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.

References

1. Monakhov V.M. New information technology of teaching: methodological and methodical problems of development and implementation. Collection "The main aspects of the use of information technology in improving methodical learning system". – M., 1987. – P. 3–17.

2. Vasil'kov Y.V., Vasil'kova N.N. Computer technologies of calculations in mathematical modeling: Textbook. – M.: Finance and Statistics, 2002. 256 p.

3. Stepanov M.E. Features of the using of computer technology for the study of functions in secondary school. Author's abstract. Dissertation for the degree of candidate of pedagogical sciences. – M., 1994. – 18 p.

4. Anisimov V.V. Methodological features of using software package in teaching mathematics and computer science. Dissertation for the degree of candidate of pedagogical sciences. – M., 1990. – 121 p.

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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

information technology project "ADANAT" (Aerodynamic Analysis of Ensuring the Establishment of Aviation and Space Techniques) by Professor Yuri Ivanovich Khlopkov. Many research grants from the Russian Foundation for Basic Research (RFBR) supported this project. The parallel calculation center of DAFE MIPT is equipped with the modern CFD software. DAFE with the famous organizations of Russia "TsAGI, TsIAM, Dorodnicyn Computing Centre of the Russian Academy of Sciences, Institute for Problems in Mechanics of the Russian Academy of Sciences, Sukhoi Aviation Holding Company, engineering company TESIS, etc" was defined many fundamental problems in the field of creation of new generation of aviation and space techniques. Development of the center allowed promoting in the solution of the most complex challenges of computing in aerothermodynamics problems. Some of these are the problems of hypersonic aerothermodynamics, rarefied gas dynamics and task about flows in turbojets, etc. Under the projects some books were published [4-12, 2].

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References

1. Kogan N.M. Rarefied Gas Dynamic, New York, Plenum, 1969.

2. Belotserkovskii O.M., Khlopkov Yu.I. Monte Carlo Methods in Mechanics of Fluid and Gas, World Scientific Publishing Co. New Jersey, London, Singapore, Beijing, Hong Kong, 2010. – 268 p.

3. Bird G.A. Molecular Gas Dynamics and the Direct Simulation of Gas Flows, Oxford University Press, 1994.

4. Khlopkov Yu.I., Zharov V.A., Gorelov S.L. Guidelines for computer analytics. Moscow, MIPT, 2000. – 118 p.

5. Khlopkov Yu.I., Zharov V.A., Gorelov S.L. Coherent structures in a turbulent boundary layer. Moscow, MIPT, 2002. – 268 p.

6. Khlopkov Yu.I. Statistical modelling in computational aerodynamics. Moscow, MIPT, 2006. – 158 p.

7. Belotserkovskii O.M., Khlopkov Yu.I. Monte-Carlo Methods in mechanics of fluid and gas. Moscow, Azbuka-2000, 2008. – 330 p.

8. Khlopkov Yu.I., Zharov V.A., Gorelov S.L. Renormalization group methods for describing turbulent flow of an incompressible fluid. Moscow, MIPT, 2006. – 492 p.

9. Khlopkov Yu.I., Zharov V.A., Gorelov S.L. Lectures on theoretical research methods turbulence. Moscow, MIPT, 2005. – 178 p.

10. Belotserkovskii O.M., Khlopkov Yu.I., Zharov V.A., Gorelov S.L., Khlopkov A.Yu. Organize structures in turbulent flows. Moscow, MIPT, 2009. – 303 p.

11. Afanasyev L.A., Khlopkov Yu.I., Chernyshev S.L. Introduction to the speciality. The aerodynamics aspects of flight safety. Moscow, MIPT, 2011. – 184 p.

12. Khlopkov Yu.I., Cernyshev S.L., Zay Yar Myo Myint, Khlopkov A.Yu. Introduction to speciality II. High-speed aircrafts. Moscow, MIPT, 2013. – 192 p.

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