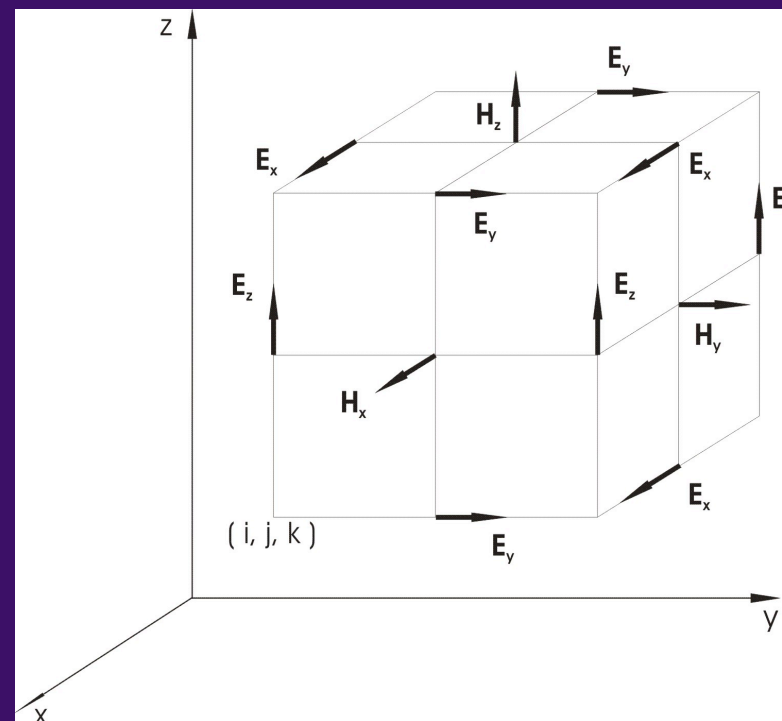


YEE CELL



- The domain is divided into a 3D lattice of cells which are assigned discrete electrical properties.
- The components of the E field are positioned on the middle of the edges and the components of the H field are at the middle of the faces of the lattice cells.
- An explicit second-order finite-difference procedure then leap-frogs, evaluating E from H and vice-versa at alternate half-time steps until equilibrium has been reached.



SAR



$$SAR = \frac{\sigma |E|^2}{2\rho}$$

where

E = electric field value, σ = conductivity and ρ = density

STANDARD ALGORITHM



- ALGORITHM A (HPA CODE)

- Each time step, calculate the average of E_x (and E_y and E_z) from the four edges of the Yee cell, obtaining the field components at the centre of the voxel.
- Square the components, then sum them to give $|E^2|$ at that time step.
- Maximum value of this is found over a half-period of the wave to produce the SAR for that voxel.

CHANGE OF THE STANDARD METHOD



• ALGORITHM B

- Each time step, calculate the squared values E_x^2 (and E_y^2 and E_z^2) from the four edges of the Yee cell.
- An average of E_x^2 is then calculated at the centre of the voxel.
- The averaged square values are then summed to produce $|E^2|$ at that time step.
- The maximum value of this quantity is then found over a half-period of the wave to produce the SAR.

CHANGE OF THE STANDARD METHOD



- ALGORITHM C

- Calculate the average of maximum absolute values $|E_x|$ (and $|E_y|$ and $|E_z|$) from the four edges of the Yee cell, obtaining the field components at the centre of the voxel for a half-period.
- Square the components, then sum them to give $|E^2|$.
- Use this to produce the SAR for that voxel.

CHANGE OF THE STANDARD METHOD



- ALGORITHM D

- Average absolute squared values $|E_x^2|$ (and $|E_y^2|$ and $|E_z^2|$) from the four edges of the Yee cell over a half-period to obtain average square fields at the centre of the voxel.
- These are then added and used to obtain the SAR

