

ITS Finite Element Mesh Structure

Improving Accuracy of Data Transfer

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ITS

- **ITS stands for Integrated TIGER Series**
 - It is made up of coupled Electron/Photon Monte Carlo Codes
 - ITS is used to solve electron/photon radiation transport problems
- **ITS is made up of specialized codes**
 - I focused on the general 3-D code, ACCEPT
 - ACCEPT has the option of printing out a Finite-Element-File
 - Files are written in Tecplot ® ASCII format

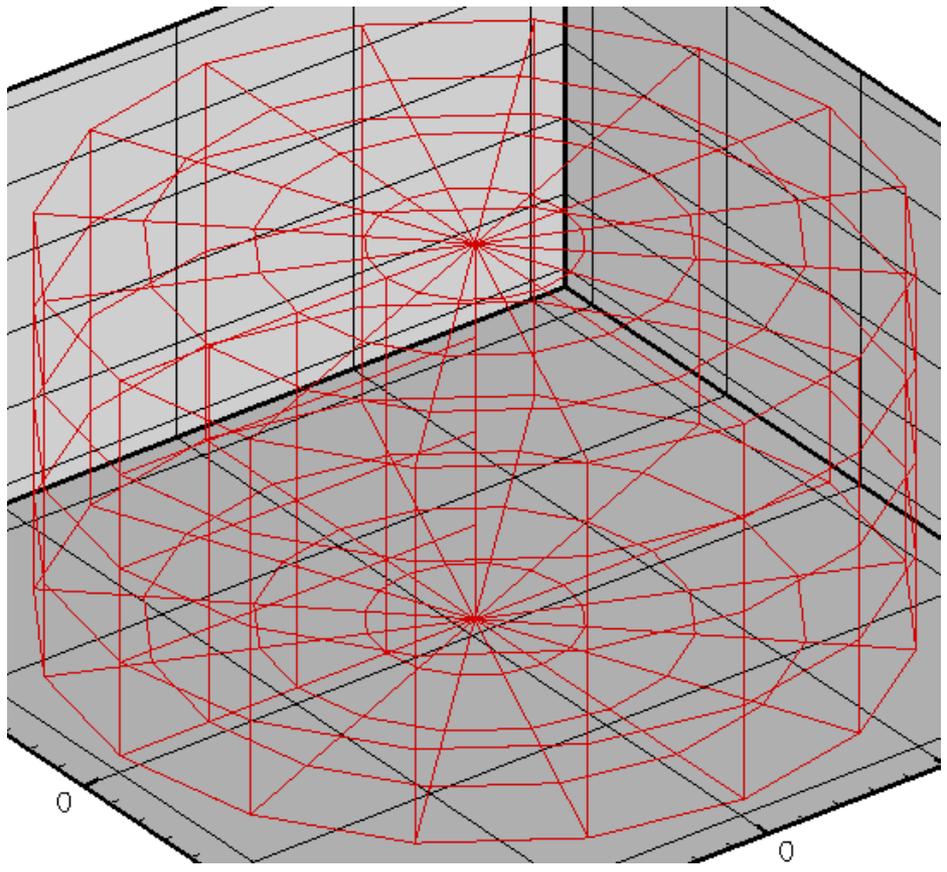


The Mesh

- **ITS transfers results to the mesh by simply summing the depositions that take place in that element**
- **The problem was elements were not always completely filled with material**
- **This occurs when a non-conformal overlay is used to subzone a shape**



