

E. HLADKYI<sup>1</sup>, O. ZAVOLOKA<sup>2</sup>**DETERMINATION OF THE EFFICIENCY OF A MULTIPLE LAUNCH ROCKET SYSTEM**

<sup>1</sup>*Yuzhnoye State Design Office  
3 Kryvorizka St., Dnipro 49008, Ukraine*

<sup>2</sup>*Institute of Technical Mechanics  
of the National Academy of Sciences of Ukraine and the State Space Agency of Ukraine  
15 Leshko-Popel St., Dnipro 49005, Ukraine; e-mail: office.itm@nas.gov.ua*

Up-to-date multiple launch rocket systems (MLRSs) are adopted by many countries of the world, and they are an effective weapon against dispersed multiple targets. Developing and upgrading MLRSs calls for estimating their efficiency with the aim to select an optimum alternative. For an MLRS, the basic measure of area target destruction efficiency is the relative damage area. This measure depends on the damage area of the MLRS itself (extent of damage by one salvo).

The paper suggests a relative criterion that allow one to estimate and optimize the salvo damage area. The criterion is based on the ratio of the salvo damage area to the maximum damage area and that of the undamaged area to the coverage area. The coverage area is defined as the area of the enveloping convex polygon for all points of missile impact in a salvo. It is shown that the domain of variation of the suggested criterion is the interval [0, 1].

Using the suggested criterion for 4 points of missile impact with a circular damage area, two basic structures are studied: a rhomb (two regular triangles) and a square. For them, optimum distances between the missile impact points that maximize the destruction level are determined. It is shown that the obtained optimum arrangement of missile impact points allows one to bring the extent of damage for the square structure to the more optimum rhomb layout (represents a part of the hexagonal structure, which is the most efficient from the standpoint of the packing problem). For a 16-missile salvo, it is shown that from the standpoint of the suggested criterion there exists an optimum relation between the missile damage area (radius) and the technical scattering parameters. The maximum value of the criterion for a missile salvo with account for the technical spread does not exceed 0.33 and is much lower than the value that can be obtained for the optimum structures (rhomb and square).

The paper shows possibilities of using the criterion in deciding on optimum missile impact points with account for various typical targets within a multiple target and missile damage area configurations other than a circle.

**Keywords:** *multiple launch rocket system, efficiency, salvo damage area, coverage area.*

1. Balagansky I. A., Merzhievsky L. A. Action of Destruction Means and Munitions. Novosibirsk: Novosibirsk State Technical University, 2004. 408 pp. (in Russian).
2. Melikov A. V. Simulation model of MLRS subunit firing efficiency estimation. Kibernetika i Programirovaniye. 2014. No. 3. Pp. 91-102. (in Russian).
3. Efficiency Estimation of Firing Damage by Missiles and Artillery. A. A. Bobrikov (Ed.). Saint Petersburg: Galeya Print, 2006. 424 pp. (in Russian).
4. Fendrikov N. M., Yakovlev V. I. Weapon Combat Efficiency Calculation Methods. Moscow: Voenizdat, 1971. 224 pp. (in Russian)
5. Circle packing. URL: [https://en.wikipedia.org/wiki/Circle\\_packing](https://en.wikipedia.org/wiki/Circle_packing) (last accessed on April 15, 2021)

Received on May 31, 2021  
in final form on October 1, 2021

