SEP REVIEW AND PROGNOSIS

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Bullet-proofing

It is hard to get anyone interested in stability theory unless they are actually experiencing a stability problem. We experienced one while preparing our last report, when Bloxsom and Kjartansson were migrating through rapid lateral velocity changes across a fault. We have heard that the stability problem is not unknown in industrial production either and are pleased to say that a complete theory on stability is contained herein, which shows that stability can be assured without loss of efficiency. Initial theoretical breakthroughs by Muir were pursued by Godfrey and Jacobs, who developed and tested a 45-degree, omega-domain migration program (see page 97) that passed very severe tests. The bullet-proofing theory appears to be correct for time domain also, but that has not yet been tested. This approach seems likely to become an industry standard.

How should we deal with shot-geophone offset?

A common shot or common midpoint gather is a function of offset f and traveltime t. Let $p = dt/df$ denote Snell's ray parameter. The process of slant stacking provides a mapping from (f,t) offset space to (p,t') Snell parameter space. All seismic theory works out far more simply and accurately in (p,t') Snell space than in offset space. An obvious example is the uniform reverberation period for multiples in Snell space, compared to the mess in offset space. But seismic *data* comes to us in offset space. The invertible mapping between the two spaces is

well-defined in principle, but many practical problems of data truncation and aliasing arise when we try to convert field data into Snell space. Conversely, when we try to convert seismic theory from Snell space to field data space, simple things become difficult and inaccurate. Constant offset migration is an example. Conversion between these spaces is at the heart of reflection seismic data analysis. Where do we stand now?

1. *Migration before stack.* Here two specific algorithms are proposed. The common midpoint slant stack method [(p,t') space] was partially field-tested by Ottolini in SEP-15, and the results are still being evaluated. The converse approach [(f,t) space] is still a Pandora's box in theory, but we have been able to find the dominating terms, and some synthetic pre-stack partial migration has been done in this report by Yilmaz and Deregowski.

2. *Velocity estimation.* We are making rapid progress with a wave equation velocity analysis program, shown in the work of Gonzales in this report. Looking back over the historical development of migration by hyperbola summing versus migration by the wave equation, we can see that a clear advantage of the wave equation method is the case in handling velocity variation and the ability to include an anlysis of aliasing, truncation, and resolving power. These advantages will carry over into wave equation velocity analysis and multiple-rejection stacking.

3. *Multiples.* Here the theory of wave equation deconvolution in (p,t') common geophone Snell space seems to have been completed by Morley's work in SEP-15. We have not yet been able to demonstrate that it can be used successfully in a field environment. We are more optimistic than ever, though, that physically-based predictive methods should have practical utility. We have moved from the theory stage to the stage of process invention and synthetic trials.

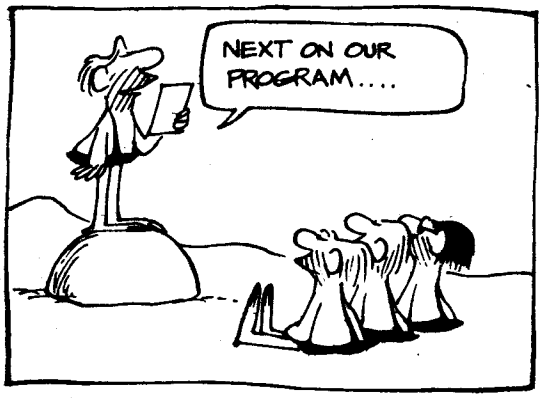
4. *Lateral velocity variation.* Here the small dip theory and synthetics are doing well, and a final report should soon be available in Walt Lynn's dissertation (SEP-17?). A paper by Yilmaz in this report begins extending the theory to larger dips, and we hope that future SEP reports will contain articles on wave equation statics corrections estimation.

Lithology

In addition to the wave equation analysis, there are several ongoing projects which we lump together under the general category of lithology. These include the estimation of Q by Kjartansson, the simulation of well logs by Godfrey and shear waves by Clayton. Progress in these areas has been helped particularly by the presence of Francis Muir and Fabio Rocca.

Summary

A year ago no one could have predicted the best of our past year's efforts. We have certainly appreciated the open-ended statement of objectives, "fundamental research in reflection seismology," that we have worked under. We are very proud of this report and believe its high quality amply justifies our sponsors' trust.


NEXT ON OUR PROGRAM....


IS A MAN WHO NEEDS NO INTRODUCTION, ...

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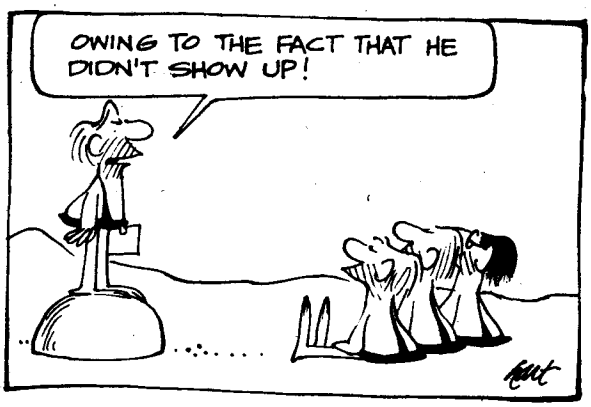
OWING TO THE FACT THAT HE DIDN'T SHOW UP!