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Linear Noise Elimination by Hybrid Modeling on the Basis of Examples from Poland

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SUMMARY

This paper deals with advanced non standard methods of land noise elimination with use of hybrid modeling and adaptive subtraction. Attached examples come from Poland from region near tide and shale gas areas.

In seismic data processing production, dedicated approach is applied which allow to use interactive complex procedures leading to removal of random or coherent noise. Advanced hybrid models are presented where models of noise are iteratively and interactively created. Adaptive procedures allow to subtract modeled noise from seismic data. These operations allow to get proper quality of reflections and seismic image. Moreover, important issue is preserving amplitudes relations in this case. Important role play amplitude scaling for noise elimination and noise models creation. Discussed are interactive procedures and non standard approach to land noise elimination where moveout corrections and non surface consistent static corrections are also used to model.

Noise removal, such as presented in this paper, is of great importance when high resolution of seismic image is needed.

Introduction

Land data are characterized by specific noise which in many cases does not allow to recognize correct image of geology. Ground roll, air waves, guided waves and side scattered waves usually are observed in prestack land gathers. These types of noise are well defined in prestack seismic data but sometimes difficult to remove, especially when lack of theirs coherency occur.
Furthermore, when high resolution of seismic signal is needed then the most important is proper noise removal from prestack gathers. Processes performed on prestack gathers such as PSTM and PSDM needs "clean" gathers otherwise artifacts could be generated.

There is a big difference between noise attenuation and noise removal and effectiveness of noise elimination depends on processing procedures and suitable preparation of seismic data. Dedicated, approach is presented which allow to use interactive complex procedures leading to remove coherent and/or random noise from seismic data. Sometimes also external no directly connected with seismic spread noise occur which has a huge influence to seismic image.

Hybrid methods of noise removal

Advanced hybrid noise removal methods take advantage of iteratively and interactively creation of noise models. These methods span few independent processing procedures such as: moveout corrections, statics, frequency filtration, trace mixing, trace subtraction, etc., and lead to generate of noise models as close as possible to the real. Because noise behavior and characteristic depend on many factors than sometimes coherency of linear noise is strongly disturb and one proven method do not give acceptable result of noise elimination.

Second step of noise elimination is subtraction this model from real data. There are few methods which allow to subtract noise from seismic data, but the most efficient is adaptive subtraction which protect against additional random noise arising when no ideal noise model was performed.

Main issue are precise noise models and following fully elimination real reflections from models with proper scaling for different types of noise. Important factor is method of amplitude scaling for noise models creation and elimination. Furthermore, the most important issue is preserving amplitudes relations in this case. When multi-channel procedures such as FK, T-P are applied than trace amplitudes had to be compensated with taking theirs character into consideration.

Figure 1 shows procedure of noise elimination when hybrid modeling and adaptive subtraction processes are used.

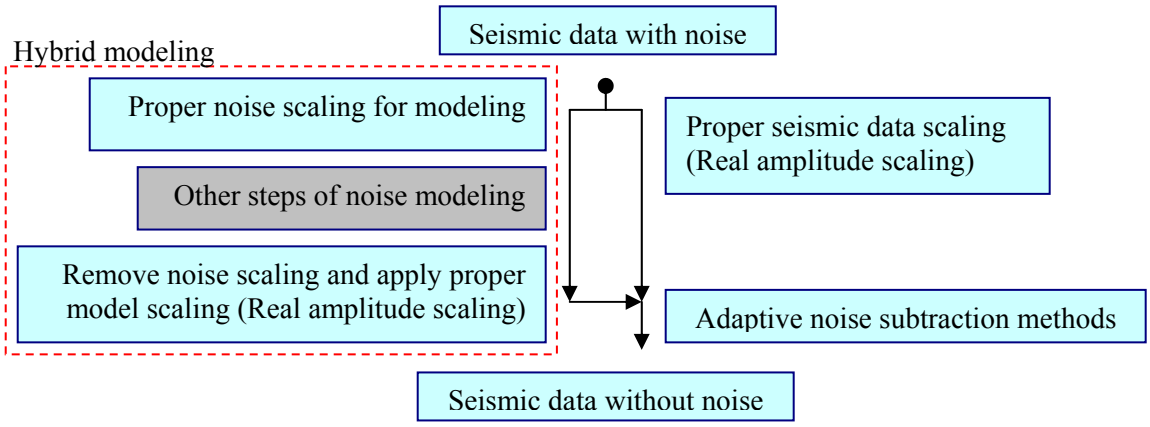

Figure 1. *Noise elimination with hybrid modeling and adaptive subtraction methods application.*

Scaling factors for hybrid modelingdepend on noise characteristic and should be computed and save for each trace. After hybrid modeling noise scaling had to be removed and real amplitude scaling should be applied if seismic data processing with preserving relations between amplitudes is demand. Scaling procedures used to noise elimination influenced to whole processing of data and incorrect amplitude scaling strongly affect to seismic image.

