Getting something for nothing (or not)

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Background

When ***strong coherent noise*** is anticipated during seismic data acquisition, it is always best to choose a ***source or receiver spacing*** that allows spatial sampling of all anticipated coherent noises ***without significant aliasing***. If this is not possible, due to financial or time constraints, there are a few simple ***processing tricks*** that can ***improve*** coherent noise ***attenuation***, though never quite approaching the attenuation possible with unaliased data.

We tested some of these tricks on a ***source gather*** from the CREWES physical modeling facility, which was ***properly sampled spatially*** during actual acquisition. To provide the ***test data***, the well-sampled gather was ***spatially binated*** by discarding every second trace. We then applied various simple ***processing tricks*** to attempt to emulate the coherent noise attenuation possible on the original well-sampled gather.

Results

Figure 1 displays the original well-sampled ***physical model source gather***, on which several reflections may be seen, dominated by a very strong surface wave and its repeats. Figure 2 shows this same gather after several passes of ***R-T filtering*** to remove coherent noise. This filtered result is our ideal. The ***binated gather*** was subjected to the ***same R-T filter passes***; and Figure 3 shows that the noise attenuation is much less successful, due to the ***aliasing*** of the surface wave.

The noise ***attenuation*** on the binated gather is ***improved*** if we apply ***partial linear moveout*** (LMO) to reduce the ***surface wave aliasing*** before estimating and subtracting the surface wave, as shown in Figure 4.

If we apply a simple 2-point ***R-T domain interpolation*** to the ***binated gather***, followed by ***R-T domain AGC***, we ***improve*** the noise ***attenuation***, but ***lose any AVO*** information (Figure 5).

If we apply ***AGC in the R-T domain*** first, then ***interpolate*** the gather, we achieve even ***better*** noise ***attenuation***, but ***still lose AVO*** information, as shown in Figure 6.

It is always better to sample properly during acquisition

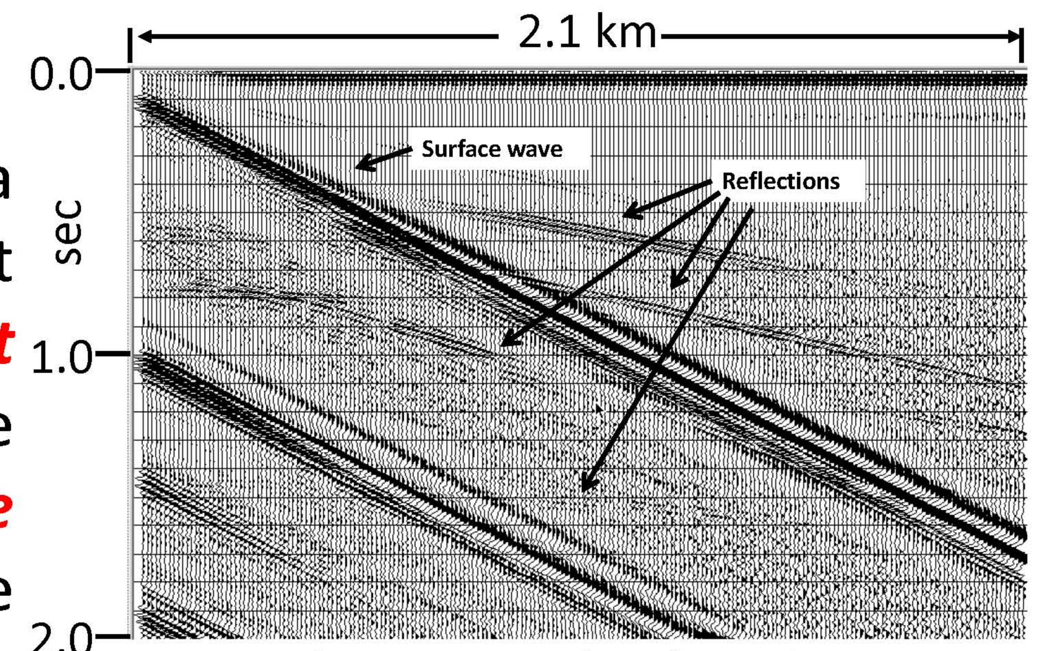

FIG. 1. This source gather from the CREWES physical modeling facility is well-sampled spatially, so coherent noise can be greatly attenuated.

