POLYCOR method of statics correction and raw data quality control in CDP data

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1. Static shifts correction in CDP data processing

«POLYCOR» is an alternative method of static shifts correction in CDP data processing. It is based on four-factor model of time shifts. This model includes kinematical shifts, dip shifts and shot point (SP) / observation point (OP) statics. «POLYCOR» method features high noise immunity. Accuracy of SP and OP statics determination in practice does not depend on shift values (for wide range of shifts values). When using this method it is not necessary to involve a priori estimation of velocity.

Standard and very common way of solving static correction problem is calculation of relative shifts between traces and solving a system of equations that provides separation of factors and estimation of SP/OP statics. Combined influence of four factors produces instability of solutions and necessity for iteration process. Convergence of such procedure depends on input data quality (signal/noise ratio) and deviation of estimated parameters (Kopchikov, 2005).

For the first time «POLYCOR» method was presented in the late 1970s in USSR, but results of efficiency estimation were not announced.

1. Method description

«POLYCOR» method is based on multiple correlations. First, series of correlation functions of first order between common offset traces are calculated and shifts of maxima of these correlation functions (formed by SP, OP and dip statics) are derived. Fig. 1 displays a scheme of calculation of cross correlation functions of first order. In series of correlation functions of first order (fig. 2a) shifts do not depend on velocity model.

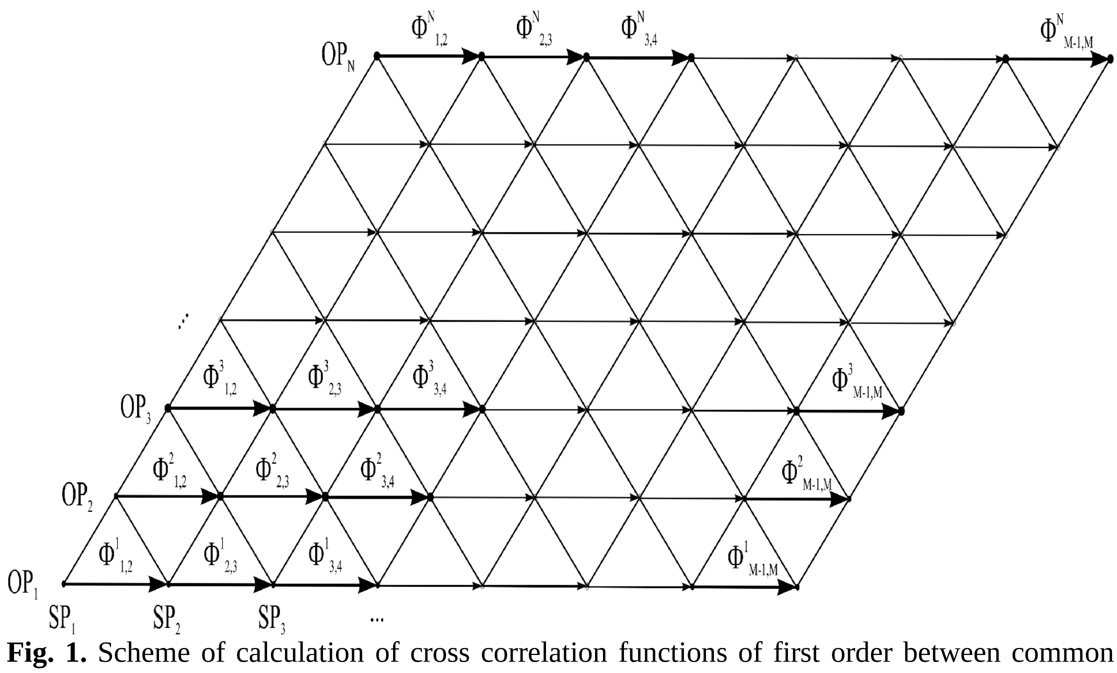


Fig. 1. Scheme of calculation of cross correlation functions of first order between common offset traces

Then correlation functions of second order are computed between neighboring series of correlation functions of first order. Fig. 2 displays common steps of «POLYCOR» method. Cross-correlation is calculated between traces of the same coordinate on the survey line and accumulated through all such pairs (accumulated second order correlation functions are on fig. 2b). In correlation functions of second order the influence of OP statics and layer dips is reduced. SP statics are determined from shifts of maxima of second order correlation functions. Calculated shifts are excluded from first order correlation functions. After that correlation functions of first order should be accumulated again and final estimation of OP statics is performed (Kopchikov et al., 2005).

