ON ONE TECHNOLOGY FOR CREATING COMPUTER TRAINING PROGRAMS FOR MATHEMATICAL DISCIPLINES

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The article deals with new computer technology designed to simplify the creation of computer models for the processes of teaching mathematical disciplines.

New computer technology, implemented in the form of tool system and designed to simplify the creation of computer models for the processes of teaching mathematical disciplines, is offered. In this technology all the advantages of following well-known technologies of similar purpose are reflected and their significant disadvantages are considered:

1. The use of technologies of object-oriented programming environments, such as Delphi, C ++, C #, and others. This technology of the creation of computer training programs (CTP), called the "direct method", may be applied by highly skilled programmers and it is beyond the power of users, which are not engaged programming. CTP, created by the direct method, are characterized by high quality of development. However, because of their closeness, there is a certain complexity of their modification.

2. The use of professional mathematical packages. Applying known mathematical packages such as Maple, MATLAB, Mathematica, MathCAD and others, one can develop CTP – virtual mathematical laboratories that quite successfully simulate the processes of teaching mathematical disciplines using libraries of appropriate packages. However, there is a certain complexity of using libraries of other packages in virtual mathematical laboratory and for the solution of similar problems it is necessary the participation of highly qualified professional with knowledge of the libraries' features of mathematical packages.

Now among well-known mathematical packages MathCAD is the most effective tool in mathematical learning. The emergence of new versions of MathCAD is accompanied by the creation of effective tools related to the mathematical learning. For example, the appearance of the server version MathCAD Appication Server (MAS) in 2003, allowed to transfer all the calculations from workstations to the servers, that opens up the wide possibilities of creating virtual mathematical laboratories for conducting distance learning.

3. Computer tool systems for the creation CTP. One manifestation of the use of computer modeling in IT-learning is the development of software tools for modeling learning processes on the example of tool systems (or TS CTP), which allow to create models (or CTP) with continuous feedback to the researcher, without programming. TS CTP are easy to learn and accessible to researchers, who are not specialists in the field of programming. Nevertheless, the possibilities of CTP depend on quality indicators of utilities of TS CTP. This is a tangible restriction in creating CTP satisfying exquisite user requirements. [1-4].

Currently on the market of IT – technologies there is significant interest in the CTP, which mimic the processes of learning mathematical disciplines as they would take place in reality. Among the similar CTP greatest interest are open models with variable structure, which can use libraries of different packages and whose behavior changes in real time depending on upcoming events. Such relevance was the reason that we have dealt with problems of the development of computer technology, implemented as a tool system, which allows to create open models with variable structure for teaching mathematical disciplines.

The solution of the problem. To solve this problem it was proposed to use modern technologies (ADO, Internet, DataSnap, Real World) of object-oriented programming environment Delphi 7 Enterprise, and libraries of mathematical package MathCAD 2009 Professional, that allowed the development of tool system, later called "TS MASTER" and the kernel for open computer models with variable structure for teaching mathematical disciplines.

"TS MASTERS" allows to create various distros for given kernel, which are open virtual mathematical laboratories with variable structure. These virtual labs are designed to conduct teaching mathematical disciplines both on one PC, and in the local area network with a large number of workstations. Qualitative characteristics of such distros are directly dependent on tools used in the tool system and the properties of the kernel, where:

– as external utilities to create documents (files with the contents of lectures, laboratory and practical lessons, as well as test questions to them) for virtual mathematical laboratories, tool system uses components from libraries of known mathematical packages. Such arbitrariness in interaction with external tools allows "TS MASTER" to easily create open virtual mathematical laboratories of various levels of complexity and purpose. For example, to create virtual mathematical laboratories for teaching of general courses of higher mathematics, as external tools for the tool system the components of the package MathCAD are more preferred. As well as, for course on mathematical modeling the packages MATLAB and FEMLAB are best suited;

– built-in utilities of tool system make it easy to change the tree-like structure (graph) of the lessons content for distro to be created , as well as to link the vertices of graph (names of lessons) with access routes to created documents and save these connections in database (DB). As a result, created distro reacts to event of choice of any vertex of the graph by automatic forming SQL query to the appropriate database server (SQL Server), which executes

a query over the database. As a consequence, the distro opens the relevant documents and allows the computational experiments on them using appropriate mathematical packages.

Below the internal architecture of program complex is shown: "TS MASTER", mathematical package, SQL Server, Remote Data Module, kernel for open computer models with variable structure and distro for the kernel, which is three-tier client / server application for conducting of distance learning in the local computer network.

Shown in Figure open three-tier virtual mathematical laboratory with variable structure consists of three parts:

– **Client part** consists of the kernel and distro to it, as well as the corresponding mathematical package. Kernel contains the objects of support of DataSnap technology on the client side (the objects encapsulated from the class TClientDataSet) and objects of socket programming TCP / IP (objects encapsulated from the class TSocetConnection) for its connection with the server part. To optimize queries to the server the language SQL is used. Distro is a user interface and interacts with the kernel through a data source from the class TDataSource. Objects that make up this distro allow to visualize the working with documents. Among them objects encapsulated from the class TWebBrowser are significant. They allow to use components from libraries of corresponding mathematical packages.

– **Application server** runs on the server side. It is mechanism of connecting of client application with SQL Server. It is also designed to minimize the load on the SQL Server. Its kernel consists of the remote data module (Remote Data Module – RDM). RDM contains objects of support of DataSnap technology on the server side (the objects encapsulated from the class TDataSetProvider) and objects that support ADO technology to access SQL Server, which works with the database that stores the table with the routes of access to documents (the content of lectures, laboratory works, exercises and tests). Due to the flexibility of technology ADO, there is an easy opportunity to optimize the operation of the three-tier virtual mathematical laboratory, replacing the database server by more powerful system with an appropriate choice of ISP connection. RDM is registered to the server SocetServer and runs for each access of client to the server.

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INFORMATION TECHNOLOGY PROJECT "ADANAT"

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The development of aviation and space technologies require reliable data on the aerodynamic and aerothermodynamic characteristics of hypersonic vehicles in the whole range of flow regimes, i.e., from the continuum flow regime up to the free-molecular regime. During de-orbiting, the spacecraft passes through the free molecular, then through the transitional regime and the finalized flight is in the continuum flow.

It is well known that for flight in the upper atmosphere, where it is necessary to take into account the molecular structure of gas and using Boltzmann equation and corresponding numerical methods of simulation [1]. While aircraft are moving in low atmosphere, the problems are reduced to the problems that can be solved in the frame of continuum theory or, to be more precise, by application of the Navier-Stokes equations and Euler equations. It is natural to create engineering methods, justified by cumulative data of experimental, theoretical and numerical results, enabling the prediction of aerodynamics characteristics of complex bodies in the transitional regime [2].

Computer modeling allows to quickly analysis the aerodynamic characteristics of hypersonic vehicles by using theoretical and experimental research in aerodynamics of hypersonic flows. The basic quantitative tool for study of hypersonic rarefied flows is direct simulation Monte Carlo method (DSMC) [3] and it is required large amount of computer memory and performance and unreasonable expensive at the initial stage of spacecraft design and trajectory analysis. The solution for this problem is the approximate engineering methods. The Monte Carlo method remains the most reliable approach, together with the local engineering methods, that provides good results for the global aerodynamic coefficients. In the work of [2, 12] indicated that local engineering methods could have significant effect on aerodynamic characteristics of various hypersonic vehicles.

At the Department of Aeromechanics and Flight Engineering (DAFE) of Moscow Institute of Physics and Technology (MIPT) was developed the