MATROSOV INSTITUTE FOR SYSTEM DYNAMICS AND CONTROL THEORY OF SIBERIAN BRANCH RUSSIAN AKADEMY OF SCIENCES

Matrosov Institute for System Dynamics and Control Theory (ISDCT)

of Siberian Branch (SB) Russian Academy of Sciences (RAS) has been found on November 1, 1980 to develop mathematical methods related to investigation and modeling objects of various nature, methods of control theory and application of new information technologies in the East-Siberian subdivision of Siberian Branch of RAS.

Department of Systems Theory and Cybernetics of the Siberian Institute of Energetics, SB of RAS was the institute foundation established in June of 1975 and planned to form a core of an independent research institute having also the functions of computing center of collective usage.

Principal research directions

- Theory and methods of qualitative investigation of evolution equations and dynamic systems, with applications;
- Qualitative control theory and methods of control with applications;
- Methods of the mathematical physics in field theory, gas- and plasma-dynamics problems;
- Theory, algorithms and computing technologies focused on optimization and operation research;
- Theoretical foundations and technologies for organization and control of parallel and distributed computing systems;
- Theoretical foundations and technologies for organization of the information and telecommunication structures;
- Methods, technologies and services of establishing informational and analytical, geo-informational, software-hardware systems in different subject domains, including supporting complex interdisciplinary scientific research.

THE INSTITUTE'S STAFF:

A of 2018, total number of the employees – 161,
researchers – 85, including:

- Academicians of RAS – 1;
- Corr. members of RAS – 1;
- Doctors of science – 23;
- PhD – 52.

AWARDS

Winners of the Federal Reward of USSR in science and engineering:
Dr. of math. L.Yu.Anapolsky, academician S.N.Vassilyev, PhD R.I.Kozlov, academician V.M.Matrosov (1984)

Winners of the Russian Government Prize: academician I.V.Bychkov, Dr. of science G.M.Ruznikov (2013).

Winners of the Irkutsk Region Governor's Reward:
academician S.N.Vassilyev, Dr. of math. V.A.Baturin, academician I.V.Bychkov, Dr. of science G.M.Ruznikov, PhD A.E.Khmelnov (2005), academician S.N.Vassilyev, academician I.V.Bychkov, Dr. of science G.M.Ruznikov, PhD T.I.Madzhara (2011).

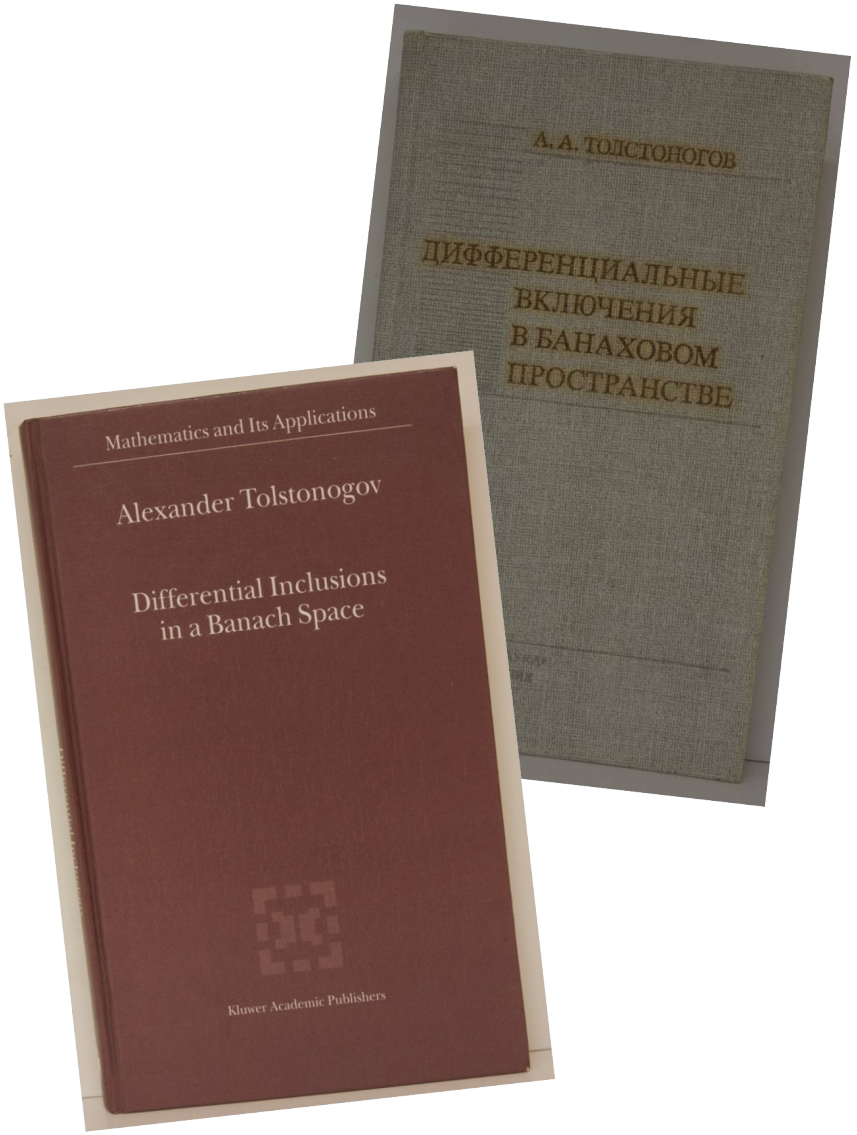
Institute scientists have developed

- research methods of stability, controllability and other dynamic properties of complex systems,
- methods of optimal control,
- control methods, including discontinuous systems,
- methods of identification of dynamical systems,
- methods of finding explicit solutions of integral-differential systems such as the Vlasov-Maxwell equations, *etc*.,
- numerical methods for constructing difference schemes for partial differential and integral equations,
- automating methods for planning and control in distributed computing systems,
- information technology for solution of technogenic and information security problems,
- information technologies for automation of data representation and intelligent data processing.

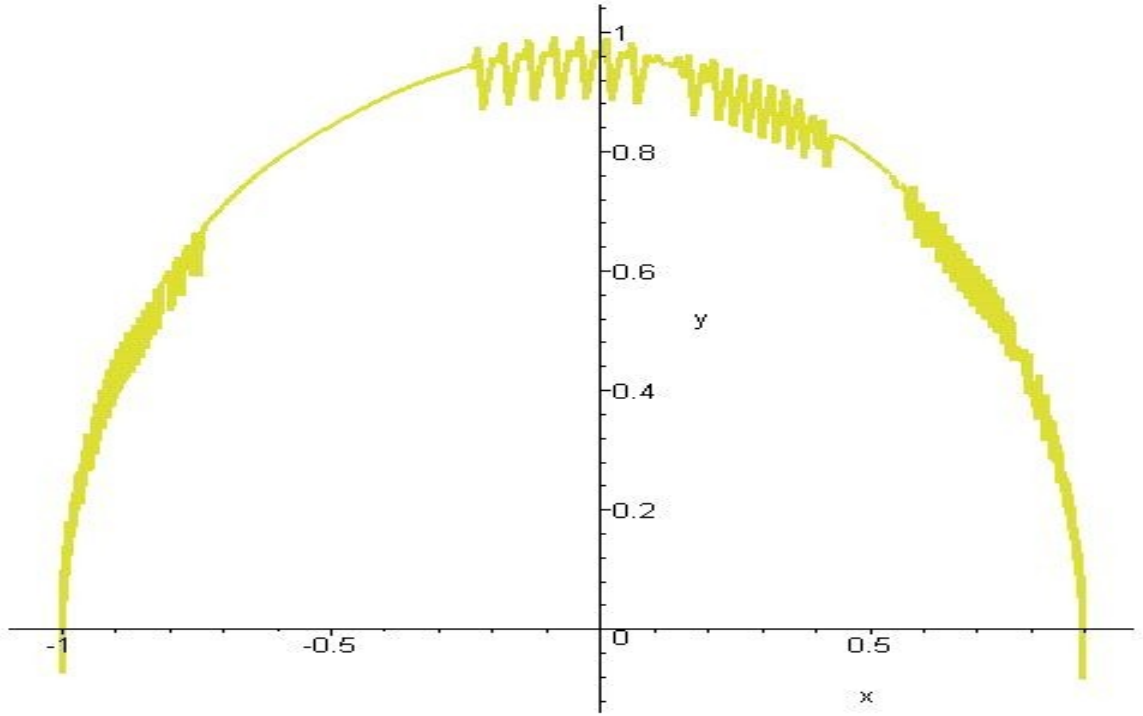
The developed methods and techniques are applied in the study of systems of technical, ecological, economic and physical nature.

