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Symbolic and numerical modeling of nonlinear dynamics of particles in accelerators

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The actual task of accelerator physics is the preliminary modeling of particle beam dynamics in an accelerator (including polarized ones). The search for optimal parameters of the control system that provides the necessary functionality of the particle beam particle control system is a resource-intensive problem, which leads to the need to use appropriate mathematical models which naturally allow parallelization and distribution of the corresponding computational procedures. At present, the main tool are software packages based on a numerical of trajectory description of the particle beam, which significantly reduces the efficiency of finding optimal parameters for control elements. In this paper, we consider a method that allowing us to form a map generating by the control system in terms of special matrices and ensure the performance of the necessary properties (for example, symplecticity).

The similar approach makes it possible to effectively use the methods of symbolic computation, which makes it possible not only to significantly reduce the time spent and simplify the analysis procedure, and also to provide the possibility of varying the parameters that ensure the necessary properties of the beam.

In this paper, we present a mathematical method that allows us to construct the necessary solutions, taking into account the symplecticity of the system with a given accuracy. Examples of the solution of such problems are given.

Primary author: SBOEVA, Ekaterina (Saint-Petersburg State University, Faculty of Applied Mathematics and Control Processes)

Co-author: Prof. ANDRIANOV, Sergei (Saint Petersburg State University)

Presenter: SBOEVA, Ekaterina (Saint-Petersburg State University, Faculty of Applied Mathematics and Control Processes)

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