Another useful element of hybrid modeling are non surface consistent static corrections. Application of time variant non SC static is very useful when lack of linear noise coherency occur. Figure 2 shows example of usage residual no surface consistent static corrections into hybrid model creation. If lack of noise coherency occur than this operation could partially or fully restore its linear character what will be crucial for processes such as FK, Radon or trace mixing.

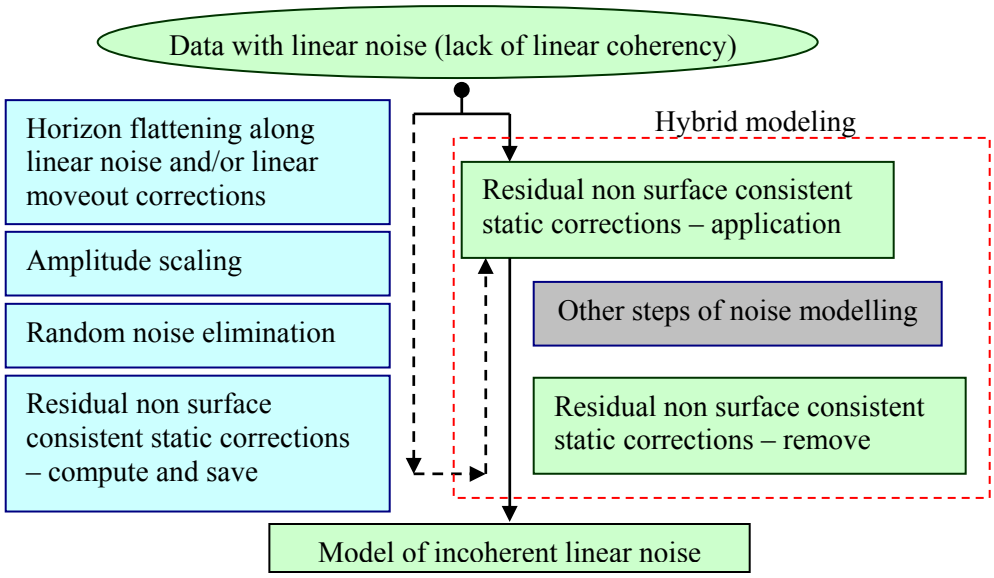

Figure 2. *Diagram presents method of linear noise model creation when coherency is recovering with no surface consistent static corrections usage.*

Next steps are preparing noise models which could be performed with many possibilities. Space variant linear moveout corrections, tau-p, FK, FKK, trace mix, spatial mix in domains: source, receivers, offset, cross-spread, could be mixed together and iteratively applied.

Figure 3 shows linear noise in tau-p and F-K domain after proper scaling with linear moveout corrections and non-SC residual static application.

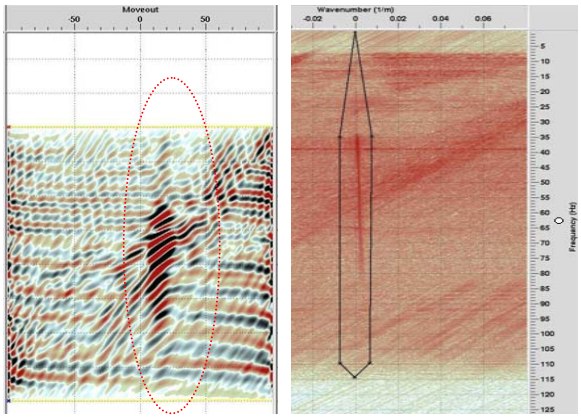

Figure 3. *Hybrid modeling of linear noise in T-P and F-K domain after LMO and non SC residual static corrections application.*

Data examples

When ground roll, guided waves and side scattered waves occur in prestack gathers hybrid modeling is beneficial to use. Example form Poland in land region where this three types of noise occurred and was eliminated is performed on Figure 4. Although air wave noise was not so visible before that operation, there is well defined after. Example of air wave noise removal effect was performed in Figure 5, where hybrid modeling and adaptive subtraction method were applied to the prestack data..

For hybrid modeling were used: non surface consistent static corrections which correct of linear noise coherency, space variant linear moveout corrections and/or horizon flattening, trace mixing for elimination true reflections from flat model of noise, polygonal FK filtering around K=0 which allow to model air wave noise, T-P filtering near P=0, noise adaptive filter. Modeling was performed for all source point gathers.

