

## ***Interactive comment on “GHOST: Geoscientific Hollow Sphere Tessellation” by Cedric Thieulot***

**C. THIEULOT**

c.thieulot@uu.nl

Received and published: 21 May 2018

Dear Reviewer,

thank you for your positive and constructive feedback.

I hereunder address the points you raised:

*The paper presents open-source software that generates radially projected spherical shell grids, used typically in geophysical applications. Although no novel scientific method is presented, the code will serve well as an exercise for everyone starting with numerical simulations in this field. Unfortunately the source code is only in Fortran, many other modern languages would benefit from such a library as well.*

This is of course a valid remark but had I written it in Python or C++ such a remark would remain since every modern language has a different way of dealing with objects

C1

and would require a different process to interface GHOST to whatever application is being written by the user. My philosophy is that fortran is a very readable language and either users will be content with the existing interface for their own application, either they will adapt (if not entirely translate) the code I provide to suit their own needs.

*As with every algorithm, complexity is key. From your timing plot in Fig 4 it looks like linear complexity  $O(n)$ , which would be ideal. If so please make a statement.*

This is a good remark indeed and I will add a statement in the text.

*In your introduction you highlight the difficulty to derive the connectivity between cells. I agree and would like to see a chapter on how you tackle this. Another quite similar topic is avoiding duplicate vertices in recursive building algorithms.*

It was indeed one of the hardest algorithms to implement. I will add a paragraph to the revised version about this topic.

*For numerical simulations it is often important that cells stay as geometrically constant as possible to avoid introducing errors based on mesh irregularities. As you have figured out, a good measure for this error is the area variance of the cells within a shell. Unfortunately you plotted this error in a way that makes selecting the “best” method concerning this error impossible. Also, why the volumetric relative error is of importance in a projected scenario (Fig.7) puzzles me.*

This is a good point. I will better document the area variance of the cells for each grid in the revised version.

*I do not understand what you do in chapter 3. Comparing analytical solutions to numerical results is always a good idea. But how do you solve  $U$ ? What method, order, . . . The nature of your problem suggests a spectral method as others would struggle with the asymptotic boundary condition, please elaborate. Also, as the absolute error within a single shell (lateral only, for i.e. the middle shell) for each cell is interesting in this scenario as it also reflects the sensitivity of the numerical method to mesh*

C2

*irregularities.*

I use an integral equation, and not the Laplace form of the text. As such no PDE is solved, only a domain integral I use a simple 'brute force' approach by looping over all elements/cells and using 2x2x2 Gauss quadrature points to compute each cell integral (see manual for `compute_gravity_at_point` subroutine - section 4.7). I will add a line in the revised version to clarify this.

*In chapter 4 the application is quite useful, but you seem to describe an interpolation method with your statement "I have written a simple interface . . ." . Please describe in detail how you interpolate the data onto the mesh (generic algorithm based on connectivity or specific algorithms for each grid type? order of interpolation?). Do not use the word simple.*

I agree that the statement 'simple interface' is vague and I will clarify this in the revised version. I am actually making use of the provided subroutine coming with the S40RTS dataset which return the  $\delta \ln v_s$  at any point.

Best regards,

Cedric.

---

Interactive comment on Solid Earth Discuss., <https://doi.org/10.5194/se-2018-7>, 2018.