BLAST WAVE OVERPRESSURE IN FRONT REGION: METHOD OF TIME DEPENDENCE RESTORING

L.S. Evterev, S.I. Kosyakov, V.S. Osolovsky

12 Central Research Institute, Ministry of Defense of Russia, 141307, Sergiev Posad, Moscow region, Russia,
e-mail: ksi1972.02@mail.ru

High dynamic load in front region of air blast leads to essential distortions during overpressure measurement and registration. Distortions have place when primary measuring converters formally correspond to peak-time characteristics of process.

To restore a real signal $g(t)$ we must solve an inverse mathematical problem of finding $g(t)$ from integral equation

$$x(t) = \int_0^t E(t-\tau)\cdot g(\tau)d\tau, \qquad (1)$$

where $x(t)$ is the registered signal, $E(t)$ is the impulses response function, which characterizes the measuring system as a whole. Known, that such problem is incorrect.

In given work the regulative operator (procedure) which restrict the functions $g(t)$ for front region within the limits of one-parametrical family of functions is used. This family is received from exact solution for motion in front region, found by means of integrating of nonlocal three-flux (NTF) model equations (Evterev & Kosyakov, 2008) in an one-dimensional flat case. The given model allows to reproduce theoretically well the blast wave front region expansing. The specified solution looks like

$$g(t) = \Delta P(t) = \frac{\Delta P_+}{1-e^{-\lambda\Delta_G}}(1-e^{\lambda\xi}), \qquad (2)$$

where $\xi = r - Dt$ is a running variable, $\xi \le 0$; $\Delta_G = D\cdot t_G$ — front width; D — blast wave propagation velocity; t_G — time of pressure increase to maximum value ΔP_+; λ — structural parameter of model.

If we use the parameters ΔP_+, t_G, D, corresponding to its experience values (statistical average for given distance r from explosion center), than we can solve equation

$$\ddot{x} + k\dot{x} + \omega_0^2 x = \Delta P(t), \qquad (3)$$

for variety of parameters λ (the decrement k of measuring system as a whole varies also). The typical result, which agrees well with registered signal, is illustrated on Fig. 1. The effect of "aggravation" (as opposed to effect of "expansion") is finding. Namely, the measuring system registers an absolute maximum of pressure so, as the time growth t_S, in some times smaller than time t_G of pressure increase to maximum value ΔP_+ in real process. All systems, that are used for measurements on distances smaller that 10 metter from explosion center, have this distorting effect. The offered method allows to make updating of measurements after carrying out of experiences.

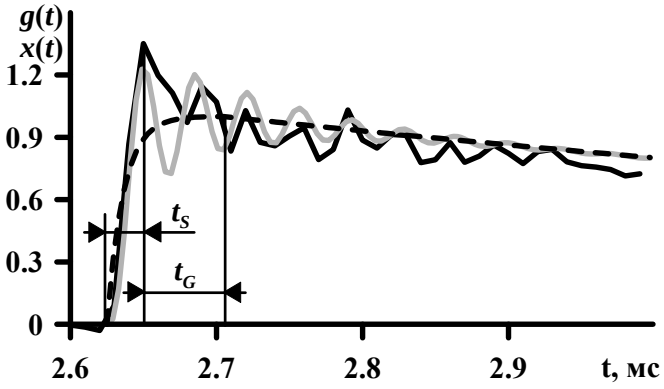

Fig. 1. Real signal restoration: ▬ - the registered signal, --- - the restored signal $g(t)$, ▬ - signal $x(t)$, corresponding $g(t)$ with accordance to (1)

REFERENCES

Evterev L.S., Kosyakov S.I.: Mechanism and Mathematical Model of the Transformation of a strong Shock Wave to a Continuous Disturbance in Air. Doklady Physics, 2008, Vol. 53, No. 3, pp. 172-174.

Keywords: the individual pulse response, restoration of a signal