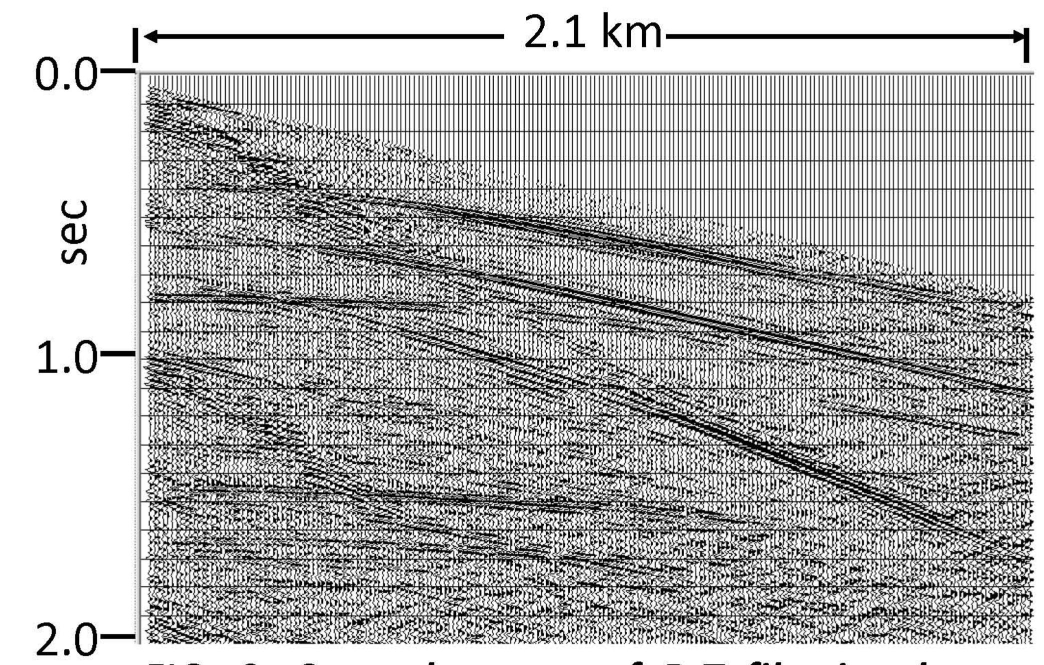

FIG. 2. ***Several passes of R-T filtering have greatly attenuated the coherent noise on the original source gather.*** Reflections are quite visible at all levels down to 1.5 sec.