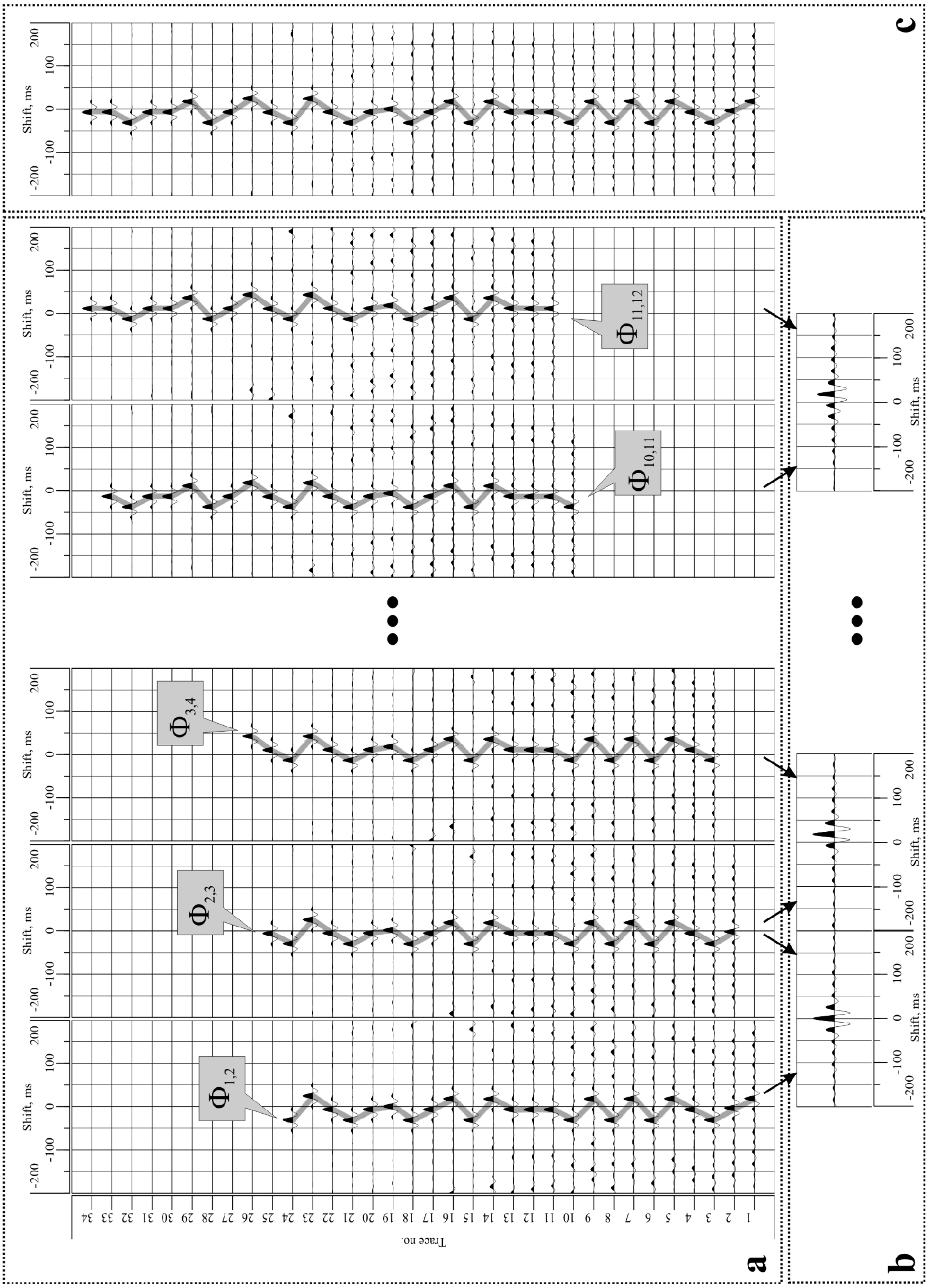


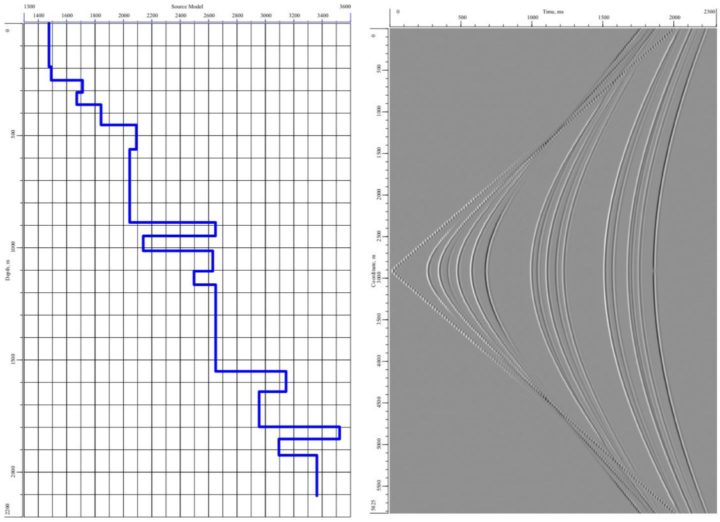
Fig. 2. Common steps of «POLYCOR» method (**a** – series of first order correlation functions, **b** – accumulated series of second order correlation functions, **c** – accumulated series of first order correlation functions)

2. Efficiency estimation of «POLYCOR» method

The points of model research were:

- Confirmation of possibility of non-iterative factor separation;