SUMMARY OF ALGORITHMS



- ALGORITHM A

- Average E_x – square – sum to give $|E^2|$

- ALGORITHM B

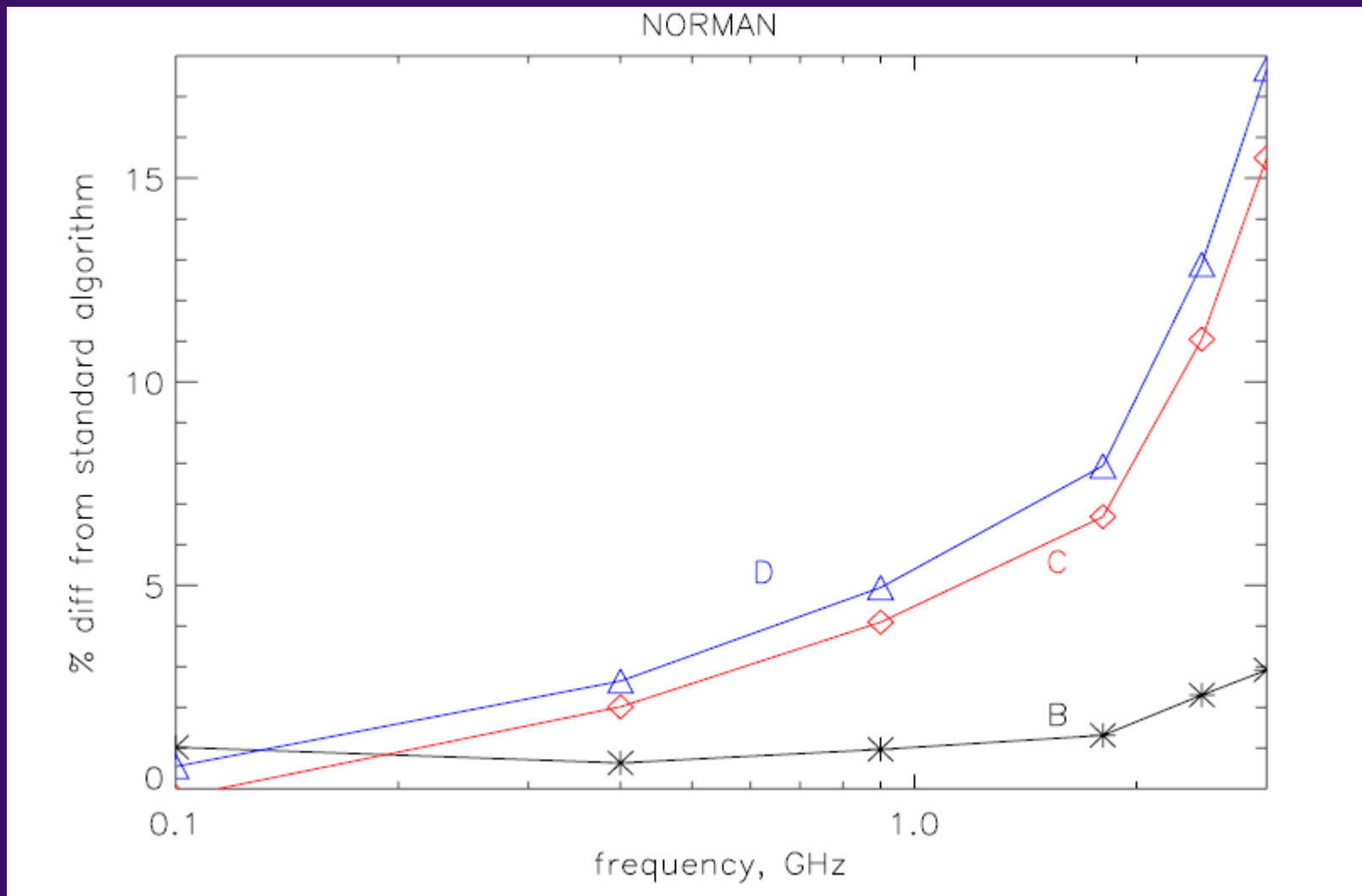
- Average E_x^2 – sum to give $|E^2|$

- ALGORITHM C

- Average $|E_x|$ – square – sum to give $|E^2|$

- ALGORITHM D

- Average $|E_x^2|$ – sum to give $|E^2|$



- ALGORITHM A

- Average E_x – square – sum to give $|E^2|$

- ALGORITHM B

- Average E_x^2 – sum to give $|E^2|$

- ALGORITHM C

- Average $|E_x|$ – square – sum to give $|E^2|$

- ALGORITHM D

- Average $|E_x^2|$ – sum to give $|E^2|$

These will always produce a higher (or equal) value of SAR as they assume that the three field components are in phase