FUNDAMENTAL RESEARCH

World first, the theory of differential inclusions with the non-convex right-hand side in the Banach space has been developed, as well as **the theory spaces of sets, sublinear functionals and operators with the applications to some problems of variation calculus, optimal control, mechanics, *etc*. (Corr. member of RAS A.A.Tolstonogov).**



The general and qualitative theories of differential equations with the discontinuous right-hand side has been developed. The applications related to investigations of mechanical systems with dry friction, to the controlled Lagrange-type systems with discontinuous controls, and to the systems with delay (Dr. of Science (math) I.A.Finogenko).



The phase plane of motion for a chain of a manipulation robot along a given trajectory (semi-circle). High-frequency oscillations have been provoked by implementation of the “sliding mode” control along a target set.

The theory of systems of ordinary differential equations, which are non-solvable with respect to higher derivatives and identically singular in the domain, has been developed.

The investigations were related to complex (but having great value in the aspect of applications) singular systems with continuous and discrete time (hybrid) and the interconnected systems of differential-algebraic and differential-difference equations.

(Dr.of sci. (math) Yu.E.Boyarintsev,

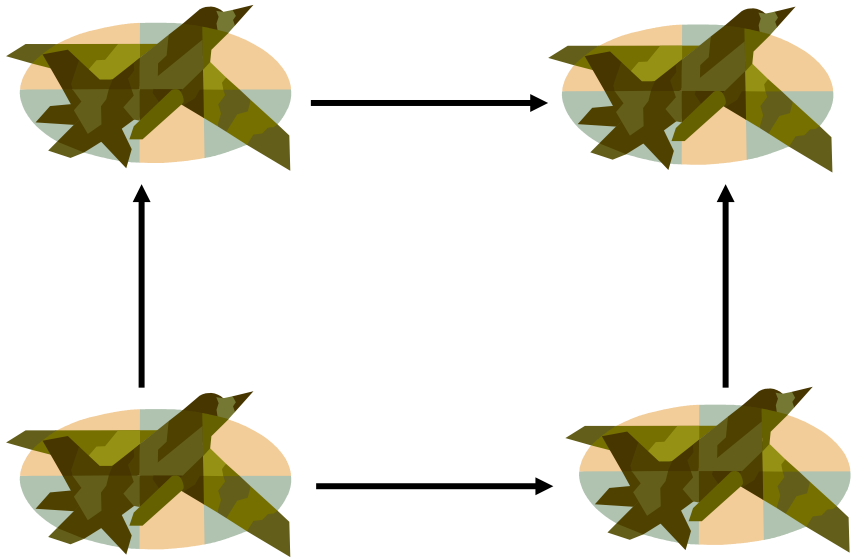
Dr.of sci. (math) M.V.Bulatov,

Dr.of sci. (math) V.F.Chistyakov,

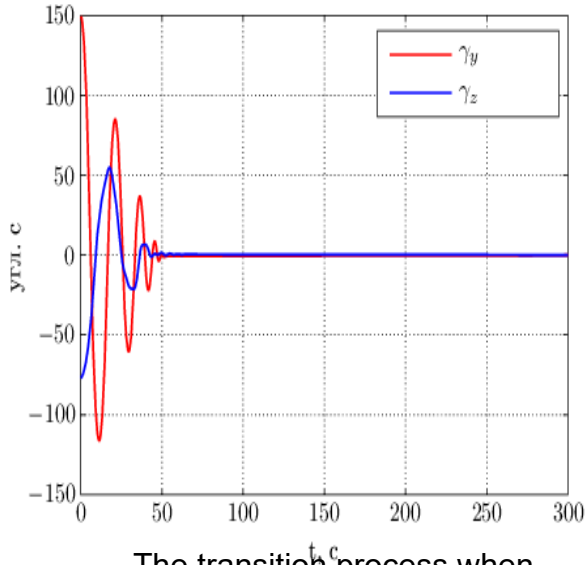
Dr.of sci. (math) A.A.Sheglova).

The nonlinear theory of internal stability for formations of moving objects has been developed. The internal stability understood as the possibility of retaining (with some precision) a given configuration by the objects. Unlike known problem statements, the new theory takes in account of incompleteness and low precision of the state measuring, uncertainty of the environment and the objects, restricted character of control, and discreteness of measurements and control implementaions.

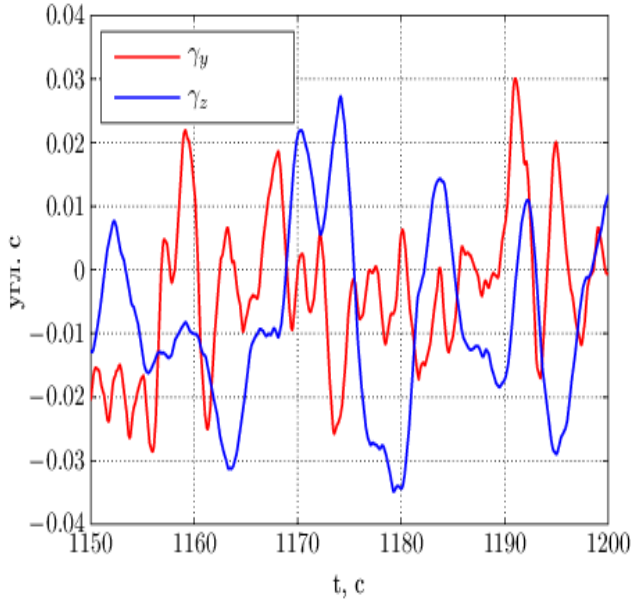
(academician S.N.Vassilyev, Dr.of sci. (math) A.V.Lakeyev).