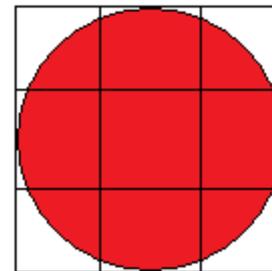
Cylindrical Mesh





Overlays and Non-Conformal Mapping

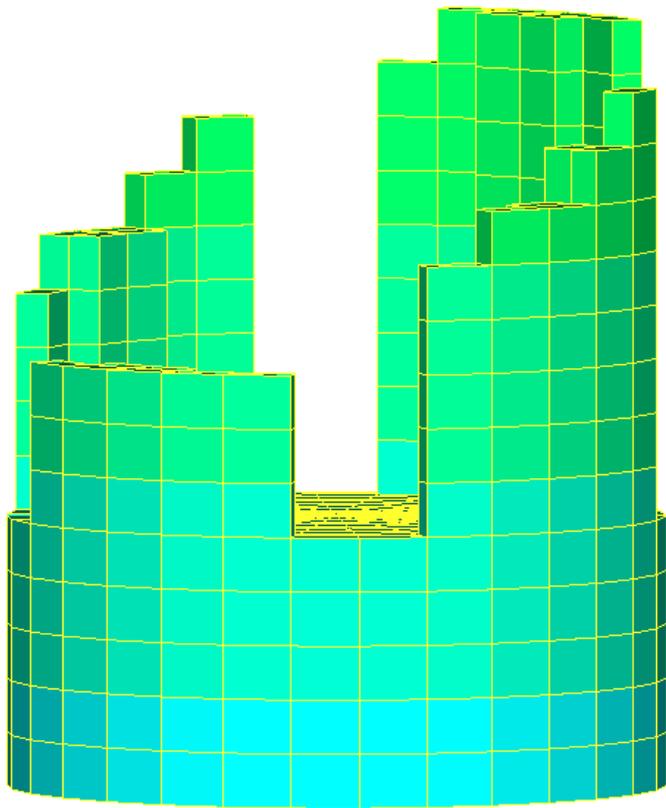
- A 2D example would be a square overlay of a circle
- Without knowing the amount of material in the box, you can't compare deposition between boxes
- Those elements with deposition were assumed to be filled with material.