- Independence of accuracy for static shift estimation from their initial values;
- Confirmation of high noise immunity feature;
- Efficiency of using method for quality control of raw CDP seismograms.

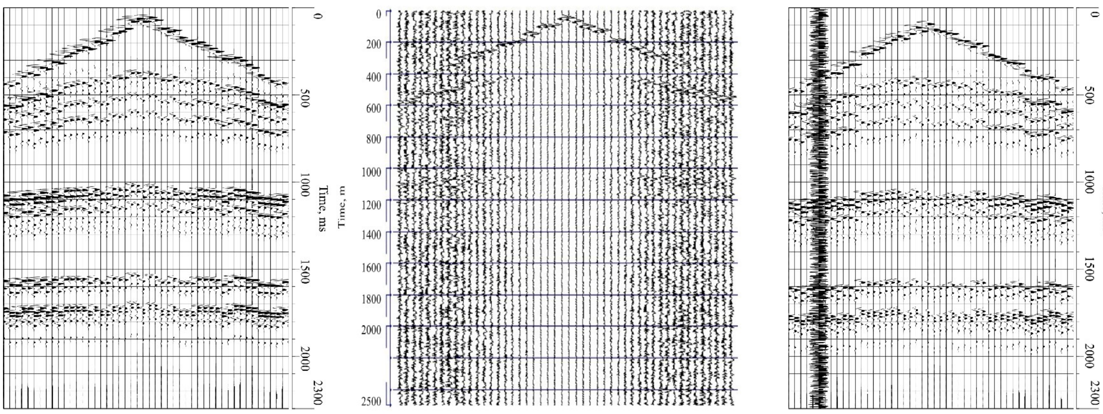
For efficiency estimation of «POLYCOR» statics correction method the synthetic data experiment was performed. For horizontal-layered model (fig. 3a) synthetic seismograms were computed (one of computed seismograms is on fig. 3b).