Based on the use of the Lyapunov vector functions (LVF), conditions has been obtained **for asymptotic stability of nonlinear and dissipative systems** for **digital control of continuous objects. Their control comprises both continuous and discrete time components. Software algorithms for dynamic analysis and parametric synthesis using sublinear LVF has been developed and implemented as software. In collaboration with the Scientific and Production Association S.A. Lavochkin, synthesis of precision angular stabilization system of non-rigid construction for large space telescope "Spektrum-UV“ has been carried out, providing accuracy to 0.03 arc. sec.**



The transition process when switching from program mode to stabilization



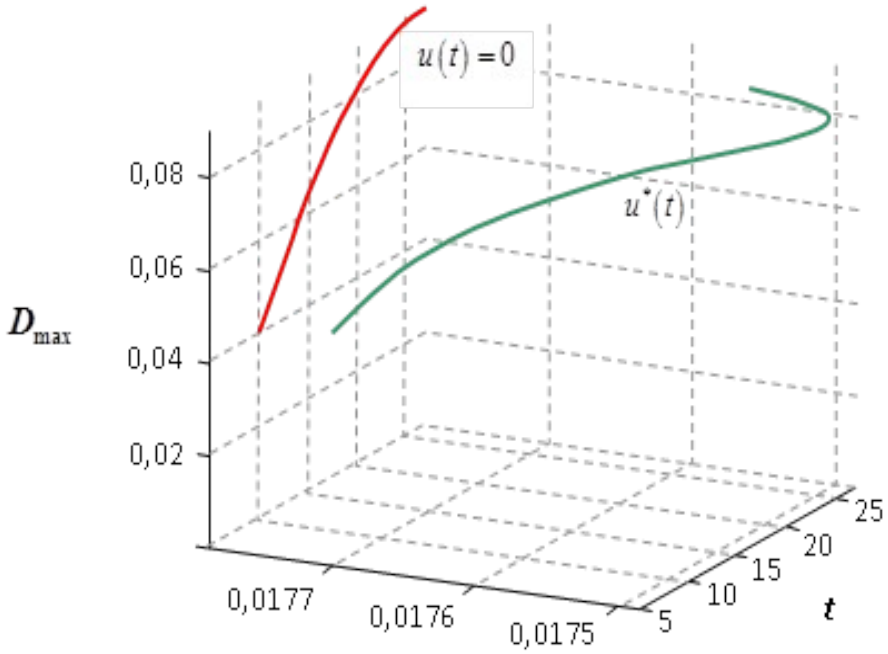
Stabilized process in the mode of precise stabilization

Publications:

1. Bychkov, I. V.; Voronov, V. A.; Druzhinin, E. I.; et al. Synthesis of a combined system for precise stabilization of the Spectr UF observatory. I. Cosmic Research. 2013. Vol. 51. Issue 3. Pp. 189-198.
2. Bychkov, I. V.; Voronov, V. A.; Druzhinin, E. I.; et al. Synthesis of a combined system for precise stabilization of the Spectr UF observatory. II. Cosmic Research. 2014. Vol. 52. Issue 2. Pp. 145-152.

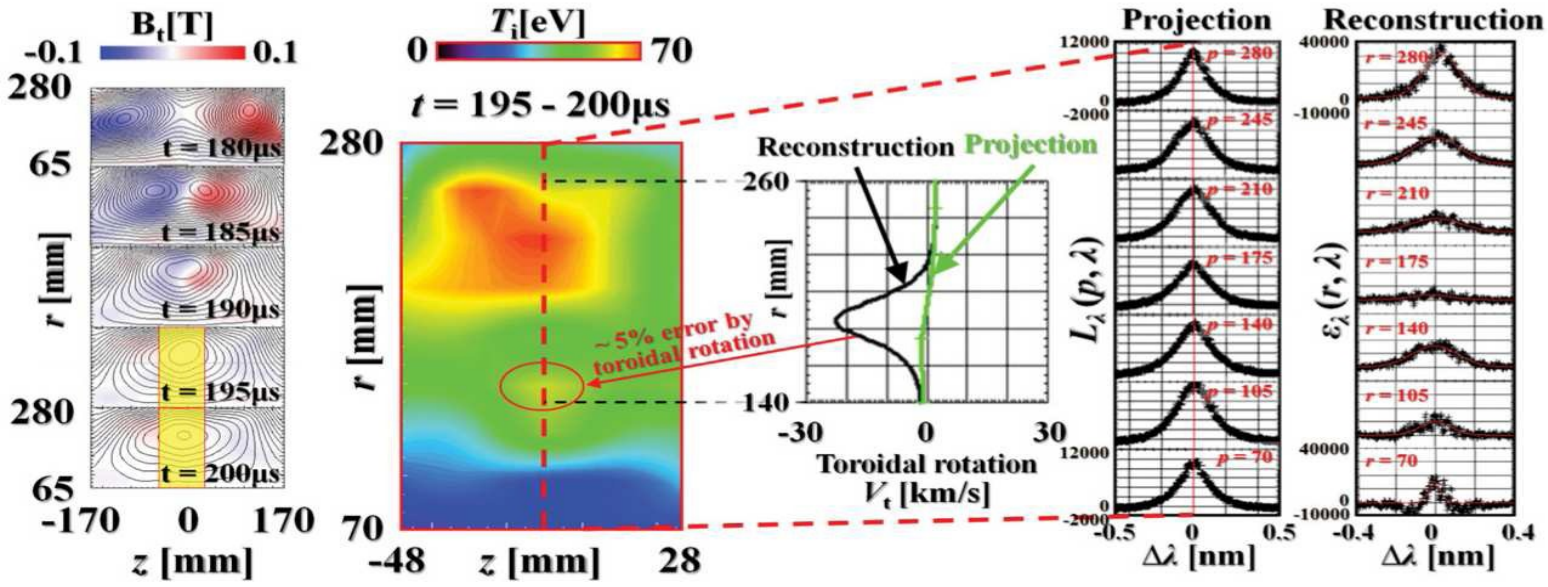
A new numerical method for constructing approximate optimal positional control in the tube of solvability of a nonlinear control system based on the method of dynamic programming and algorithms for solving problems of optimal control software with state constraints has been developed. Algorithms for numerical construction of the solvability of the tube as a union of reachability sets of the control system has been implemented. The sets correspond to different time intervals and are obtained by solving a series of problems of optimal control. Using the proposed algorithms, computations of optimum vertical maneuvers of the aircraft in case of possible missile "air-air“ attacks from the rear hemisphere has been carried out with the mathematical models.

(Dr.of sci. (eng.) A.I.Tyatushkin)



The maximum possible range of the rocket launch (D_{max}) from pursuit aircraft is decreased by 10% as a result of missile maneuver of the pursued aircraft with an approximately-optimal control $u^*(t)$. Here, ρ characterizes the density of the atmosphere (altitude), t is time.

In callaboration with the High-temperature plasma center, University of Tokyo (Japan), plasma diagnostic methods has been developed for the appliance TS-3 / TS-4 (of spheric mac type) using scalar and vector tomography.



The results of the reconstruction of two-dimensional distribution of the ion temperature in the experiment of magnetic reconnection

Publications

1.Tanabe H., Kuwahata A., Oka H., Annoura M., Koike H., K.Nishida, You S., Narushima Y., Balandin A., Inomoto M., Ono Y. Two-dimensional ion temperature measurement by application of tomographic reconstruction to Doppler spectroscopy // Nuclear Fusion. 2013. Vol. 53, Issue 9. Article No. 093027.

