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October 10, 2007
To the Associate Editor, Geophysics:

Re: Paper GEO-2007-0117

This letter is in response to the review received Oct 5^{th}, 2007 of paper GEO-2007-0117.R1 entitled *Riemannian wavefield extrapolation: Non-orthogonal coordinate systems*. I thank the four reviewers for their comments, and for catching a number of mathematical and language typos in the manuscript. I respond to the individual reviewer's comments below.

I look forward to hearing the response from Geophysics regarding the manuscript corrections.

Sincerely,

Jeff Shragge
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Geophysics Department
Stanford University

Response to Reviewer 1

1) x has been changed to $\mathbf{x}$.

2) I have changed $\mathcal{U}$ and $\mathcal{I}$ to U and I.

3) Actually, I only apply a single SSF correction step; however, I apply a mask that applies the correct local shift. This is the reason why there are fewer calls to the SSF operator than the PSPI in Table 1.

4) A smoother version of the model has been used, and the ray-field is smoother.

Response to Reviewer 2

Abstract: I have made all the edits recommended by the reviewer.

Introduction: I have made the edit recommended by the reviewer.

Acoustic ...: I have made all the edits as recommended by the reviewer.

Numerical modeling examples: 1) These techniques are fairly easy to implement in the code (as they are independent of the chosen coordinate system). However, I am choosing to keep the artifacts in the images as they communicate common phenomena to the readers. The text now gives the well-known specific example of cosine boundary tapers.

Numerical modeling examples: 2) The main reason why this figure is included is because it demonstrates that this meshcan be used for plane-wave migration in a dynamic coordinate system. The plane waves are therein defined between 1000m and 9000m; however, previously, this was not explicitly stated in the text. Because the waves are of this breadth, they do spread to both sides of the model as they overturn.

Generating triplication-free coordinate meshes: I agree with the reviewer in all of the raised points. Actually, these comments were exactly what I was trying to convey to the reader. That they were taken differently by the reviewer indicates to me that my explanation was not sufficiently clear. I have rewritten this paragraph to state more explicitly what I believe the reviewer was commenting on:

> Differences in the modeled amplitudes at and above the salt interface in the upper two panels are attributed to differences between finite difference and one-way wavefield extrapolation implementations. Finite differences better models amplitudes in the presence of velocity gradients in the propagation direction. Thus, incident energy is more accurately partitioned at the top sediment-salt interface leading to the lower (and more correct) amplitudes of subsalt multi-pathed arrivals. The RWE wavefield underestimates the reflection contribution and allows significantly more energy to

> be transmitted into and through the salt body. This modeling inaccuracy leads to the more pronounced multipathing below the salt body and the more complicated wavefield behavior relative to the Cartesian wavefield example. Incorporating higher-order terms (Zhang, 2002) into the RWE formalism, though, would likely diminish the differences between the finite difference and RWE results.

Response to Reviewer 3

I have gone through the text and have changed all of the $\mathrm{i} = \sqrt(-1)$ to be consitently i (rather than i). I chose to use the Roman font to prevent confusion, since i and j are often used for tensor indicies (e.g. g^{ij}).

Response to Associate Editor

The prevailing issue discussed by this reviewer was that I did not distinguish explicitly between my non-orthogonal development and that of Sava and Fomel (2005). I have rewritten the paragraph in question according to the reviewer's suggestions and now moreee explicitly state the differences between my metric tensor from that of Sava and Fomel (2005).

> The derivation of the 3D RWE acoustic wave equation deviates here from that found in Sava and Fomel (2005), who represent the metric tensor with only four independent coefficients. The remaining two independent coefficients are explicitly set to zero in order to satisfy the semi-orthogonal geometry restriction. In this development, I follow a more general approach that represents the metric tensor with the full six independent coefficients. This is the key extension developed in this paper that leads to the greater flexibility in coordinate system design discussed below.

A second issue was that figure panels should be labeled 'a','b','c' rather than 'upper left' etc. I have rewritten the text and redone the figures accordingly.

The reviewer also suggested a number of grammatical edits and wording changes. I have incorporated almost all into the updated version of the text.