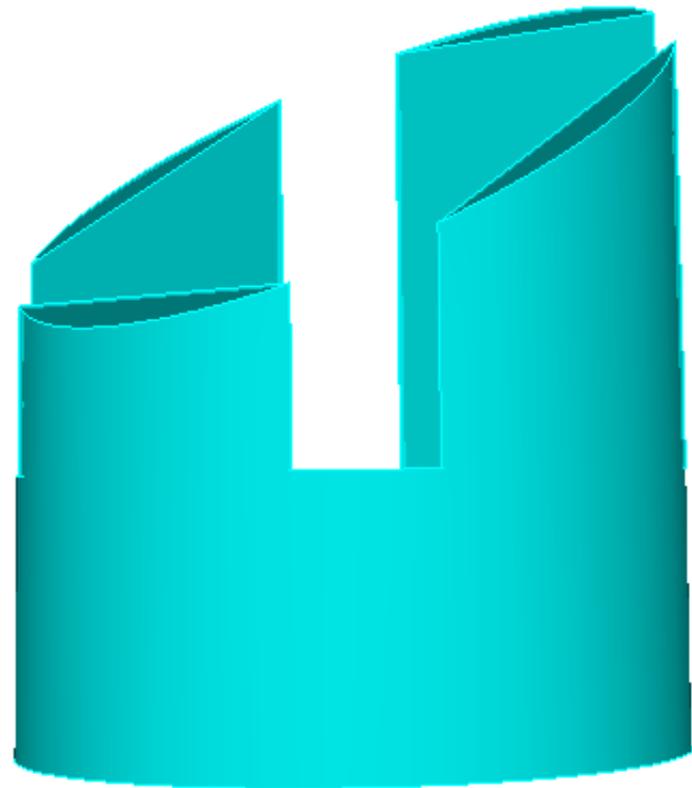


Cylindrical Overlay

ITS Mesh



CAD Model



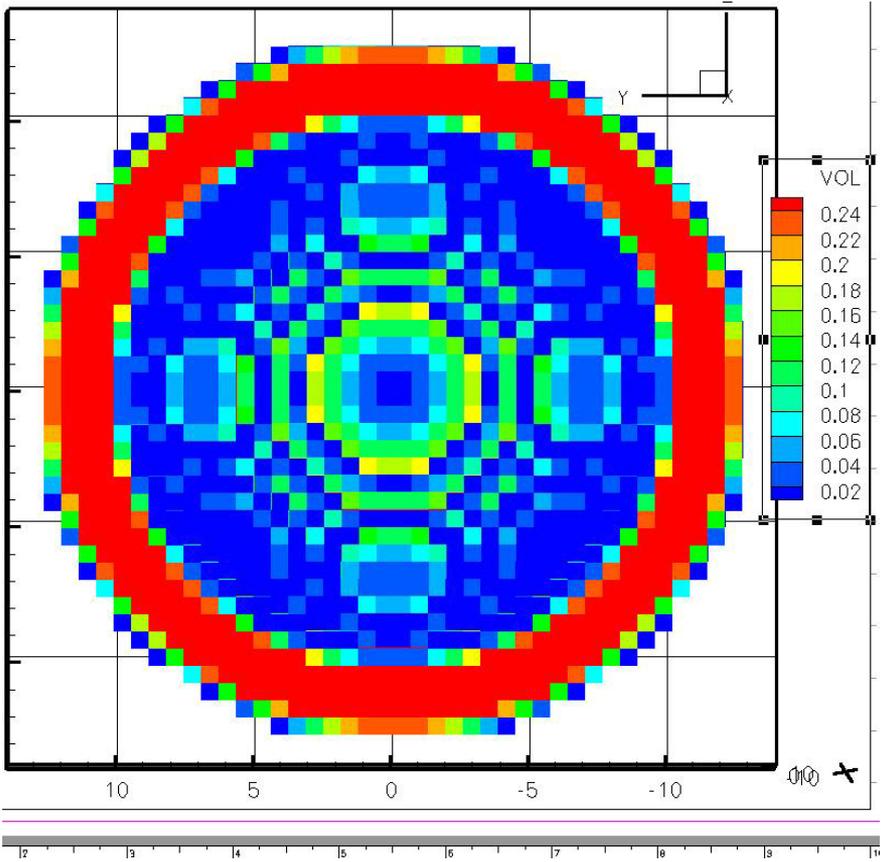


Adding Volume

- **The actual volume of the material was added to the output**
- **Any format that included energy or charge deposition had volume added**
- **This allows for the comparison between energy deposition per source and energy deposition per volume or mass**



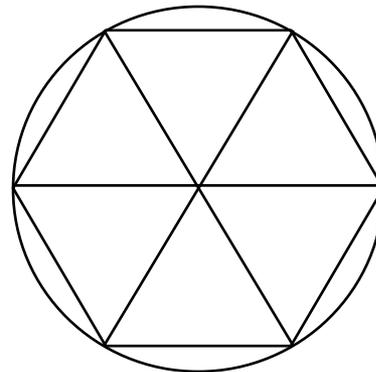
Hollow Sphere





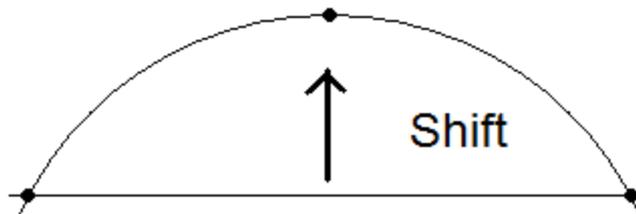
Curved Surfaces

- The finite elements used by ITS are hex 8
- A hex 8 element is 8 node, 6 faced element with flats sides
- The flat edges of the hex 8 make it unable to accurately describe curved edges
- To describe curved edge, higher order nodes were required



Higher Order Nodes

- Higher order nodes are additional nodes added to the edges of the hex 8 box
- This gives each edge 3 points
- The 3 points can be used to map a quadratic to create a curved edge
- Higher order nodes capability was added on a zone per zone basis





Visualization

- In addition, two utility codes, `its2tec` and `its2exo`, had to be changed to accommodate these two major changes
- `Its2tec` helps make the output from ITS be better visualized Tecplot ®
- `Its2exo` rewrites the ITS output in the binary EXODUS II format which is a common
- EXODUS II is a common format used by all Sandia finite element codes



Conclusion

- **Data is now more accurately transferred to the finite element files**
- **This will allow for more accurate results from mechanical simulations**