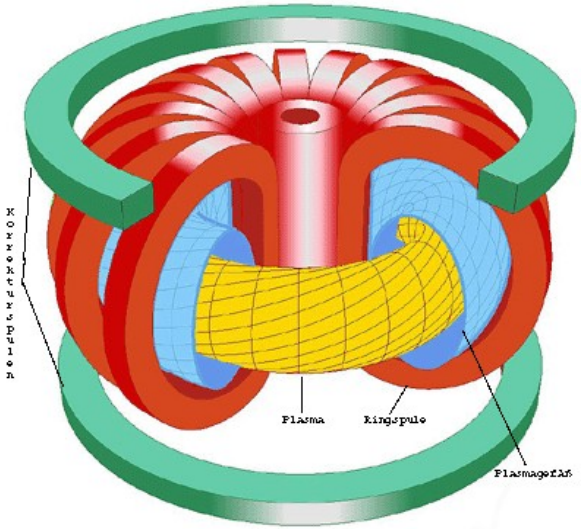
2.Tanabe H., Oka H., Annoura M., Kuwahata A., Kadowaki K., Kaminao Y., You S., Balandin A., Inomoto M., Ono Y. Two Dimensional Imaging Measurement of Magnetic Reconnection Outflow in the TS-4 Plasma Merging Experiment // Plasma and Fusion Research. 2013. Vol. 8. P. 2405088-1–2405088-4.

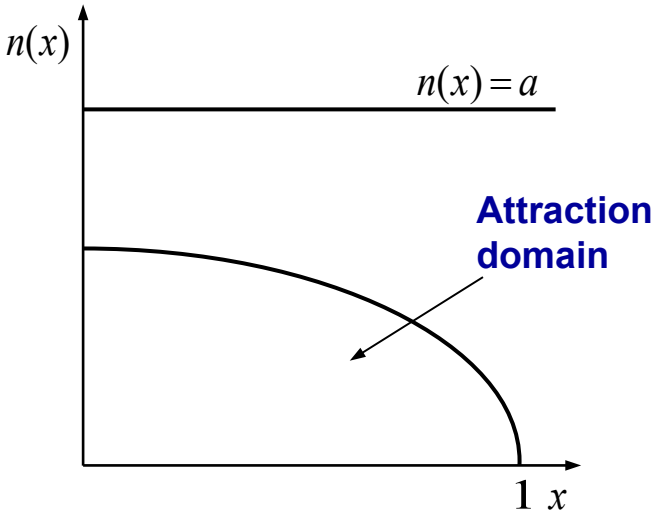
Steady-state solutions and sufficient conditions of their stability have been obtained for an n-component Vlasov-Maxwell system, which describes the dynamics of plasma in the kinetic approximation.

The existence of bifurcation points, in whose neighborhood there appear non-trivial solutions, has been proved.

A mathematical model related to the balance of constrained plasma densities in such installations as Tokamak has been investigated

(Dr. of sci. (math) G.A.Rudykh).





Steady-state distribution of plasma density $n(x)$ along the radius x for $\xi = 2.32$, $\lambda = 0.167$

Approximate methods intended for solving optimal control problems have been developed:

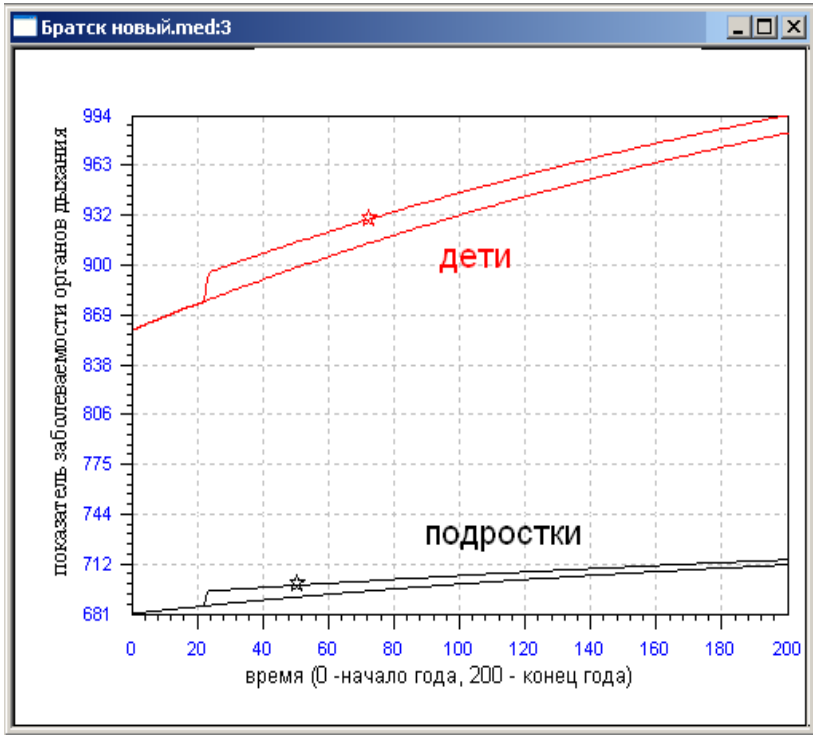
- **strong and weak first- and second-order improvement;**
- **methods based on local approximations of the reachable set;**
- **methods of finding impulse-optimal controls.**

The following applied problems have been solved:

- **trajectory problems related to control of flight dynamics of helicopters;**
- **problems of optimal control of maneuvering aircraft;**
- **problems related to control of industrial manipulation robots;**
- **problems related to optimization of transient regimes of electric-energetic networks.**

(Dr.of sci. (math) V.A.Baturin, Dr.of sci. (eng.) A.Yu.Gornov, Dr.of sci. (eng.) A.I.Tyatushkin).

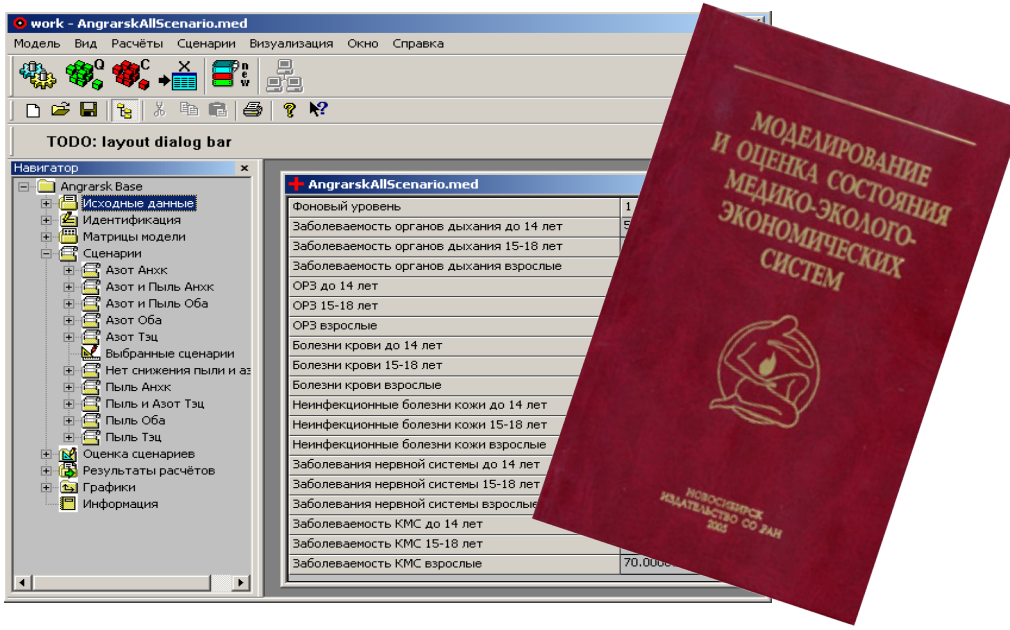
In collaboration with East Siberian scientific center of human ecology of SB RAMS, a medical-ecological-economic model of forecasting the dynamics of population health indicators in an industrial city has been developed. This model takes in account strong short-time discharges of pollutants into the atmosphere (Dr. of sci. (math) V.A.Baturin, PhD (math) D.E.Urbanovich).



