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SOME ASPECTS OF ON LINE PROGRAM DEVELOPMENT OF SEISMO-ACOUSTIC SIGNAL RECEIVING AND PROCESSING

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It is known that the intellectual system of monitoring abnormal seismic processes for forecasting an earthquake obtains seismic and acoustic signals from seismic and acoustic sensors which are mounted on the preserved oil wells [1,2,3]. A simple receiving trace of seismic and acoustic signals is shown in Fig.1.

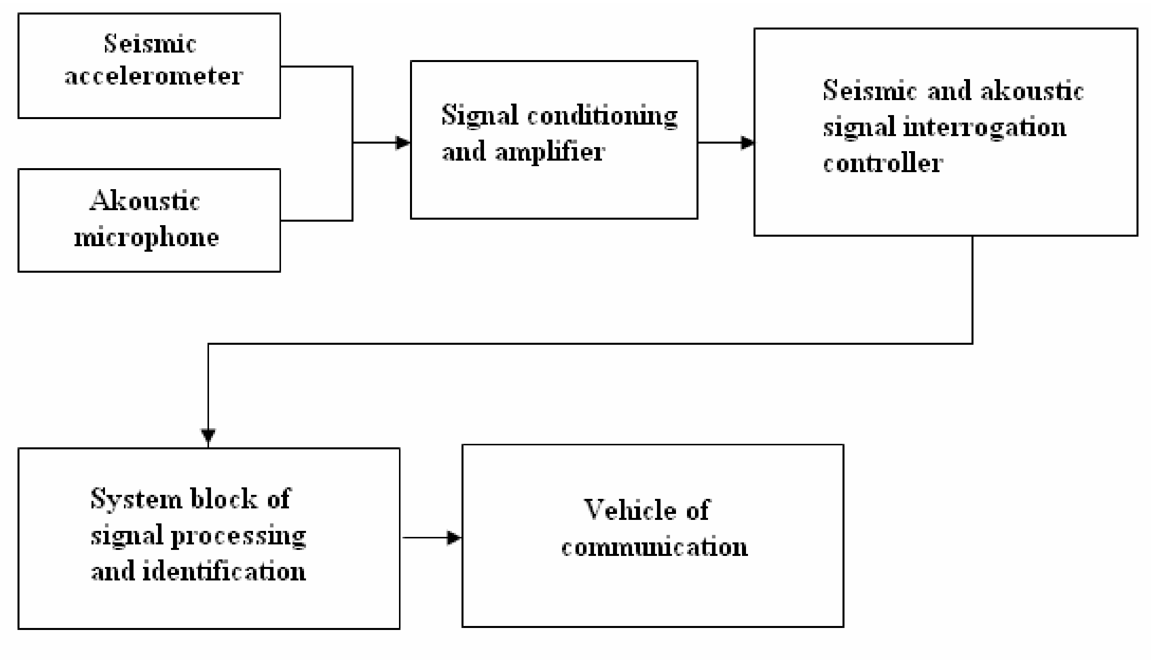

Fig. 1. Seismic and acoustic signal receiving trace.

There as an accelerometer we used three directional accelerometer CMG 5T produced by English firm GURALP Systems ltd in this trace. Bruel&Kjaer Microphone type 4952 is used as a microphone. These units are widely used in the world in the various applications seismic, early warning strong motion systems and permanent noise measuring systems in hard areas. These units are produced according high requirements and could be used in permanent applications for a long times.

Seismic and acoustic signals reception controller software receives seismic signals by 200 Hs, acoustic signals by 2000 Hs frequency [4]. Signal interrogation software begins to work when power is on. In the controller stage we are solving following questions:

- Frequency of information interrogations;
- Information capacity (number of points in a bulk of information);
- Interrupt information exchange with Pc from Com Ports;
- Program protect of information from channel noise influence.

Seismic and acoustic signals are handling in different hybrid blocks of algorithms in system block. The simple scheme of hybrid algorithm blocks is shown in Fig. 2.