a **b**

Fig. 3. Synthetic data experiment (**a** – source horizontal-layered model, **b** – one of synthetic CDP seismograms)

For different parts of synthetic data experiment random SP and OP statics independent from each other were added to synthetic seismograms. Into all seismograms a background white noise of different intensity level was added. For quality control purpose white noise with signal/noise ratio = 1 was added (into all receivers of one seismogram and one receiver in each seismogram with the same coordinate on the survey line). Fig. 4 displays synthetic seismograms with statics and noises.



a **b** **c**

Fig. 4. Synthetic seismograms with statics and noises (**a** – seismogram with SP/OP statics, **b** – seismogram with background noise, **c** – seismogram with bad receiver)

Meansquare dispersion of static shifts and relative level of white noise (meansquare dispersion of signal amplitudes to noise amplitudes ratio) were the parameters of synthetic data experiment. For synthetic seismograms with different types of noise SP/OP static estimation was performed. After that standard deviation between computed and a priori static shifts was calculated. Fig. 5 displays results of synthetic data experiment.

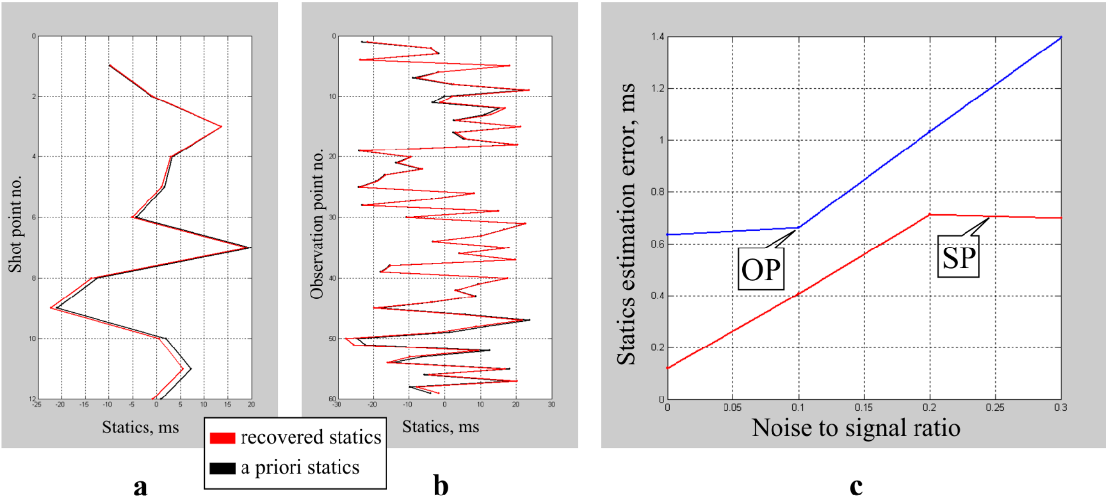


Fig. 5. Results of synthetic data experiment (**a**, **b** – comparison of recovered and a priori statics for SP (**a**) and OP (**b**), **c** – SP/OP estimation error vs. white noise level in source seismograms plot)

Examination of noise immunity was performed for different levels of white noise in source signal: 10, 20 and 30% of signal energy. Fig. 5c displays the plot of statics estimation error vs. different noise to signal ratios. On a fig. 5a and 5b comparison of recovered and a priori SP/OP statics for medium noise level (20% of source signal energy) is displayed. Standard deviation for SP statics determination is 0.6981 ms and for OP statics determination is 1.3948 ms.

3. Synthetic data experiment results

Comparison of recovered and a priori static shifts has showed the following facts:

- Accuracy of SP static determination does not depend on a priori defined OP static shifts and accuracy of OP static determination in turn does not depend on a priori defined SP static shifts;
- Presence of white noise in signal in practice does not affect accuracy and reliability of algorithm (except for edges of survey line and signal/noise ratios < 1)

References

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