Solid Earth Discuss., 7, C568–C572, 2015
www.solid-earth-discuss.net/7/C568/2015/

Solid Earth
Discussions
Open Access

Interactive comment on "*Instaseis*: instant global seismograms based on a broadband waveform database" *by* M. van Driel et al.

M. van Driel et al.

vandriel@erdw.ethz.ch

Received and published: 4 May 2015

Thanks first of all to the reviewer for these comments that helped us to substantially improve the manuscript.

General comments:

This paper describes a new approach for the rapid calculation of global seismic wave- fields in a spherically symmetric earth model. It is based on the well-established AxiSEM code developed by Nissen-Meyer and colaborators, and the main inovation here is the construction of a database of Green functions which allows wavefields to be rapidly generated for arbitrary source reciever geometries. This is a very useful contribution, and will provide a valuable tool for the

seismological community.

The paper is largely concerned with documenting a number of technical issues related to building effecient software for this application. The latter portions then describe in more detail the functionality of the software, and point to some potential applications. For a typical seismologist reading this paper, I would imagine that the initial sections are a little over detailed and "jargony", while it is the later sections which describe potential applications which will hold the most interest. On the whole, I think this is fine, and that the material is worth presenting. I do perhaps wonder if a little could be done to make the initial sections of the paper clearer and more appealing to less computer-literate readers (of whom I count myself).

We fully agree here and tried to improve readability of the first sections, see also detailed comments below. Also, at the end of the introduction, an overview of the sections is given, so readers interested in applications can easily skip the technical part and jump to section 5.

Specific comments: 1) On pg 964 there is a discusion of how global co-ordinates are mapped to local co-ordinates in the mesh elements. Overall this is well explained and clear. But I did wonder how the code deals with points lying on a material discontinuity of the model. At such points certain derivatives of the wavefield are discontinuous, and so it is necessary to know which side of the boundary the point lies – how is this done?

Generally speaking, this is a very unlikely situation because these 1D surfaces have zero measure in the 2D domain. Numerically, it is very unlikely for two double precision floating point numbers computed in different ways to be equal. Practically, in the algorithm that finds the element the point belongs to, there is a small tolerance and it would always choose the one found first. In our meshes this is always the shallower element. Also, the code optionally returns the shear modulus for the element chosen,

SED

7, C568–C572, 2015

which would allow to identify which layer it belongs to.

2) On Pg 965 starting on line 9, a discusion of resampling techniques is given, with several methods mentioned. Though perhaps these methods are elementary, I think it would help to add a few references to this section where further information could be obtained.

We added a reference to Burger & Burge (2009), who gives an extended introduction to various interpolation methods including all methods mentioned in our discussion.

3) On pg 966 and 967 there are a number of terms and phrases – presumably coming from computer science – which are not clear to me, and I think further clarification may be needed here. What does "data-source agnostic" mean? And similarly what is "Instaseis is developed with a test-driven approach utilizing continuous integration" meant to convey? I suspect that for people more familar with computer science these will be obvious statements. But given that the potential readership of this paper will mostly be seismologists, I think it would be best to avoid jargon if possibe.

The paragraph with the continuous integration (and some others) is dense and short on purpose. We intend to convey that we put a dedicated effort (in comparison to some other scientific software) into providing a stable and usable platform which is not solely a scientific task. By using the technical terms, we make clear that we did not invent these things ourselves but use well established approaches from the computer science community and it is exactly these terms that could be fed into a search engine to find more about it - both for 'test-driven development' and 'continuous integration' google finds the corresponding wikipedia articles as first results.

We replaced "agnostic" by "independent" and rephrased the sentence slightly to clarify its meaning. Also, we added a short explanation of "continuous integration".

4) On pg 970 line 8, reference is made to "partial memoization". Again I am

SED

7, C568–C572, 2015

unfamiliar with this term. It seems likely that this is described within the following text (though this is not completely clear). But even if this is the case, what is gained by using this technical term?

It is a technical term precisely denoting what we are using: http://en.wikipedia.org/wiki/Memoization

However, we replaced it with "buffering strategy" and rephrased the sentence to clarify.

5) On Pg 972 line 13, it is stated that the computation time of Yspec scales linearly with the number of sources. While this is true for the current implementation, it is not true in principle, and with some more book-keeping the code could be adapted to deal with multiple seismic sources. Perhaps the sentence in the paper could be altered to reflect this limitation of Yspec (and similar codes) is one of implementation, and not a fundamental issue. That being said, I certainly do agree with the general point of the paper that AxiSem produces the whole spatial wavefield, and this feature is a great advantage for producing such databases and for other applications (e.g. kernal computation).

This is an interesting fact that we were not aware of and we added the respective note in the manuscript.

Technical corrections:

1) In the abstract, reference is made to "arbitrary 1-D models or other spherical objects such as Mars". Given that Mars isn't actually a sphere, I wonder if this could be phrased differenty?

We rephrased this to: AxiSEM is easily adaptable to arbitrary spherically symmetric models of Earth as well as other planets.

2) On Pg 969 line 20, the phrase "which allows to do the computations" does not flow naturally.

SED
7, C568–C572, 2015

We rephrased this to: However, *AxiSEM* scales well on up to 10,000 cores such that global wavefields can be computed at the highest frequencies within hours on a supercomputer.

Interactive comment on Solid Earth Discuss., 7, 957, 2015.