2

Saturday, May 3, 2025 3:34 PM

2. Two-dimensional discrete-ordinates transport

   (a) Create a code that uses either MOC or diamond difference to compute the scalar flux throughout the domain.

   (b) Create a solver that uses a product quadrature that has a set (Gauss Legendre) of directions (and weights) for $\Omega_z \in [0, 1]$ and a different set for $\Omega_x \in [-1, 1]$

   (c) Assume that the domain is composed of a suite of 5cm thick (and infinitely tall) square blocks of any of the 7 materials in Table 1.

   (d) There can be any number of blocks in each (x,y) dimension.

   (e) Stochastically, or intentionally, chose the material distribution and problem size, $x \in [0, ?]$ and $y \in [0, ?$.

   (f) solve for the flux on a $\Delta x = 0.1$ cm mesh throughout the domain.

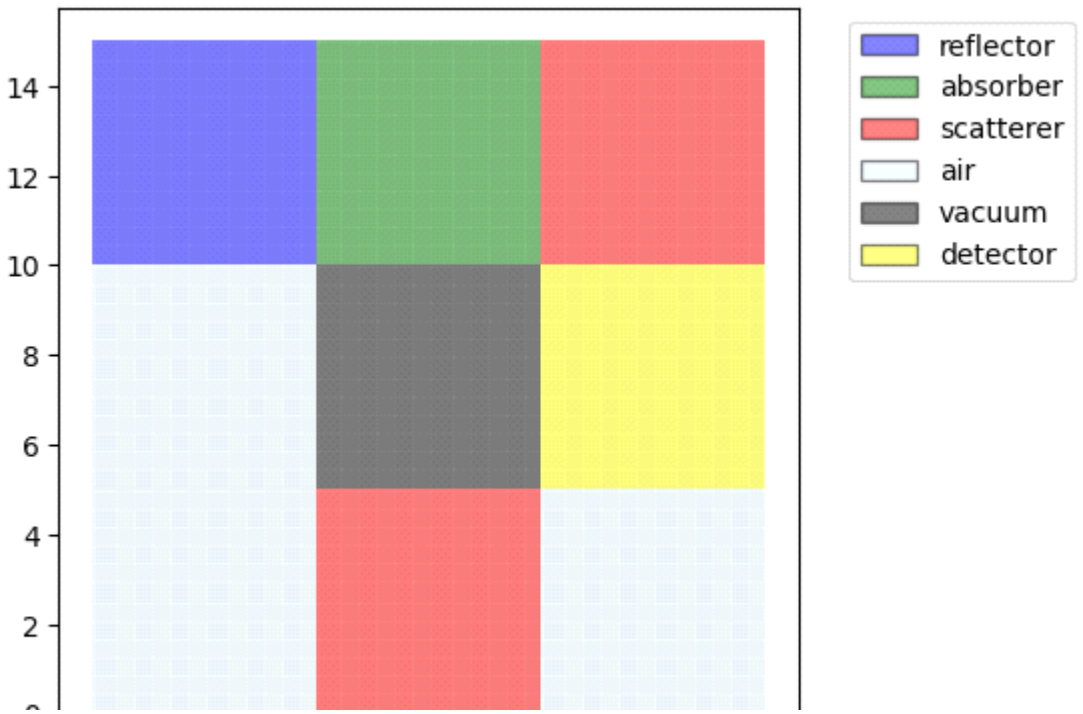
   - How can you create problems (e.g. 1D in x) that will let you determine if you've implemented it correctly?
   - What will you do to make you feel that your answer is correct?
   - Can you define a problem (material, size, quadrature set) that clearly reveals ray effects?

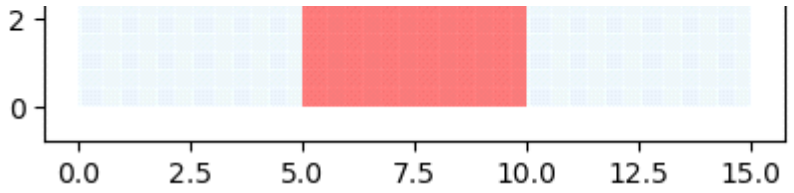
Here is my MOC code: https://github.com/bradenpecora/ME388F/blob/main/HW6/moc_cart_threaded.py

To test if my implementation is correct, I would need to implement reflecting boundary conditions, which is actually pretty difficult. I could test against a problem that had reflecting boundaries and was symmetric along one axis to simulate a 1D problem.