An example of computations for Bratsk city. The influence of health care is taken into account as a function of the funding.

The software system implementing the model allows one to conduct

- **identification of the model's parameters;**
- **formation of development scenarios and numerical experiments;**
- **analysis of scenarios;**
- **assessment of the economic loss.**



OPTIMAL CONTROL

Matrosov Institute for System Dynamics and Control Theory
of Siberian Branch of Russian Academy of Sciences

Mathematical Control Theory

Direction of research:

1. Qualitative behavior of control dynamical systems:
   Reachability sets (inner and outer estimations, asymptotic dynamics),
   Invariance (necessary and sufficient conditions),
   Existence of solution and Variational stability;
2. Optimal control:
   Relaxation (extension) of optimal control problems,
   Necessary and sufficient optimality conditions,
   Numerical algorithms;

Problem classes:

3. Control of ordinary and hyperbolic partial differential equations
4. Impulsive and Hybrid Control (control of systems with discontinuous trajectories);

Methods:

5. Comparison principle in System Theory,
6. Hamilton-Jacobi equations and inequalities: Canonical Theory of Optimality, Modified Lagrangian techniques and nonstandard duality in nonconvex optimal control problems,
7. Constructive extension of singular control problems, problem regularization techniques (Gurman-Kelly transformation, time reparameterization).

Main results

1. Feedback necessary optimality conditions for smooth and nonsmooth control problems, strengthening of the classical and nonsmooth Maximum Principle. Nonstandard duality for nonconvex linear and quadratic (with respect to state variable) optimal control problems.
2. Impulsive extensions of singular control problems (constructive extensions of ordinary systems with trajectories of unbounded variation and semi-linear hyperbolic PDEs, based on problem regularizastion; measure differential representations of systems with polynomial impulses).
3. Necessary and sufficient optimality conditions for discrete, impulsive and hybrid problems with different types of constraints (state, intermediate state, jump endpoint constraints) employing sets of super- and subsolutions to Hamilton-Jacobi equations.
4. Necessary optimality conditions for control systems with uncertain initial data (control of continuity equations).
5. Monotonicity of Lyapunov type functions and invariance for impulsive control systems: definitions, criteria, applications.
6. Asymptotic dynamics of reachable sets for standard and impulsive control systems (limit behavior of reachable sets, asymptotic formulas).
7. Numerical algorithms for standard and impulsive optimal control problems (based on Pontryagin and feedback control variations).

Applications

1. **Robotics**
   (control of manipulators);

2. **Mathematical economics**
   (investment control, macroeconomical models);

3. **Mathematical biology**
   (crowd dynamics, population control);

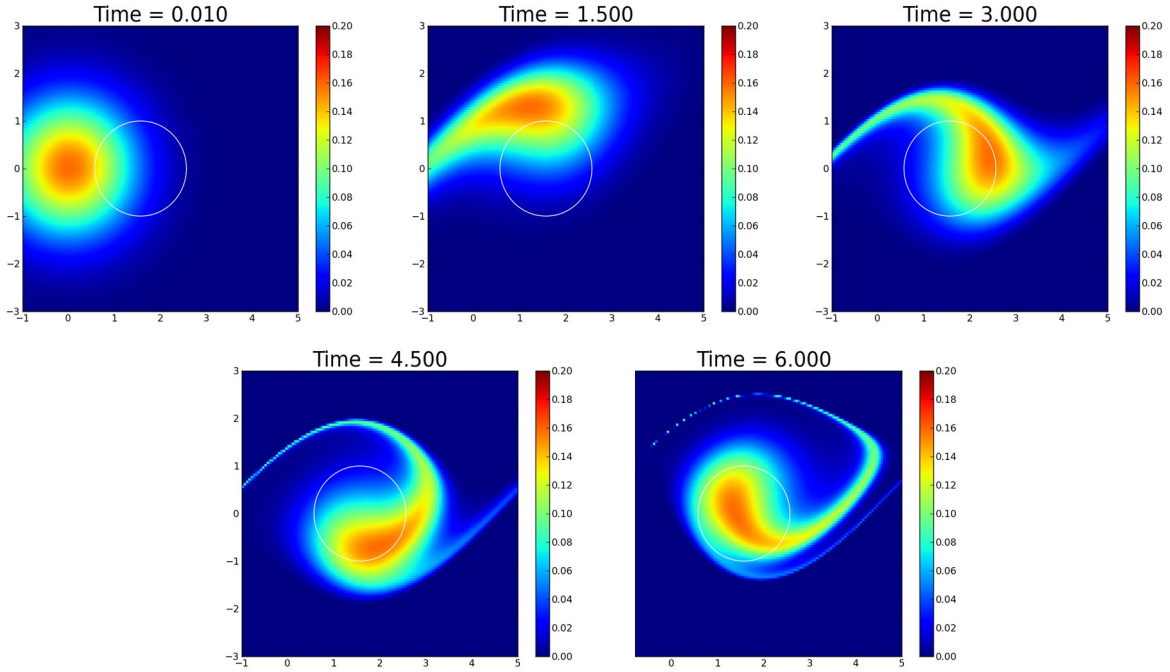
4. **Bionics**
   (control via blocking of degrees of freedom).

Optimal control of Continuity Equations

Applications:

- **Control of dynamical systems with uncertain parameters,**
- **Focusing of beams in accelerators.**

Example: Steering of a dynamical system with v(x1; x2; u) = (x2 + u; cos x1) to a target set A (white circle) by the time moment T = 6. Initial data is normally distributed.ких и экологических моделей. (*PhD N.I. Pogodaev*)



Mass transfer with nonlinear controlled dynamic system

Optimal Control Problem, box control restrictions

- Controlled dynamic process is described by a system of ordinary differential equations;
- It is given initial conditions and time interval for system;
- The control belongs to the parallelepiped set;
- In order to solve of the optimal control problem, the terminal functional is to be minimized.

Applications

Flight dynamics, space navigation, mechanics, robot technology, power systems, economy, ecology, geography, medicine, sociology, nanophysics, etc.