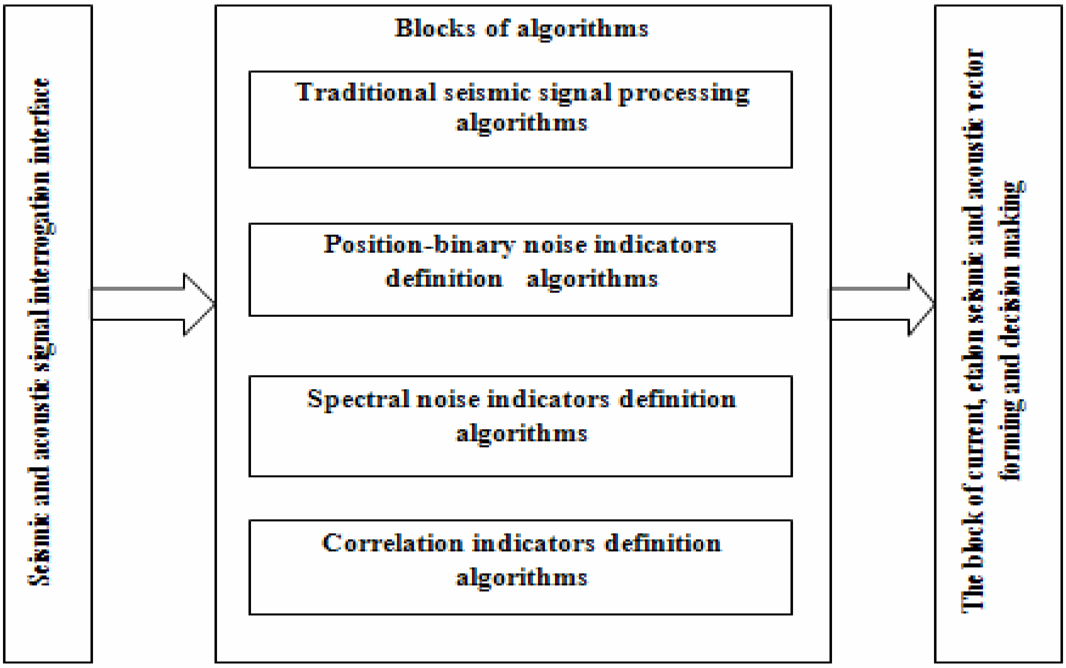

Fig. 2. Hybrid algorithms of signal processing.

At the termination outflow of each block of algorithms there determines corresponding characters of seismic and acoustic signals.

In the traditional seismic signal processing block of algorithms determines:

- Time of fixation (receipt) P and S waves;
- A time interval between receipts P and S waves;
- Distance to the epicenter of earthquake;
- Magnitude of earth tremors;
- Time of fixation *R* and *L* waves, etc.

In the block of algorithms of positional-binary noise indicators are determined:

- Factors K_{qi}, *i=1*, 1, 2, …, reflecting the ratio of the number N_{qk} of PBIS $q_k^*(i\Delta t)$ to the total number *N* of samples of the signal $g\ (i\Delta t)$.
- Factors $K_{qi}\varepsilon$, *i=0*, 1, 2..., reflecting the ratio of the number of noises to the total number of positional-pulse signals.
- Factors $K'_{qi}\varepsilon$ reflecting the ratio the number of transitions to the total number of samples.

In the block of algorithms of determining the spectral noise indicators are determined:

- Estimations of factors of spectral decomposition of informative frequency

$$a_{\omega Ti}^{++},\ a_{\omega T_i}^{--},\ a_{\omega T_0}^{+-},\ a_{\omega T_i}^{-+},\ b_{\omega T_i}^{++},\ b_{\omega T_i}^{--},\ b_{\omega T_i}^{+-},\ b_{\omega T_i}^{-+}$$

- Estimations of sign factors of spectral decomposition of a signal

$$a'^{++}_{\omega Ti}, a'^{--}_{\omega Ti}, a'^{+-}_{\omega Ti}, a'^{-+}_{\omega Ti}, b'^{++}_{\omega Ti}, b'^{--}_{\omega Ti}, b'^{+-}_{\omega Ti}, b'^{-+}_{\omega Ti}$$

- Errors of products from the influence of noises $\lambda^*_{a\omega}$ and $\lambda^*_{b\omega}$.

In the block of algorithms of determining the correlation indicators are determined:

- Differences of estimations of autocorrelation functions between non-centered signals and centered signals $\lambda_{gg}(\mu = \mu_{\max})$.

- A difference of correlation functions of the signal and noise, and the centered signal and noise λ_{gn} [1-3,5,6].

As a result we have gained current vector of seismic and acoustic signals. Every parameter of the vector indexes by the interrogation channel of controller. During the signal processing there forms etalon vectors for the different normal and abnormal seismic activities in the system block.

On the whole signal interrogation and processing carries out on line. In the integrated programming system of DELPHI latest versions for the real time organization of the work there applies following algorithms:

- organizes the procedure of timer interrupt processing(for example Procedure Timer4). Execution period of procedure defined by the Timer4.interval value. The number 1000 corresponds to the one second. Minimum value may be 50 and corresponds to the 50 millisecond. For the step organization in the body of procedure we use a variable T4_STEP:integer. The value accepts the number of necessary steps. For the first time it accepts the value 1 to go to the first step.

- organizes operating code Case T4_STEP of. There executes the block according the T4_STEP. At the end of every executed block defines the number of next executable block and Timer4.Interval.

Following real time program fragment made for connecting by the GSM channel:

```
procedure TForm1.Timer4Timer(Sender: TObject);
var
…
Begin
…
  case  t4_step  of
…
     101:   begin
        t4_stO:= 'ATD2332104'+ #13#10;    //..;
        ComPort1.send(T4_STO);
        timer4.Interval:=3000;    T4_STEP:=102;
                 end;  //101
    102:   begin
           T4_s_in:=ComPort1.fcomsay;
           if  T4_s_in>=12  then  T4_STEP:=103;
             end;  //..102
     103:   begin
           t4_STI:=comport1.fCominput(7);
           IF pos('CONNECT',T4_STI)<>0   then begin
                                         T4_STEP:=104;
                                                   end;
           IF (pos('NO CARRIER',T4_STI)<>0)  or
           (pos('BUSY',T4_STI)<>0)     then  begin
             timer4.Interval:=5000;    T4_STEP:=101;
                                              end;
             end;  //..103    BUSY, NO CARRIER
     104:     begin
            T4_s_in:=ComPort1.fcomsay;
           if  T4_s_in=0  then   begin
            T4_STEP:=106;
                              end
           else   begin
            T4_STEP:=105;
```

```
                end;
           end;  //..104
      105:   begin
           t4_STI:=comport1.fCominput(7);
           timer4.Interval:=2000;   T4_STEP:=106;
            end;    //..105
      106:     begin
                     T4_STEP:=1;
              end;   //..106
      …
End;   //..case
      …
End;     //..of procedure
```

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