Bay-Area Radiation Transport (BART), a Research-purpose Parallel Transport Code Framework

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Introductions

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Equations and Discretizations

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Finite Elements and Linear Algebra

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Meshing Capability

Homogenized and pin-resolved meshing capability in parallel

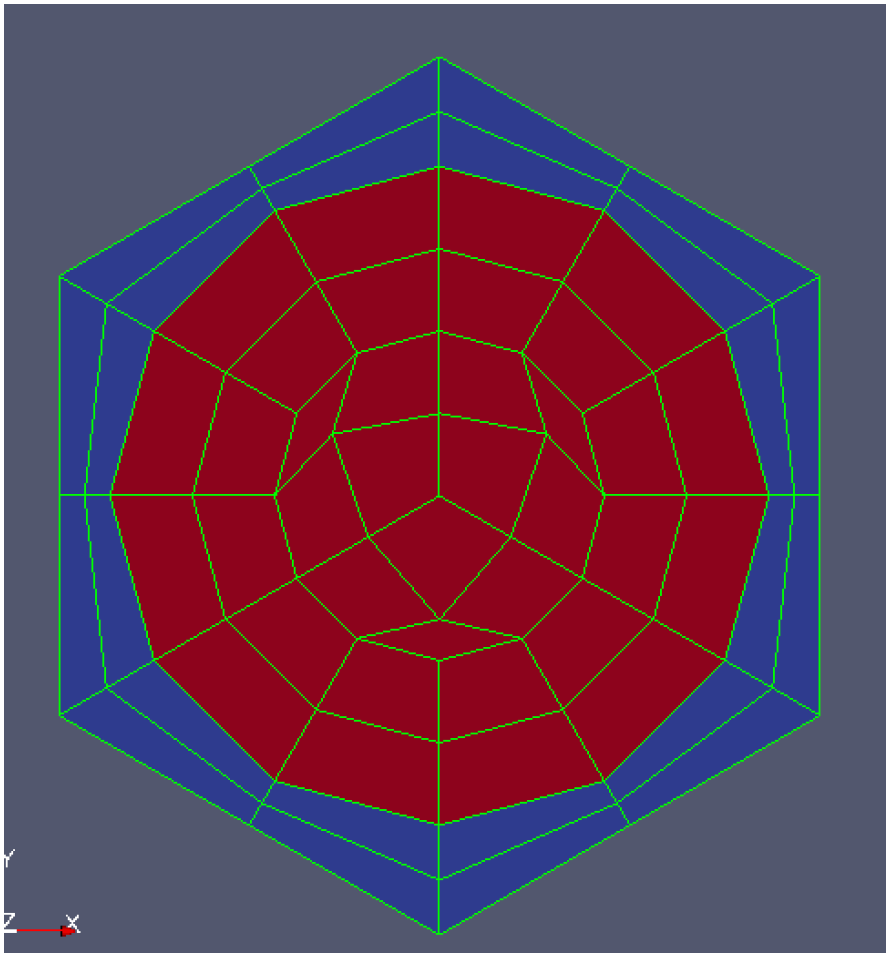
BART was initially implemented for homogenized mesh

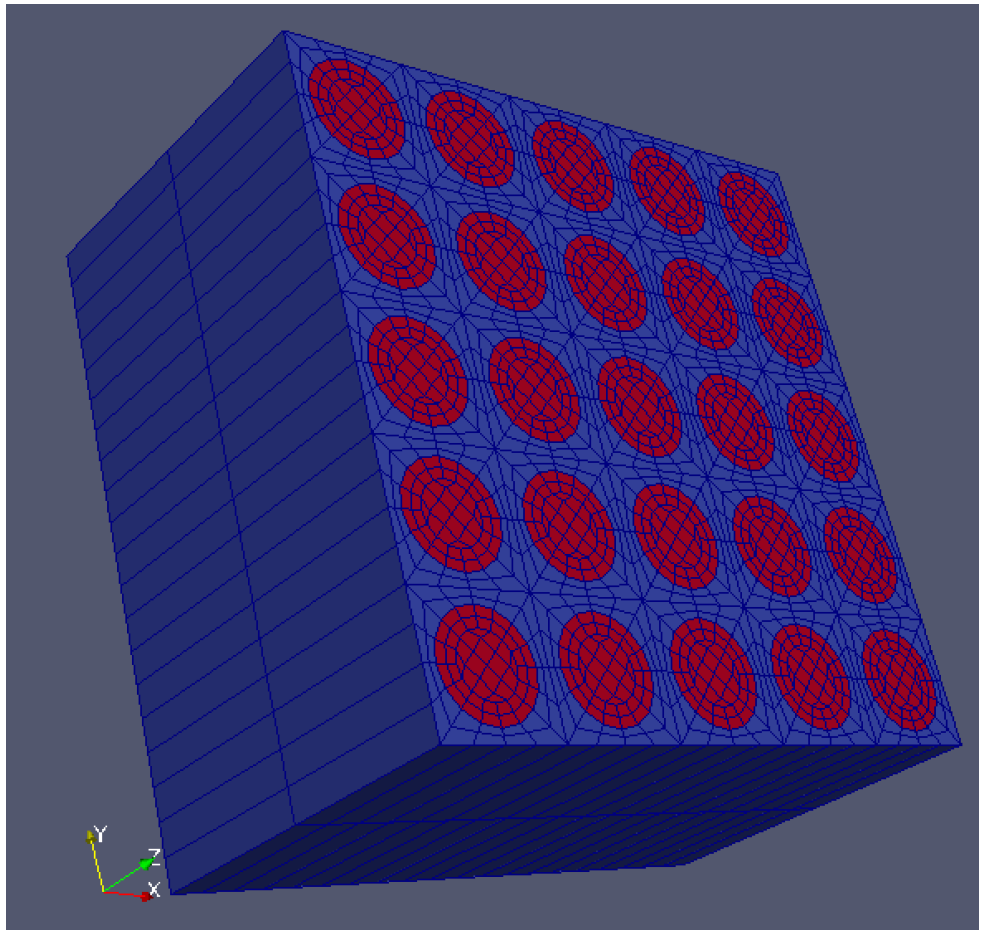
- Hyper-rectangle meshing based on `deal.II`:
  - Lines in 1D, rectangles in 2D and regular cuboid in 3D
  - Material ID assigned to coarsest mesh and stored in cell objects tractable when refining