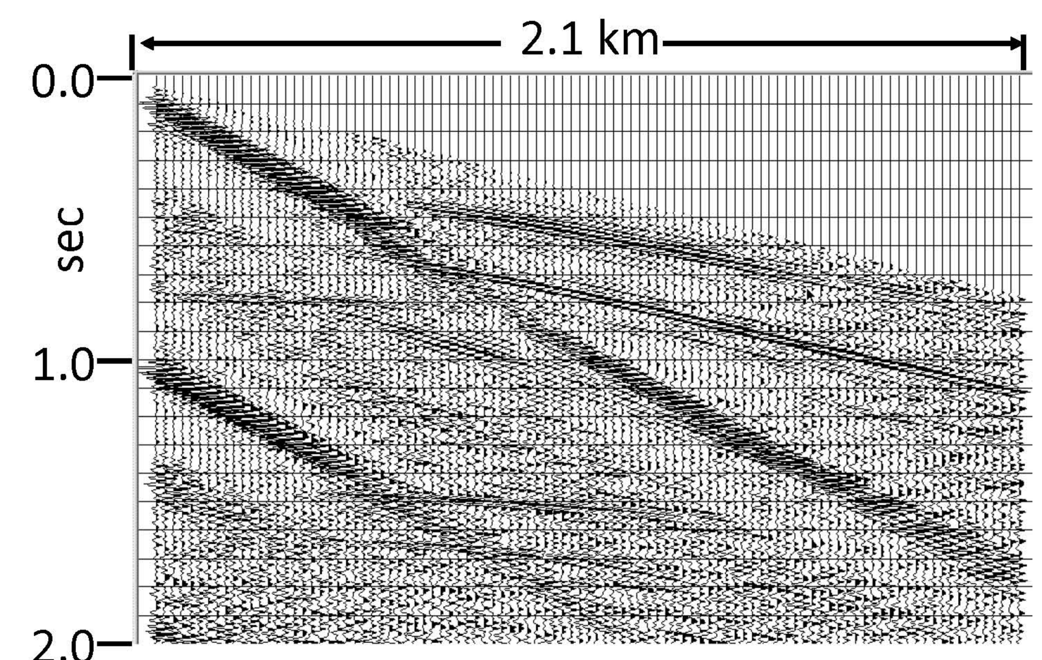

FIG. 3. The original source gather from Figure 1 was ***binated spatially***, then subjected to the same R-T filters as the original gather. This result shows lots of ***residual coherent noise***, most of it ***badly aliased***.

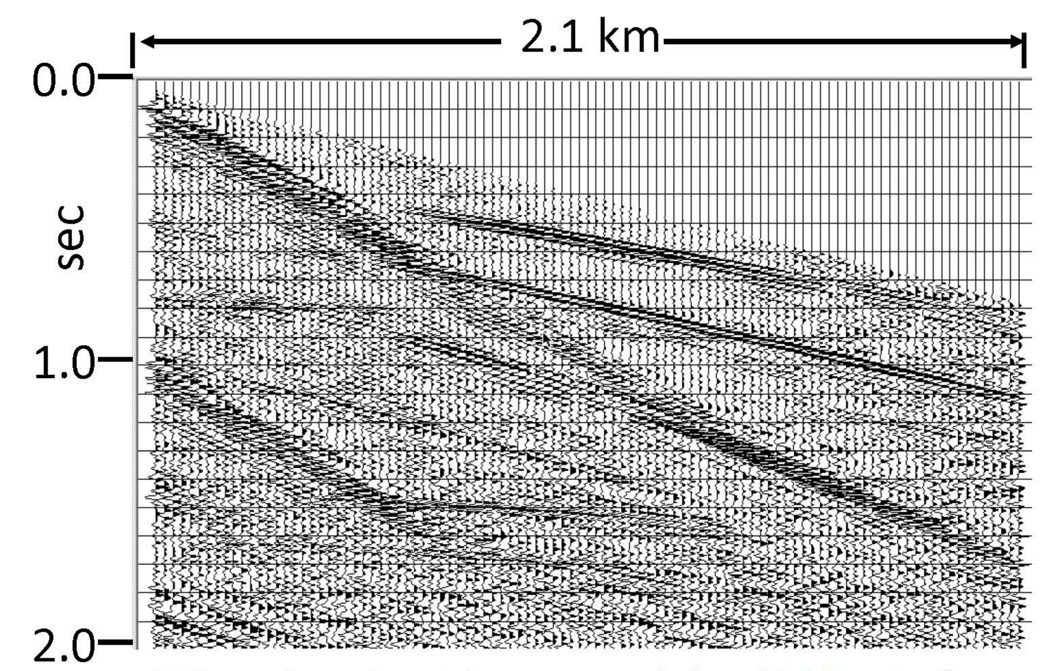

FIG. 4. Applying ***partial LMO*** before estimating the coherent noise can reduce the aliasing of the noise ***and improve attenuation results***.

