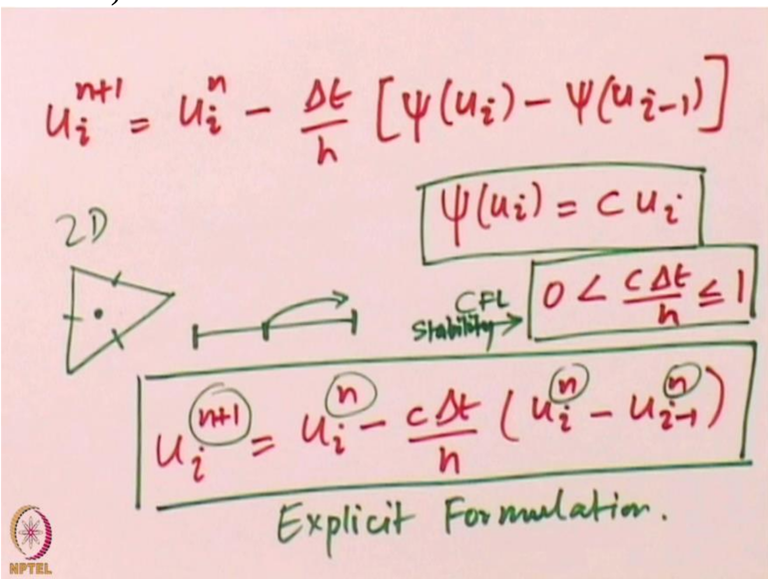

Towards the end we also introduced a simple heat conduction problem using finite volume method.

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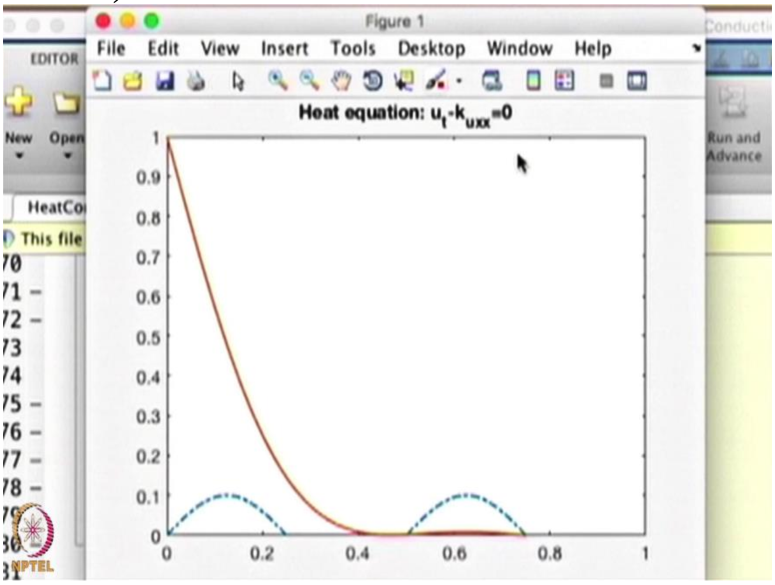

And also explained how we can model such problems using matlab.

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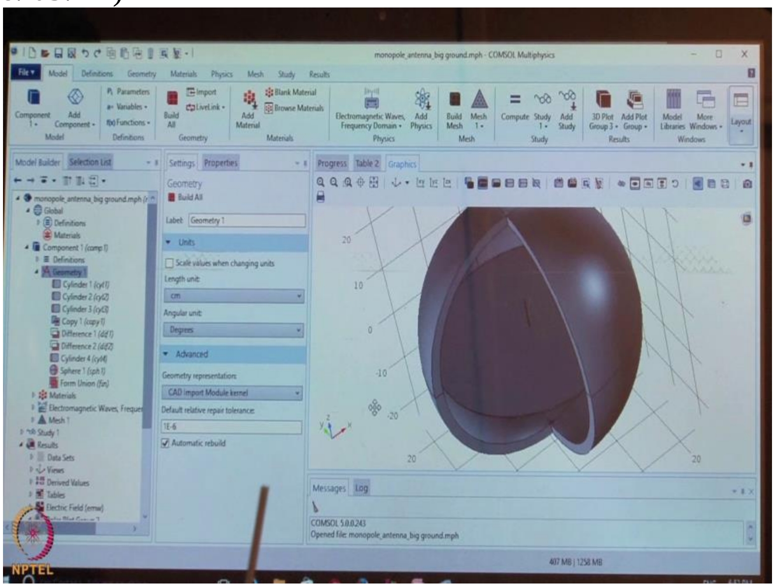

In this week's lecture during the lab tour we also modelled and simulated the permanent bar magnet and monopole antenna problems.

