Abstract

Modern research process of scientific problems often requires large computational resources. To solve them we have to use distributed computing systems. Researcher groups need to use them simultaneously and mostly remotely. The paper describes build of the distributed system for collaborative research process. As example was chosen a problem of the optimization dynamics charged particle beams using high-performance computing systems. The solution of many topical tasks leads to nonlinear optimization problems for example the controlling beams of charged particles [1-10].

Optimization is performed by minimizing some quality functional the choice of which is a corollary fact that the control functions which provides a functional minimum should determine the accelerating structure with the desired characteristics. The problem is usually formulated as finding the control functions for which the controlled system satisfies the given constraints. There is a necessity of the quality functional choice which ensures the problem solution. Research objectives: the development of a distributed information-computational system for the analysis of charged particle beam dynamics.

Figure 1: System architecture.

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SYSTEM ARCHITECTURE

Three-tier architecture has been proposed at the design stage fig. 1. The system uses a mixed control model: centralized control manager (client-server interaction) and broadcast event management (internal client management)[11]. The main features of the system elements were determined in decomposition stages. System structure provides the problem encapsulation, virtualization of working with remote components, modularity and the external programs connect ability.

Application domain analysis allows to identify the main interaction interfaces and classes that allows to structure virtualization engine for models and methods implemented on late-binding technique. The database structure was derived from the application domain infological model.

Customer level is implemented as a web application fig. 2 and fig. 3.

RESULT

The system approbation had carried out: implemented the longitudinal motion model of charged particles in the structure with spatially uniform quadrupole focusing. The model optimization had carried out (with augmenting the knowledge base).

The following problem is the search admissible control. The following longitudinal motion equation for charged particles in a radio frequency quadrupole (RFQ) structure [9]. Search admissible control carried for the proton accelerator at 352 MHz frequency. The following limitations were taken into account: \((UT)_{\text{max}} \leq 45\) and limitations on characteristics of the structure and controls.

At the first stage, the initial control search satisfying certain constraints extension, which is being implemented in several ways: searching in the knowledge base and applying initial control search techniques. One embodiment of the found structure has the following characteris-
Particle dynamics, new methods of acceleration and cooling

At subsequent stages the iterative process of improving the solution is carried out by one of the specified methods of optimization. After a few steps is received structure satisfies the given limitations. Structure has the following characteristics: almost 100% particles captured into the acceleration mode, maximal defocusing factor 0.01, the output energy 3.1 MeV and length of structure 1.65 m. The properties of program motions, controls, and phase space portraits of beams in separatrices are illustrated fig. 4.

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REFERENCES