

Speeding-up the optimization calculation in technical problems

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Abstract: The paper presents the problems related to reduction of the duration of technical problems optimization. The reduction is achieved with the use of the genetic algorithm to be run on multiprocessor computers. Exemplary computation tasks are depicted and the methods of parallelization of the optimization process are presented, on the example of the analysis of heavy-current busducts and luminous flux distribution.

Keywords: optimization, genetic algorithm, parallel computation.

I. INTRODUCTION

Dynamic evolution in the field of the technology related to development of new materials and production technologies enables manufacturing the devices distinguished by better operational parameters. It is possible thanks to carrying out the appropriate, usually complex and time-consuming calculation at the stage of designing. The calculations are aimed at detailed analysis of the phenomena undergoing in the considered system, meeting, at the same time, a set of constraints and criteria. Taking into account high complexity of the computation, it is often highly time-consuming. Reduction of the duration of the analysis may be achieved, among others, by the choice of proper calculation method and the use of the computers of high computational power. The problem of reduction of the calculation time arises in various fields of the technology [1,2] and, therefore, the paper presents the methods of reduction of duration of an optimization task.

II. IMPLEMENTATION OF THE GENETIC ALGORITHM RUN ON MANY PROCESSORS

For purposes of the optimization tasks, particularly the ones with many decisive variables, the genetic algorithm method is successfully applied. The method enables parallelization of the computation process, irrespective of the kind of the considered problem. It consists in a concept in which one main process is responsible for all the genetic operations and for determining the adaptation function distributing particular individuals among the other processes (Fig. 1). The computation may be parallelized both on multiprocessor computers (parallel computers) and on the computers provided with one multi-core processor.

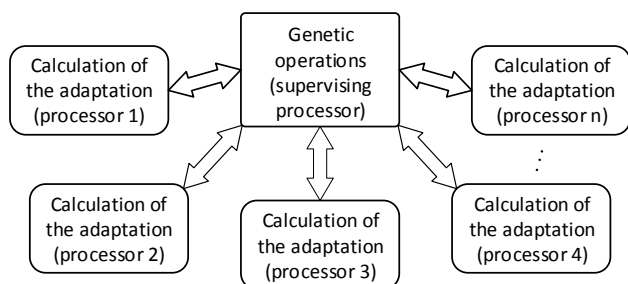


Fig. 1. Organization of the genetic algorithm on several processors

III. EXAMPLES OF THE COMPUTATION

The paper includes presentation of the examples of optimization computation with the use of a parallelized genetic algorithm. The investigation is focused on the reduction of computation time by application of the parallel algorithms. Figure 2 shows the results of the calculations carried out sequentially on a single processor and on a parallel computer. The first example is related to the optimization calculation of a heavy-current busduct [1], carried out on a parallel computer of cluster type, provided with 12 processors. The second example presents the results of the light field distribution [2] on the i7 processor composed of 4 cores of the HT type.

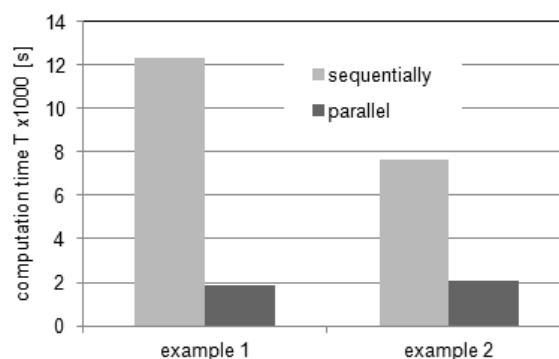


Fig. 2. Computation times of the exemplary tasks run on multiprocessor computers

IV. CONCLUSION

The examples presented in the paper allow to show that the use of parallel computation together with application of the genetic algorithm enables significant speed-up of the calculation. The presented parallelization method is effective in the cases in which the data are not very often interchanged between the computation threads. This is just a case of the genetic algorithm.

V. REFERENCES

- [1] Jajczyk, J.: "Optimization calculations with the genetic algorithm method on a computer cluster", *Przegląd Elektrotechniczny*, R. 90 NR 4/2014, pp. 232-234.
- [2] Kasprzyk L.: "Optimization of Lighting Systems with the use of the Parallelized Genetic Algorithm on Multi-Core Processors using the .NET Technology", *Przegląd elektrotechniczny*, R. 88 NR 7B/2012, pp. 131-133.