Is the bicubic travel–time interpolation time consuming?

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Motivation

During the discussion at the 1999 SEG meeting in Houston, I met an opinion, that the bicubic travel time interpolation is very time consuming, and that the bilinear interpolation is much faster.

Introduction

The method for interpolation of ray-theory travel times in nodes of 3-D grids presented in Report 7 (Bulant & Klimeš 1998a, 1999) is based on three successive steps. Those are the decomposition of ray tubes into ray cells, the determination of the gridpoints located within individual cells, and the interpolation to the determined gridpoints. Two interpolation schemes may be used for the interpolation of travel times. Those are the bilinear interpolation scheme and the bicubic interpolation scheme. The interpolation method is coded in program 'mtt.for', where the kind of the interpolation scheme may be selected.

Numerical example

When we look at the equations for the determination of the gridpoints located within individual ray cells, and at the equations for the interpolation, the interpolation does not seem to require many numerical operations compared to the determination. Moreover, the determination must be done for more gridpoints than the interpolation, and some additional computational time is also required by the decomposition of ray tubes into ray cells.

To prove these considerations, I have measured the computational time required for the two interpolation schemes. I used an example of the interpolation in model '98', described by Bulant & Klimeš (1998b). The results are summarized in the following table:

Kind of interpolation scheme:	Bicubic	Bilinear
Execution time of program 'mtt.for':	4 min 33.98 s	4 min 33.79 s
Execution time of the determination of gridpoints located within the cells:	2 min 42.04 s	2 min 41.85 s
Execution time of the interpolation:	3.87 s	3.68 s

In: Seismic Waves in Complex 3-D Structures, Report 10 (Department of Geophysics, Charles University, Prague, 2000), pp. 113–114

Conclusion

The difference between the computational time required for the bicubic interpolation and the computational time required for the bilinear interpolation is negligible with respect to the computational time required to run the whole program. This conclusion has been numerically verified only for the presented computation, but I believe that it holds in general.

References

Bulant, P. & Klimeš, L. (1998a): Interpolation of ray–theory travel times within ray cells. In: Seismic Waves in Complex 3-D Structures, Report 7, pp. 17–32, Department of Geophysics, Charles University, Prague.

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