# ЕСТЕСТВЕННЫЕ НАУКИ

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## THE USE OF PARALLEL COMPUTING FOR PROBLEMS OF SCATTERING RADIOWAVES

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*In this paper the authors consider the main features of using the parallel approaches in analyzing the problems of estimating of electrodynamical characteristics for diffraction structures by using the approaches of the physical optics technique. The particularities of methodological approaches for combined algorithm are stressed. The computer application was developed when we consider main steps of algorithm.*

*Keywords: mathematical simulation, diffraction, electrodynamical object.*

Parallel programming appeared more than 50 years ago, when channels independent hardware controllers were invented, allowing the Central processor to execute application programs simultaneously with various operations associated with the input-output of other programs.

At first, parallel programming was mainly in the field of operating systems. By the end of the 1960s, multiprocessor computers were formed. Then there were opportunities to use new developments not only for developers of operating systems, but also for application programmers.

The use of parallel computing systems (PWS) can be called as one of the strategic directions in the development of computer technology.

This is due to the fact that there are certain limitations on the performance of conventional serial computers, but there are new problems, in solving which there are not enough opportunities used at the moment computer technology.

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Despite the relatively short life of wireless networks and the recently adopted standards governing the transmission of data over a wireless network, such networks are under active development.

On their side, easy installation (integration with wired networks) and cost-effectiveness. Electrodynamic calculations of such structures can improve the efficiency of information transmission.

The problems associated with the synthesis of antenna components and complex structures with different shapes, in many cases leads to bulck of mathematical calculations that connected with according requirements of numerical calculation computer. That is why, the parallel computing can be considered as highly advisable.

For paralleling numerical analysis, the main idea is that the problem can be divided into a collection of not so great problems, the considering of them can be doing simultaneously. When we use parallel calculation, coordination is necessary in many cases. There are various approaches of parallel calculation: at the bit level, at the instruction level, for data, for tasks.

When designing diffraction structures, it is important to find the geometric dimensions of the structures that provide the electrodynamic characteristics necessary from the point of view of practice.

In this case, one of the issues in the design is to choose which structure of the antenna. In

the case where the antenna type has not been previously indicated, its choice in the implementation of structural optimization processes can be done on the basis of the fact that several types of antennas are compared based on the experience of previous developments.

When carrying out traditional design after selecting the type of antenna, its calculation is carried out on the basis of the method of successive approximations, in other words, the parameters change this is the size of the antenna, its elements (parametric optimization) and compare the electrodynamic characteristics with the necessary ones.

For the current state of antenna theory, there are opportunities for certain cases not to do parametric optimization based on certain procedures, to make a connection between the electrodynamic characteristics and the geometric parameters of the antennas, that is. The problem of antenna synthesis is solved.

At the decision of tasks of synthesis is: classic staging and design synthesis. In the first case, the amplitude-phase distribution of the current (or field) is found, which correspond to the given electrodynamic characteristics. But it is still not possible to determine the design of the antenna, giving the found current distribution.

In solving the problem of structural synthesis is the definition of the entire geometry of the antenna based on the given electrical characteristics, and as the initial parameter in solving such a problem, take the amplitude-phase distribution obtained from the classical synthesis problem.

At the present time, a certain objects can be defined as a combination of two-dimensional strips. They have length, distance to the receiver, angles in vertical and horizontal planes, respectively.

Also, a part is specified, in which the point of receiver will move across the numerical analysis, and the «reference» radar cross section (RCS), to which the synthesized body should aspire.

Each components in such population, whether it is a strip or an receiver point, is described through coordinates in a Cartesian plane system.

When you change the coordinates of one of the points for a single strip, the values characterizing the strip should be changed partially or completely (for example, when you change the coordinates of the beginning of the strip, such indicators as its length, the coordinates of the center, the angles of incidence and observation, the distance to the observation point are automatically changed.

Parallel computing in k threads are implemented by partitioning the faceted system into k parts.

The parts of the system differ from each other only by observation segments. Each thread needs to calculate its average value of RCS on the interval.

After completion of all flows, the arithmetic mean of the results obtained is calculated the desired average of the RCS of the whole system.

We use several characteristics: **DD** shows the value, connected with variation of nodes coordinates within object, the error of optimization calculations - **EE,** the set of useful algorithm goings - **NSQ** and the total number of runs for each pair of values from the test set - **N.** Also we calculate the value of coefficient **MM=NSQ/max{NQ},** which shows the index of success of the synthesis algorithm for each dataset. The test results are shown in table 1.

Table 1

The analysis of test results for al sis of complex objects

| DD | EE | NSQ | NQ | MM |
|---|---|---|---|---|
| 0,025 | 0,026 | 31 | 40 | 0,32 |
| 0,025 | 0,27 | 32 | 41 | 0,335 |
| 0,025 | 1,2 | 33 | 42 | 0,347 |
| 0,25 | 0,026 | 37 | 45 | 0,42 |
| 0,25 | 0,25 | 39 | 47 | 0,431 |
| 0,25 | 1,3 | 44 | 58 | 0,491 |
| 1,6 | 0,023 | 64 | 79 | 0,725 |
| 1,6 | 0,24 | 75 | 87 | 0,862 |
| 1,6 | 1,2 | 79 | 98 | 0,91 |

Conclusion. A parallel algorithm for the analysis of objects of complex shape, and on its basis algorithm for finding the geometric shapes of objects with the specified characteristics of the reflection of electromagnetic waves. The performance of the obtained analysis algorithm is tested and the validity of its use is proved.

The dependence of the successful completion of the synthesis algorithm on the magnitude of the change in the coordinates of the nodes of the system and the accuracy of finding the optimal implementation of the object is revealed.

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## РЕШЕНИЕ ЗАДАЧ РАССЕЯНИЯ РАДИОВОЛН НА СЛОЖНЫХ ОБЪЕКТАХ НА ОСНОВЕ ПАРАЛЛЕЛЬНЫХ ВЫЧИСЛЕНИЙ

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*В работе авторы рассматривают основные особенности использования параллельных подходов при анализе задач оценки электродинамических характеристик для дифракционных структур с использованием процессов техники физической оптики. Подчеркиваются особенности методологических подходов к комбинированному алгоритму.*

*Ключевые слова: математическая модель, анализ, синтез.*