Pin-resolved meshing

- Recent development enables the use of pin-resolved mesh
  - Rectangular (prism) pin is supported; hexagonal (prism) pin is under development
  - **Goodness:** meshing does **NOT** depend on `Cubit` or `gmsh`. `BART` realizes wrapper functions based on `deal.II` to draw complex geometries.
- We compose different pin models and replicate based on pin types in 2D.
- 3D meshes is realized by extruding 2D mesh.

Pin-resolved mesh demos

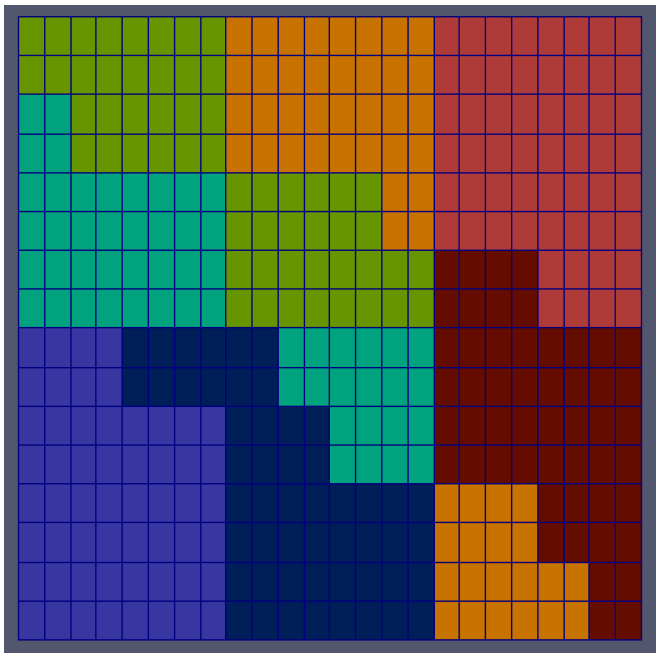


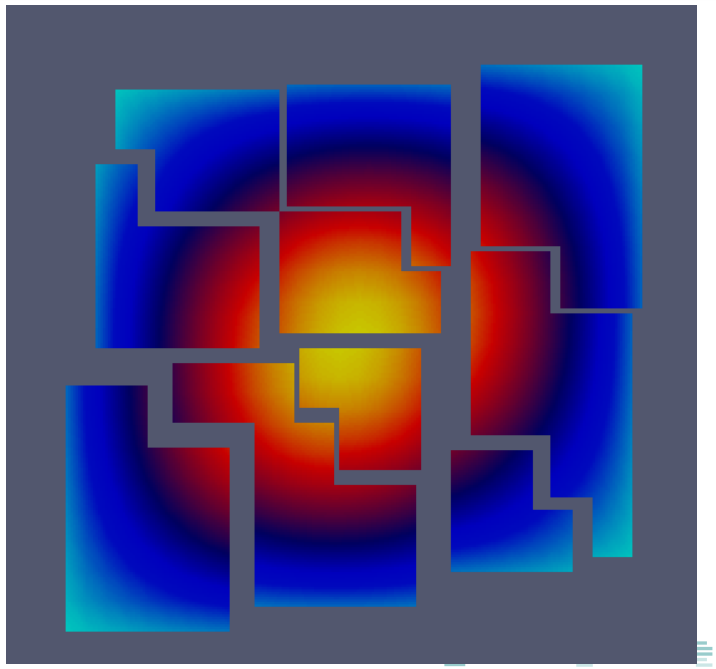


Meshing in Parallel

Distributed triangulation

- Triangulation (meshing) needs to support parallelism for parallel computations.
- `deal.II` supports two ways of triangulation in parallel
  - Shared (`ParMETIS` based): every processor has a copy of the global triangulation.
  - Distributed (`p4est` based): every processor only knows cells living on itself and a layer of neighboring cells from other processors on the local triangulation boundary
- `BART` supports distributed meshing from `deal.II`.
- 1D meshing is serial as `deal.II` has no parallel support





Unit Testing, Continuous Integration and Code Coverage

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Conclusions

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