SOFTWARE: **OPTCON (OPTimal CONtrol)**

- MAPR (1980-1986, mainframes BESM-6)
- KONUS (1986-1990, mainframes ES)
- OPTCON-I (1989-2001, MS-DOS)
- OPTCON-II (2002-2003, Internet Server)
- OPTCON-III (2004-2009, Windows 95/98/2000/XP/VISTA/LINUX)
- OPTCON-IV (2010, Windows/LINUX)

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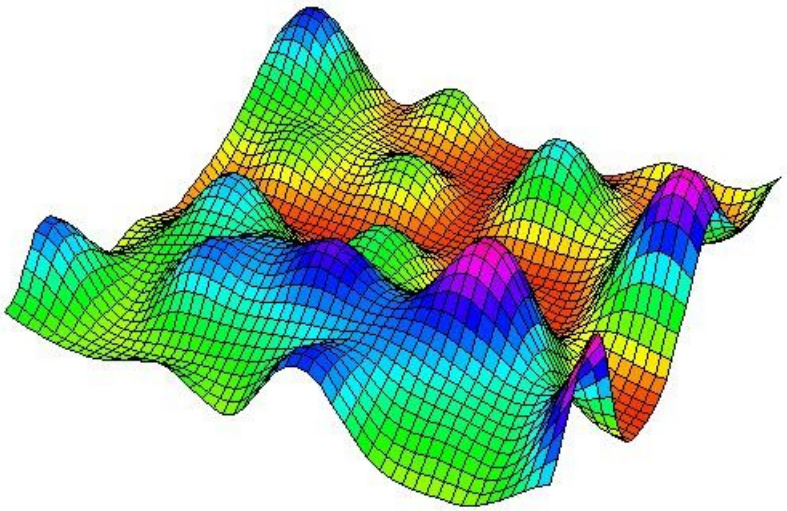
New Methods for Equilibrium, Hierarchical and Optimal Control Problems

The global search methods (Global Search Theory) for problems with equilibrium, hierarchy, and dynamics are developed in the Laboratory of Nonconvex Optimization. Special global search strategies for the nonconvex problems with functions represented by the difference of two convex functions are proposed and justified. These strategies are new original and quite efficient approach for finding a global solution of nonconvex problems of mathematical optimization, in which there may exist many local solutions, which are rather far from the global one.



The approach has been tested on a wide field of nonconvex problems:

- the search for equilibria in competitions (conflict situations or games);
- hierarchical (bilevel) optimization problems;
- optimal control problems.

The investigations of these problems are strongly motivated by real word applications in different fomains such that economics, political sciences, computer sciences, biology, transportation, engineering, *etc*.

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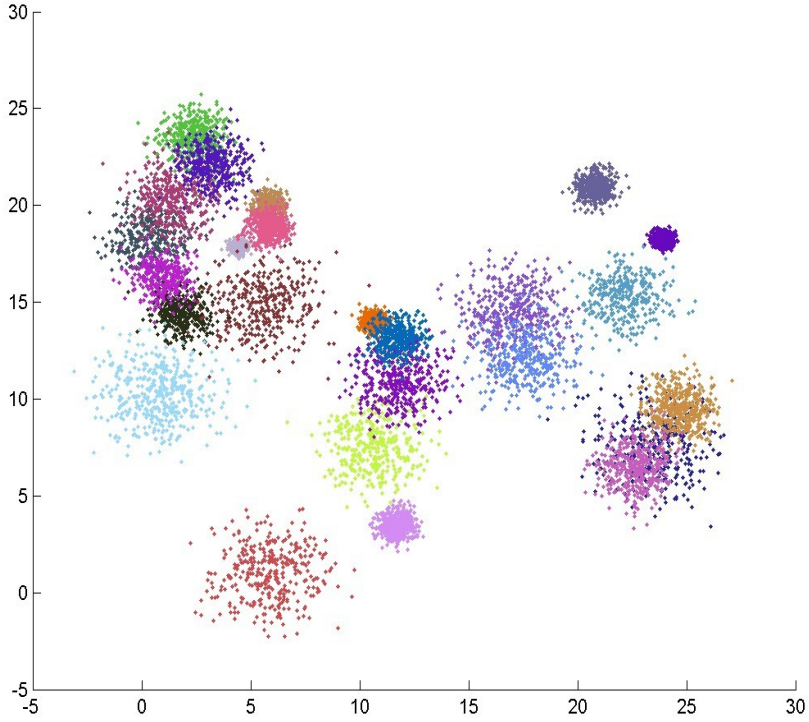
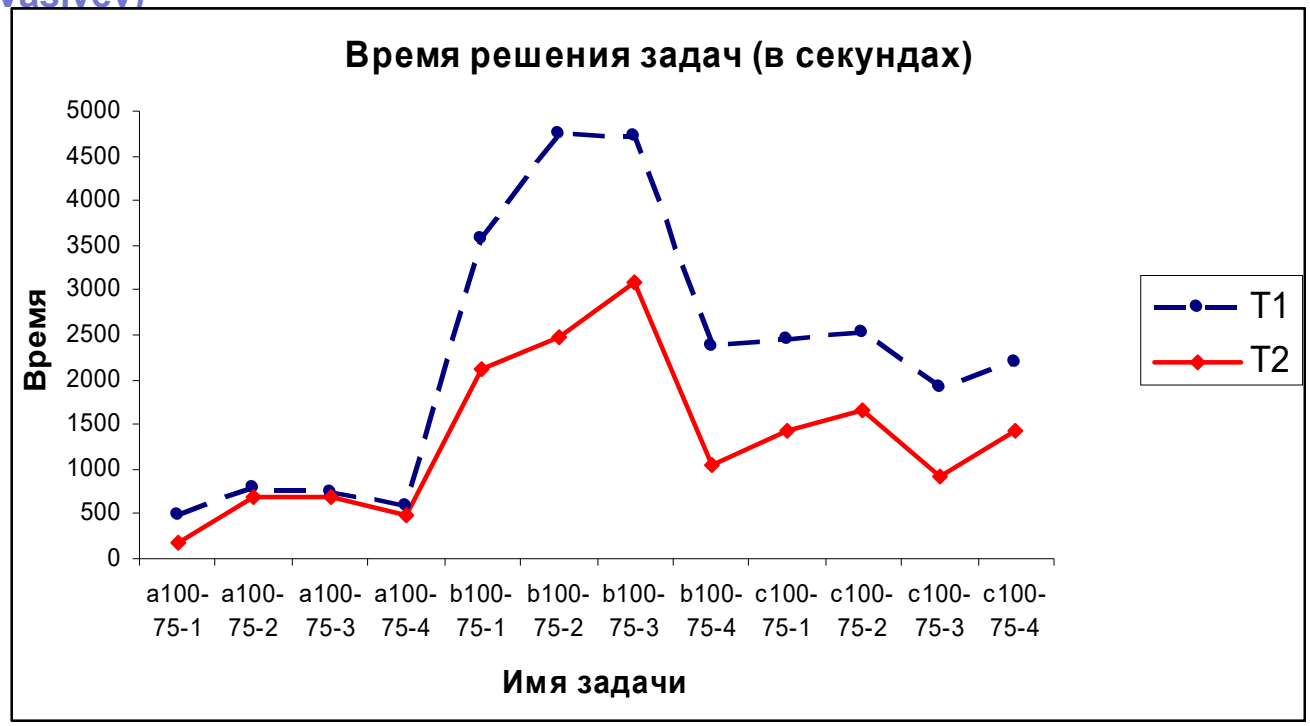
Discreet location models and algorithms for big data cluster analysis

Scalable parallel algorithm has been developed, which is being scaled on HPC systems with more than 1000 parallel processes and solve tasks with more than 10^6 objects and 10^{12} variables. This algorithm has been approved in the big data cluster analysis.



