

METHOD FOR DETERMINING OF JONES-WILKINS-LEE PARAMETERS USING THE CYLINDER TEST RESULTS AND NEURAL NETWORK

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The paper presents a method for determining the parameters of the equation of state (EOS) of explosive detonation products in the JWL form based on the cylinder-test experiment data.

The method for finding the EOS JWL parameters is based on the combined use of mathematical modeling of the experiment using the method for solving the direct problem of cylindrical tube expansion and the method for selecting the optimal EOS parameters that achieve the best match between the experimental and calculated wall expansion trajectories.

The optimization problem is solved in two stages. At the first stage, a neural network trained on the results of mathematical modeling of the problem by the method [1] is used, and at the second stage, the particle swarm method [2] is used. This approach has shown significant savings in computing resources due to the fact that launching a lightweight neural network allows one to obtain an approximation of the minimum of the objective function, in the vicinity of which the initial approximation of the optimization algorithm is subsequently selected.

To validate the EOS JWL parameters, mathematical modeling of test problems was carried out in a formulation corresponding to the cylinder-test experiment with the EOS parameters determined by this method. The results are in good agreement with experimental data.

References

1. **Zaguskin, V. L.** Method for calculating the isentropic coefficients of detonation products [Text] / V. L. Zaguskin, N. A. Grigoriev, T. N. Novikova, V. A. Filistovich // Proceedings of the IV All-Union Conference on Detonation. – 1989. – Vol. 1. – P. 244–250.
 2. **Kennedy, J.** Particle swarm optimization / J. Kennedy and R. Eberhart [Text] // Proceedings of ICNN'95 – International Conference on Neural Networks. – 1995. Vol. 4. – P. 1942–1948. doi: 10.1109/ICNN.1995.488968.
 3. **Shestakovskaya, E. S.** Mathematical modeling of the cylinder test experiment / E. S. Shestakovskaya, A. P. Yalovets, N. L. Klinacheva, O. A. Shershneva // Proceedings of the All-Russian Scientific and Practical Conference “Scientific Session of National Research Nuclear University MEPhI-2024 on the Topic “Innovative Nuclear Technologies”. – 2024. – P. 151–153.
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