Abstract and Prior Work

IMC [1] runtimes are dominated by photons in thick media where effective scattering is high. Our hybrid method removes effective scattering which makes the cost independent of MFP. Prior work includes:

- Stochastic
- Hybrid
- Deterministic
- FSC RW [2]
- IMD [3]
- F&C RW [2]
- DSA [6]
- MC HOLO [9]
- SMM [7]

The Hybrid Moment Method

Following Olivier [10], the model problem is,

\[ \Omega \cdot \nabla \psi + \sigma_t \psi = Q_0 - \nabla \cdot \Omega \cdot T \]

(1a)

The correction tensor and boundary factor are,

\[ \beta = \int \Omega \cdot \nabla \psi \, d\Omega - \frac{1}{2} \int \psi \, d\Omega \]

(2a)

(2b)

The boxed term is addressed in Future Work.

Figure 1 shows the iteration. The boxed term in Eq. (3) may be causing the degradation in 2D because of noise, which we think we can dampen.

Figure 2 shows that the error in 1D fits our prediction but not in 2D. The error is with respect to the MMS solutions,

\[ \psi_{1D} = (1 + \mu + \mu^2) \sin \pi x \sin \pi y, \quad \psi_{2D} = \alpha \sin \pi x \sin \pi y, \quad \alpha = \frac{\beta}{\Omega} \]

\[ \Theta = \left( \frac{\alpha}{\alpha} \right) \]

(3)

Result #1: Error goes like \( C_1/\sqrt{N} + C_2 h \) in 1D but not in 2D problem

Result #2: Cost is independent of MFP

Figure 3 shows that our hybrid method (Nose') doesn’t slow as \( \epsilon \to 0 \) [11], but IMC slows as \( 1/\epsilon^2 \).

Figure 3: Runtime for thick diffusion limit calculation

References


Future Work

The boxed term in Eq. (3) may be causing the degradation in 2D because of noise, which we think we can dampen.