Branch and cut algorithm

Efficient branch and cut algorithm for figuring out optimal solutions to the problems of placement with customer preferences has been developed and implemented in software. Computer experiment confirmed the effectiveness of the method for solving large-scale problems. The method is applied for Cancer cells cluster analysis, Supply Chain, and Logistic problems. (PhD I.L. Vasilyev)



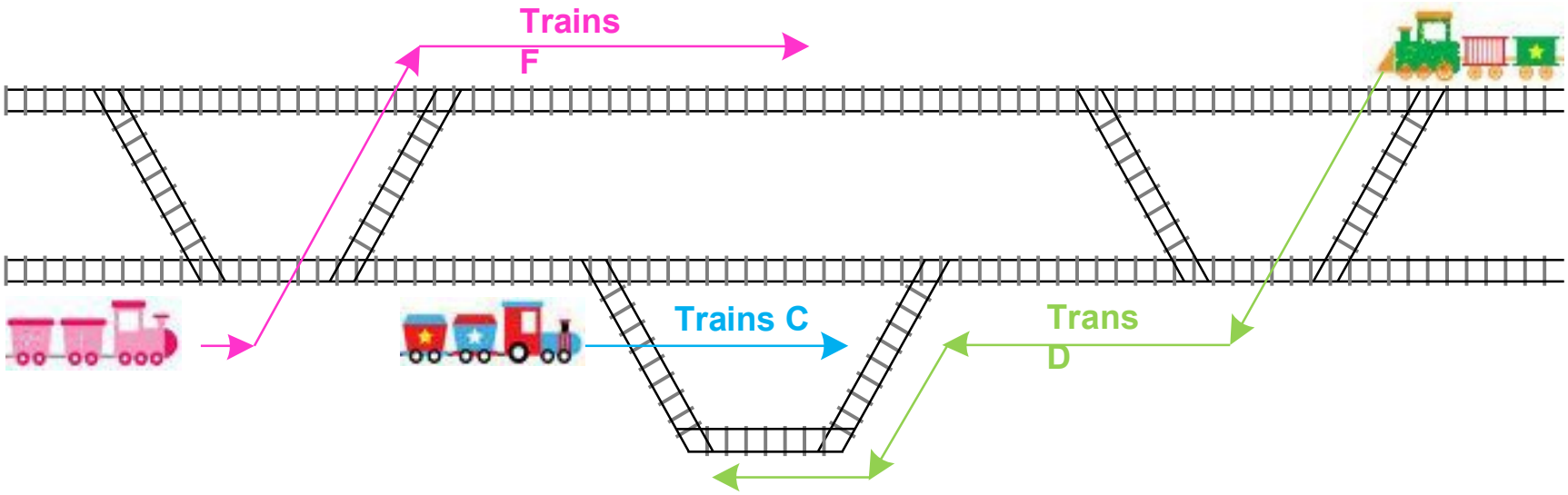
Graphic of time for solving a series of problems with 75 enterprises and 100 customers for the two approaches:
T1 is a better one found in the literature;
T2 is for the developed method of branch and cut.

Horizontal axis is a problem name, vertical one in time spent (seconds) for obtained solution.

The railway dispatching problem on multi-track territories

Heuristic approaches based on mixed integer linear programming

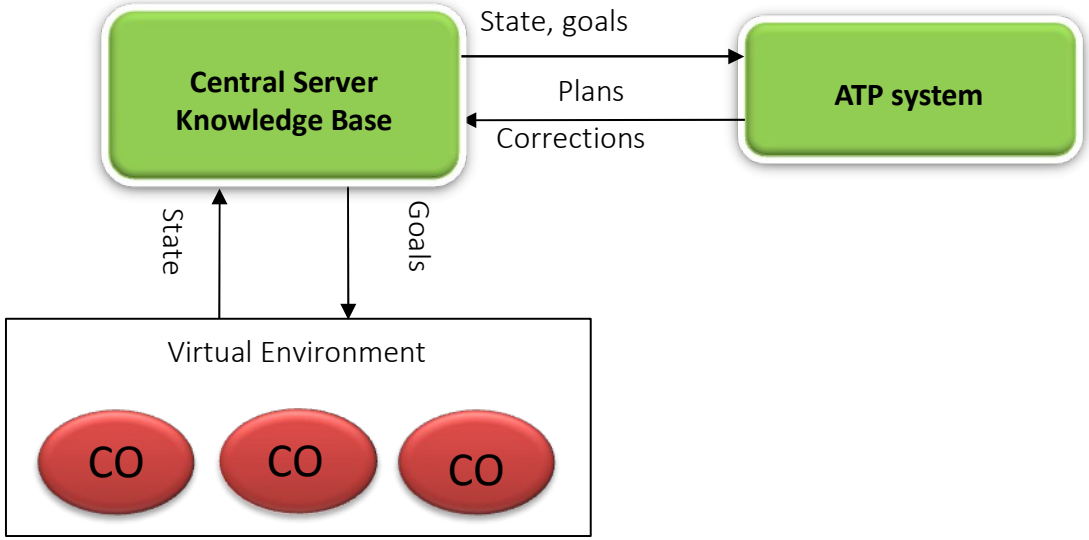
Two heuristic approaches to solve the real problem based on a Mixed Integer Linear Programming formulation has been developed. The best results in the competition of the Railway Application Section of the INFORMS Annual meeting 2012.



Mathematical model of the safe movement of trains is synthesized by analyzing the traffic patterns on multi-track territories of railways.

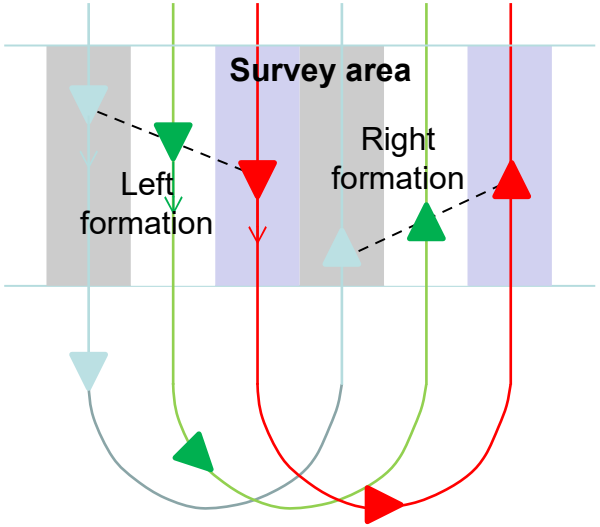
Control problem for a group of autonomous underwater vehicles

The developed methods and means of intellectualization of representation and processing of knowledge based on automated theorem proving in the calculus of positively constructed formulas (PCFs) which is used at the top level of centralized system of group control for the construction plans with the help of logic deductions on a specification of the goal from the specification of functional capabilities of the controlled objects considered as separate ones or those joined into a group. Real-time data from the objects going to the knowledge base and is accounted while designing the plans.



Discrete-event modeling is applied at different levels of AUV group control system. To study and synthesis of discrete-event systems, Lyapunov functions method is applied, as well as the original method of logical-algebraic equations. For example, for the problem of decentralized redistribution of AUVs over the water areas according to their priorities Lyapunov asymptotical stability is proved for the set of system states describing even distribution, which is as closed as possible to the proportional one.