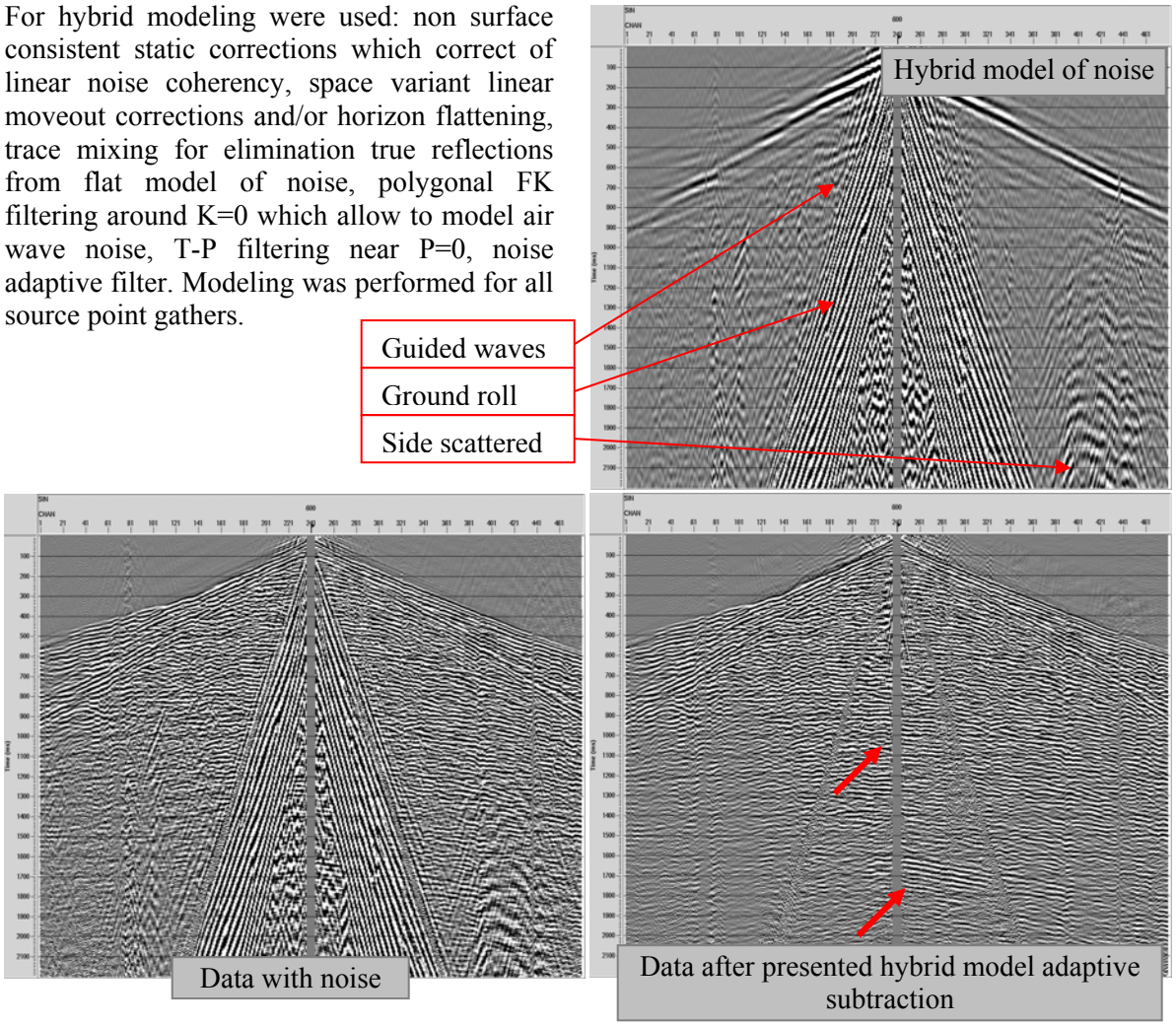

Figure 4. *Ground roll, guided waves and side scattered waves elimination with hybrid modeling and adaptive subtraction method.*

