Answers to Reviewer #1

Ms. Ref. No. JCOMP-D-13-00928
Discontinuous Finite Element Solution of the Radiation Diffusion Equation on Arbitrary Polygonal Meshes and Locally Adapted Quadrilateral Grids
Journal of Computational Physics,

This paper is a very high quality paper for the Journal of Computational Physics and should be accepted for publication without reservation. One of the main strengths of this paper is its very thorough review of spatial discretization technology for radiation diffusion. It is well written, and includes a comprehensive set of test problems applied to the new discretization proposed.

Thank you

I have some suggestions for improvement, but as a reviewer, I do not require these additions to the paper for publication.

Thank you

On the list or prior works, a reference or references should be included for each item in the list. For the first two items, no references are included.

Thank you

The derivation of the discretization is complicated enough to warrant an appendix which goes through the details of the mathematics (e.g. how to get to Eq. 3 and Eq. 8), like one would find in a thesis or dissertation. I am a proponent of including these detailed types of explanations in papers because I think they enhance the read-ability of the paper; however, some disagree with this philosophy.

Thank you

The author could state more clearly how this work is distinct from previous work. The author mentions that others have applied a Discontinuous method to diffusion operators. How is the proposed method different? In section 3, the author writes: "Many variants of such discontinuous discretization methods exist for diffusion problems" It may be a good idea to say, the discretization in this paper is different because

Thank you

I am curious as to why the statement was made that "we have opted to use two loops: one over the elements" Did this have an impact of computational performance? It seems like the reason why was never addressed.

Thank you

For the discussion at the top of page 9 about C and $h_\perp$ a picture may be helpful, especially when describing the inradius and circumradius for polygons.

Thank you

I am curious if the author has tried standard linear basis functions (u(x,y) = a + bx + cy) on quadrilaterals to see if this works for the DFEM type diffusion discretization.
Thank you

What code was this method implemented in? Was it just a test code? Was it MATLAB? Were there any parallel runs? What linear solver package was used, if any?
Thank you

I think a potential weakness of the paper is that the author does not compare the new method to any of the existing methods. If this is not hard to do, these results would be very interesting to include in the paper. Additionally, these results could be included in a future paper or conference proceedings.
Thank you

For the linear test problem results, what are the iteration counts for the linear solve as the mesh is distorted? Was the iteration count a lot different for the different mesh types? For quads vs. polygons?
Thank you

A reference for computing bounded Voronoi diagrams is a good idea.
Thank you

For the convergence plots, I think the terminology is a bit inconsistent. In the text the author writes in terms of dof. In the plots, he uses number of unknowns. This could be a bit more consistent, but is a minor detail.
Thank you

In general, an understanding of how resistant this method is to negative solutions would be another interesting thing to study, especially in a time dependent case, with a delta-function like source. I would anticipate that this method would perform a lot better than the CFEMs.
Thank you

Does the author anticipate a straight-forward application to RZ geometry and 3D geometry? Will the method recover spherical symmetry in RZ geometry. Brunner, et. Al. have observed an issue with this for RZ geometry. See T.A. Brunner, "Perserving Spherical Symmetry in Axisymmetric Coordinates for Diffusion," in Proc. International Conference on Mathematics and Computational Methods Applied to Nuclear Science and Engineering, May 5-9, 2013, Sun Valley, ID (2013), CD-ROM

Thank you