

**The scientific advisor's review
of final qualifying work
by Zhdanova Anastasiia Yuryevna
«Stochastic optimization methods for beam dynamics problems»
Direction 09.06.01 «Informatics and Computer Engineering»
The main educational program MK.3021.2017 «System analysis,
informatics and management»**

The relevance of research. The paper considers stochastic optimization methods for an intense beam in the field of a traveling wave, which make it possible to reduce the phase spread at the exit of the accelerator, reduce the relative spread in energies, and increase the particle capture coefficient. At the moment, many approaches to constructing accelerators have not been fully studied and optimized; the study of this kind of problems is urgent. Also, these tasks store a large amount of data, which is often impossible to process using traditional methods. Much of this data is non-linear. The results of this work can be applied in any field of knowledge where linear accelerators are used. The most promising is the application of the considered methods in medicine.

The structure of the final qualifying work and the methodological basis of the research are logical and do not raise questions.

The structure of the work reflects the tasks set. The introduction gives the rationale for the chosen research topic, as well as the mathematical model chosen to describe the beam dynamics in the field of a traveling wave in the framework of a linear waveguide accelerator. The purpose and objectives of the study are also reflected. In the formulation of the problem, the description of the tasks is given in a more detailed way, which makes it possible to reflect in more detail the essence of the work. In the literature review by the author Zhdanova A.Yu. relevant research in the selected area and already existing solutions are provided, as well as a number of existing projects that deal with the selected range of tasks are mentioned. In the first chapter, a mathematical model for optimizing the dynamics of intense beams of charged particles is presented in the form of dynamic equations of a beam of charged particles, and a criterion for the quality of controls is also highlighted. In the second chapter, numerical modeling of the dynamics of intense beams of charged particles and a comparison of the particle swarm methods, the genetic algorithm for global optimization and the genetic algorithm for multicriteria optimization are carried out. The author's graphs are provided for each of the above methods, which made it possible to clearly demonstrate the results obtained. Also, the final conclusions for each of the methods are separately highlighted and the positive and negative aspects of each of them are given. In the conclusion of the work, the author Zhdanova A.Yu. provides the final results. All the tasks were solved in the course of work.

Scientific novelty of the work. Modern algorithms, genetic algorithms for global and multicriteria optimization are considered, and their comparison is carried out. The results obtained can be extended to accelerators used in real conditions. Also, during the study, the Matlab environment was used for the numerical modelling, which allows for quick and efficient testing of hypotheses, building new algorithms and implementing existing methods.

Controversial provisions. The paper considers only a small-sized bunch of particles injected into the accelerator, which does not affect the final comparison of the results. However, for further practical application, the experiment can be repeated with a larger number of injected particles.

The final qualification work "Stochastic optimization methods for problems of the dynamics of a beam of charged particles" meets all the requirements for students under the program for the training of scientific and pedagogical personnel in graduate school MK.3021.2017 "System analysis, informatics and control" in the direction of training 09.06.01 "Informatics and computer technology ", implemented at St. Petersburg State University, information about the sources is given in accordance with the requirements of GOST 7.1-2003, GOST 7.0.5-2008, GOST 7.82-2001. The author of the work is Zhdanov A.Yu. deserves an excellent mark.

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