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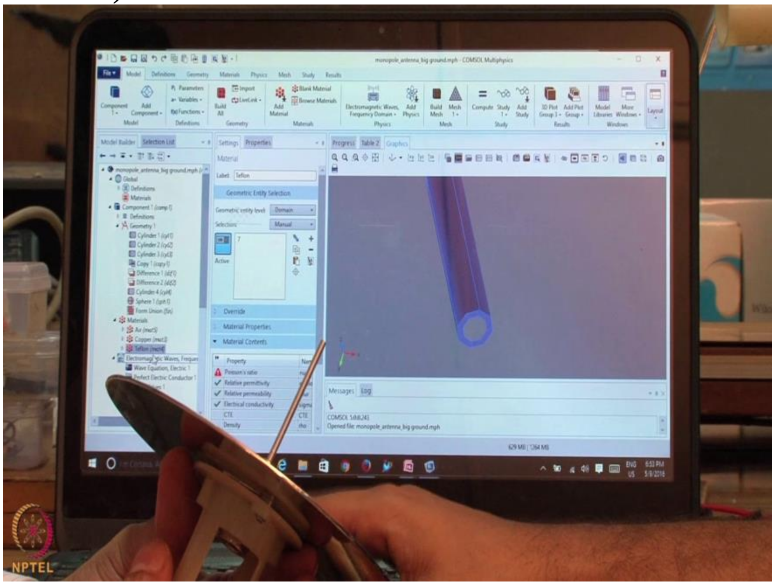

We carefully learned the theoretical aspects and applications we studied this week

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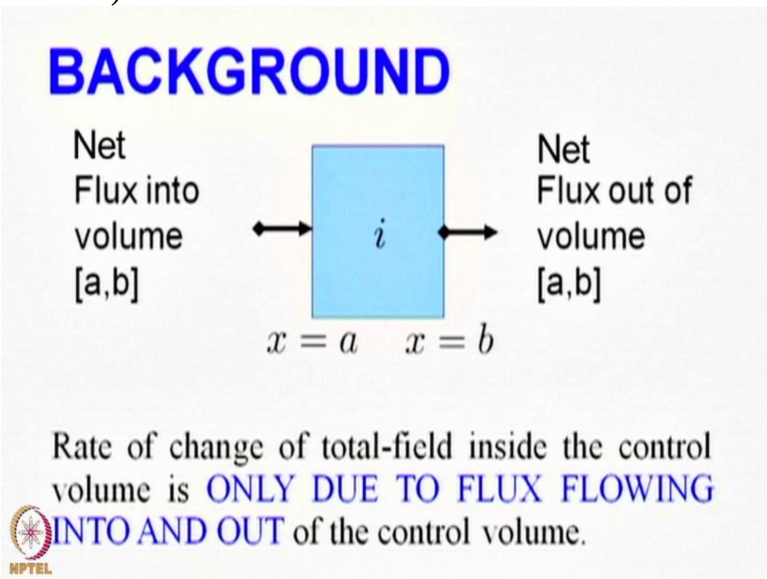

Finite volume time domain method is not normally discussed in any graduate course work in computational electromagnetics

Hence take this opportunity to learn as much as you can during the course work and also disclose your work

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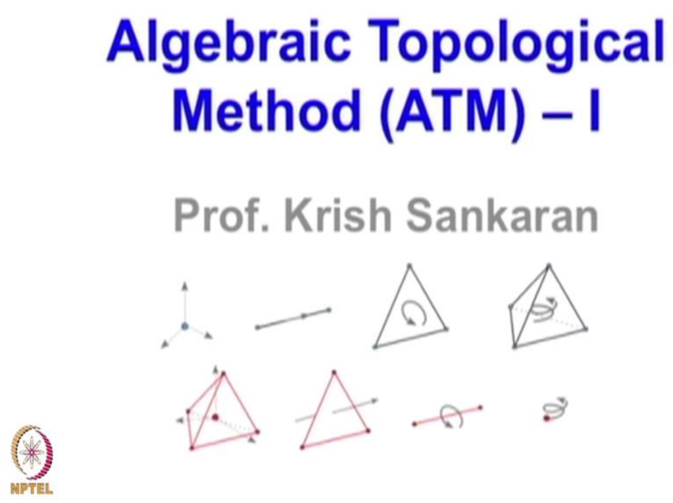

In the next week we would be introducing one of the most beautiful methods in computational electromagnetics there is not Algebraic topology. This is one of the rarest methods that you will learn in any course work or computational electromagnetics. I am very much excited and I hope you are equally excited as well. So we will see you next week Until then Good Bye!