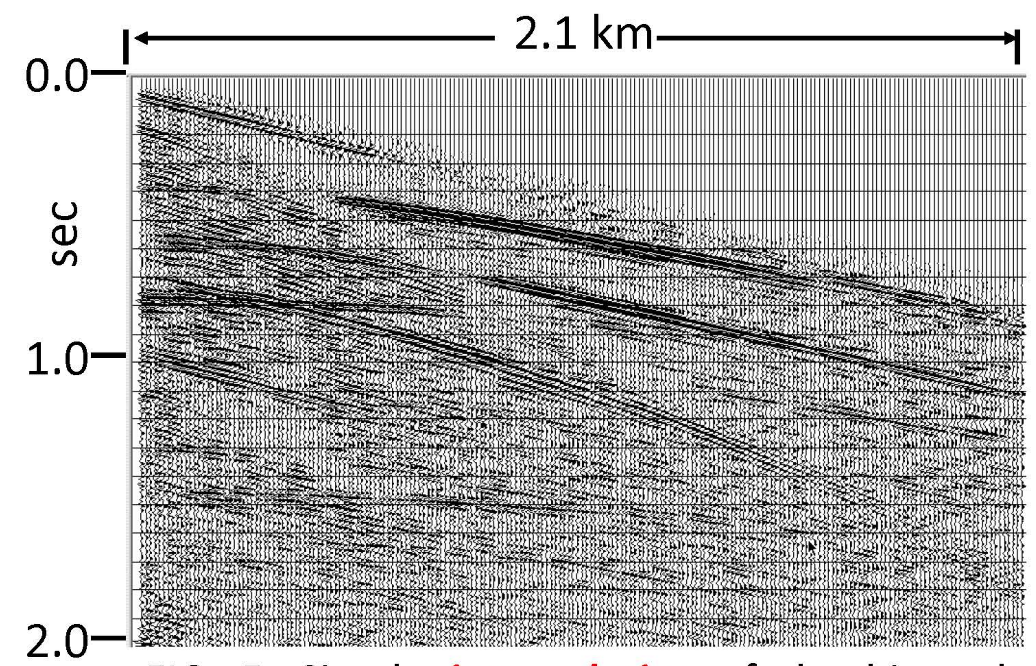

FIG. 5. Simple ***interpolation*** of the binated gather, followed by ***AGC in the R-T domain*** is even more effective in removing coherent noise. ***Deeper reflections are still obscured, however, and AVO information has been lost.***

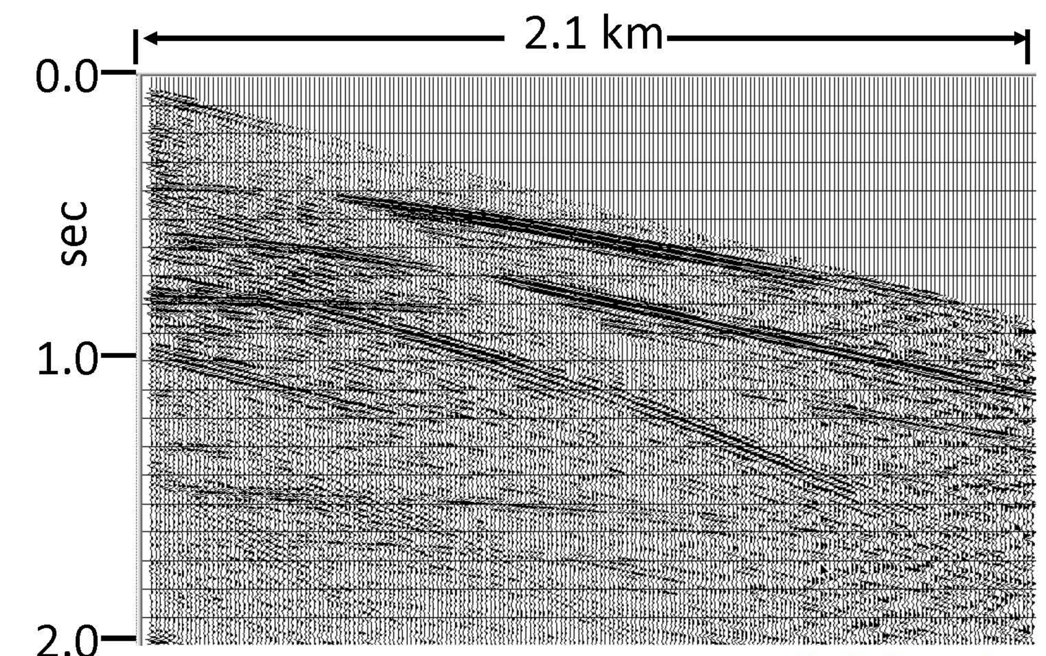

FIG. 6. If we ***reverse the order*** of ***R-T domain AGC*** and ***R-T domain interpolation***, the results are even better, but ***deeper reflections are still weak, and AVO information is gone***.

Traces in all plots are individually normalized, so relative amplitudes are not accurately portrayed.