Project details for semester 2

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My main aim in this computational physics project is to study the Finite Difference Time Domain method and also the Finite Integration Technique, try to find out the best process available. These numerical techniques would be used to solve the partial differential equations of Maxwell's electromagnetic equations involving the space and time derivatives of the electric and magnetic field vectors. The details of the numerical methods is mentioned below:

1. I would assume a wave propagating in the +z direction with E(z, t) and H(z, t) components.

2. Then these wquations would be discretized using central difference approximation .

3. Next we calculate E and H values by leap frog integration method.

4. I will use MATLAB to write the codes for 1D FDTD method.

5. After this, i would try to extend this same logic to perform 3D FDTD method in MATLAB.

6. The order of error of the central difference approximation indicates that using a too large Δz would lead to numerical inaccuracies.

7. Sampling points must also be taken in large numbers for largely varying signals as we assume our signals are.

8. Another important factor would be the stability of the process, i.e the em waves can not travel faster that c,ropagating a distance of one cell requires a minimum time of $\Delta t = \Delta z/c$, herefore, for a one dimension case, $\Delta t \leq \Delta z/c$.

9.We would use a time function f(t) dependant on all parameters in our program, as the source of E field.

Now we come to the FIT details. These are as follows

1. This process divides our space into discreet grid or meshes of different shapes.

2. Any continious equation is transformed in the discreet domain by allocating an electric voltage at the edges and electric fluxes on the faces of a primary grid, and magnetic field on the edges and flux on the faces of a secondary grid.

3. The variables are the integral degrees of freedom which are fields and fluxes.

4. Thus i will discreetise maxwell's equation in either coordinate meshes or tetrahedral meshes.

5. Then we produce a set of Maxwell's Grid Equation, which are then solved in either time domain or frequency domain.

- I intend to learn the FIT process in a much more detailed manner as it is used extensively for modern approach