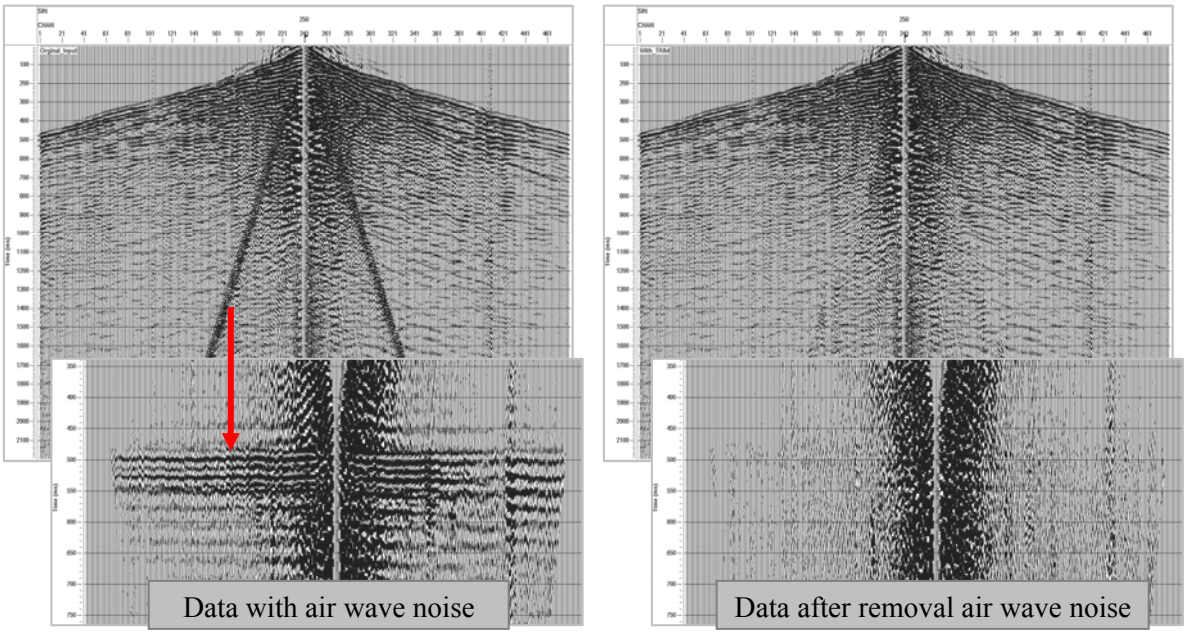

Figure 5. *Example of air wave removal process with hybrid modeling and adaptive subtraction.*

External noise not directly connected with seismic spread sometimes occur because of factories, pumps, vehicles and other external seismic sources. Example bellow shows noise which comes from other nearby worked seismic crew. Advanced hybrid modeling and adaptive subtraction methods were used. True reflections were preserving with fully external noise elimination.

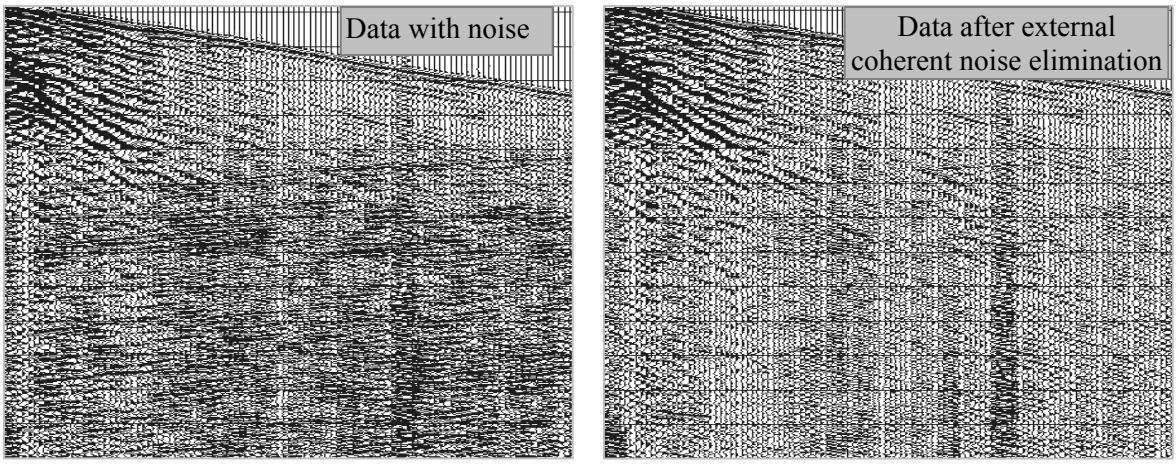

Figure 6. *Example of external side coherent noise removal process in prestack data.*

Conclusions

For seismic data interpretation important are: high resolution of seismic signal, true amplitude relations and detailed time and depth prestack migration image. These requirements need special approach to noise elimination when strong incoherent linear noise occur. Hybrid methods are important components of seismic data processing in this case because commercial approach is many cases is far not enough to achieve satisfactory result. Proven methods which are combined with presented approach lead to the best solution of noise problems.

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References

Yilmaz O. [2001] Seismic Data Analysis, Volume 1, Society of Exploration Geophysicists, USA.
Sheriff R. E., and Geldart L. P. [1995] Exploration seismology, Cambridge University Press, USA
Cox M. [1999] Static Correction for Seismic Reflection Survey, Society of Exploration Geophysicists, USA