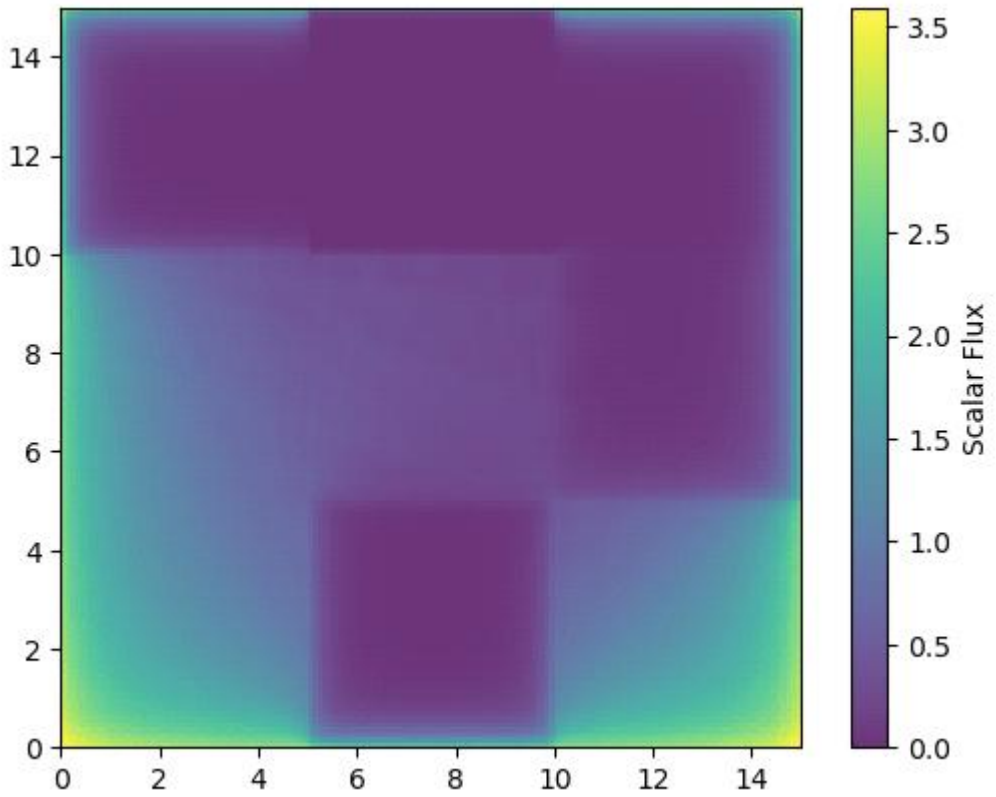
You can also do a convergence study to see if your answer is correct. The results should converge as you increase the resolution of the mesh and the number of angles in your quadrature set.

Ray effects are pretty easy: Define a high resolution grid with a small quadrature set. If you have low scattering, ray effects will be more prominent.

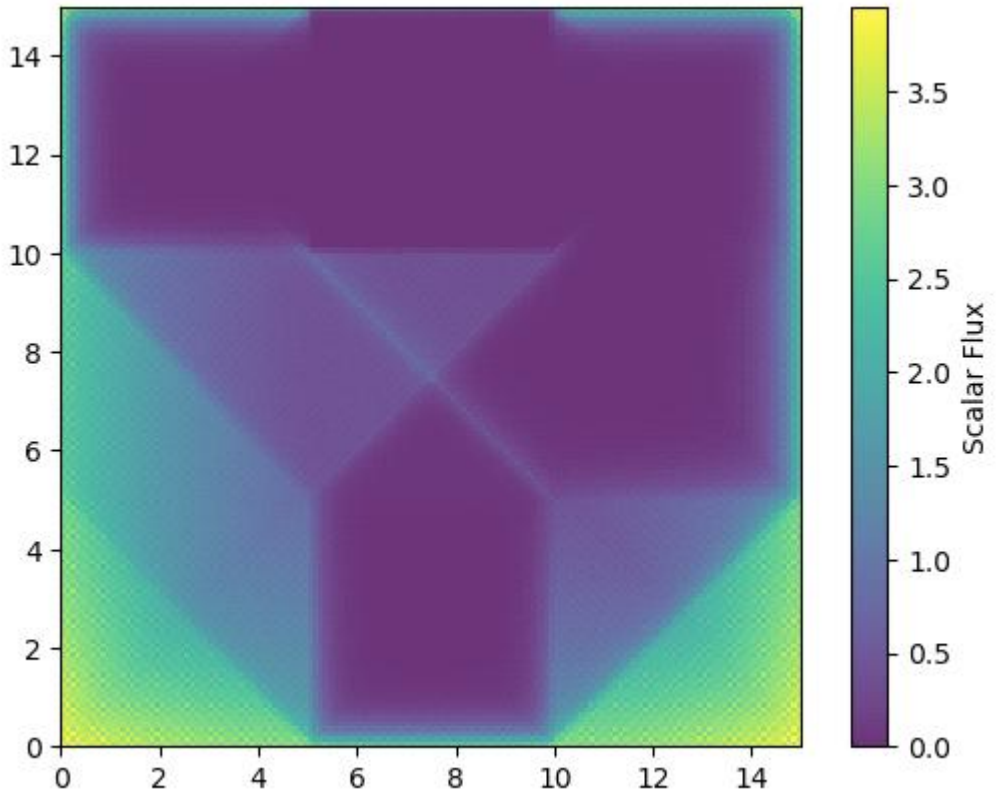




32 azimuthal angles, 16 polar angles, ray width 0.5, incident flux on all outer surfaces



4 azimuthal angles, 2polar angles, ray width 0.5, incident flux on all outer surfaces


14
12
10
8
6
4
2
0
0
2
4
6
8
10
12
14
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Scalar Flux