Surveillance mission for Multi-AUV system



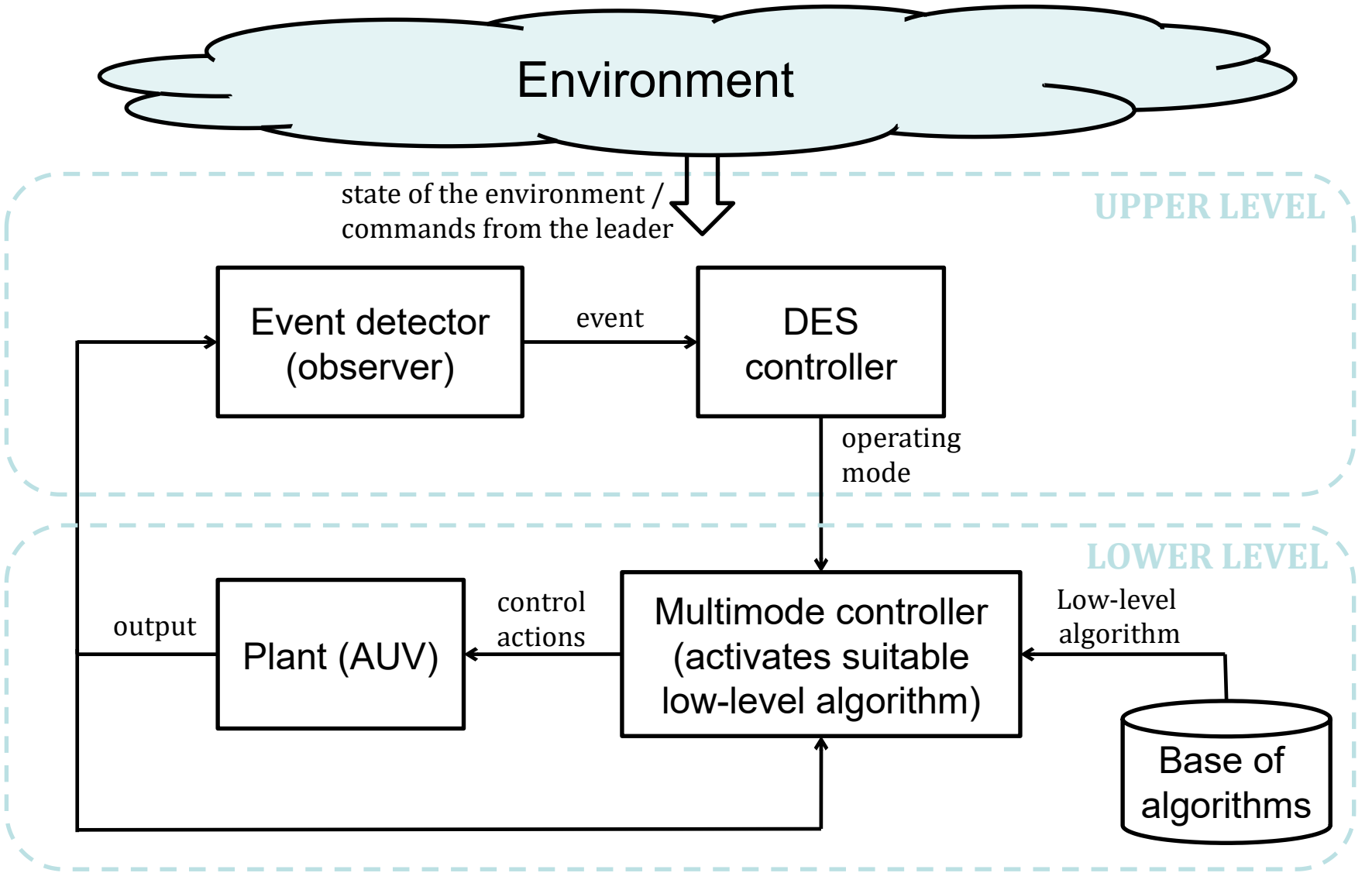
AUV group moves at a given depth along the trajectories generated by a human operator in the form of a lawn-mowing pattern that covers the area under survey and

1. **keeps a desired formation during working travel (when survey equipment is active);**
2. **avoids collisions with obstacles.**

Operation modes of the group (elementary behaviors)

I. **Formation-keeping mode (moving in the left or right formation),**
II. **Formation-gathering mode,**
III. **Obstacle avoidance mode,**
IV. **Programmed modes (*e.g.* for making U-turn).**

Hybrid control system



Simulation results

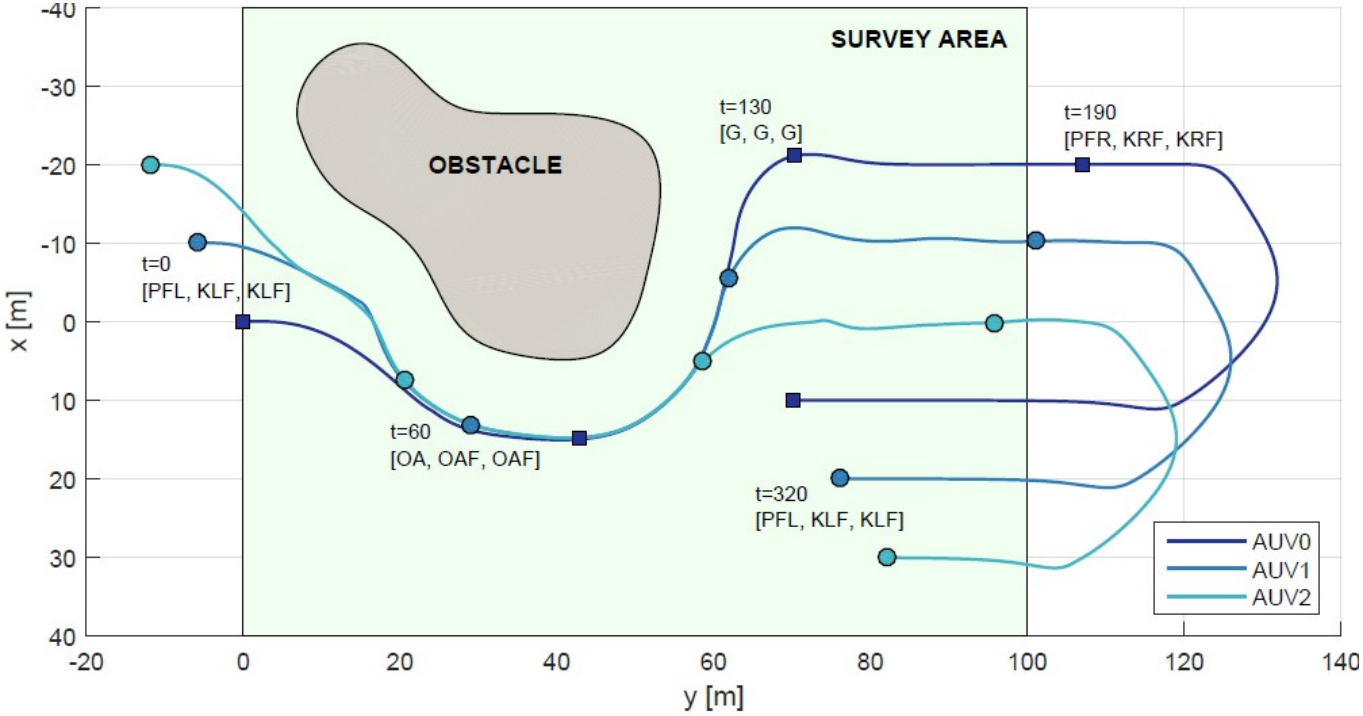
Model parameters

$m \approx 2200$ kg, $I_z \approx 2000\,\mathrm{kg}\cdot\mathrm{m}^2$;

control period (common for all AUVs in all modes) : $h = 0.2\,\mathrm{s}$

measurement (estimation) errors: distances - $0.2\,\mathrm{m}$; angles - $0.02\,\mathrm{rad}$

constraints on control force and torque: $\overline{F}_s = 320\,\mathrm{N}$, $\overline{G}_s = 160\,\mathrm{N}\cdot\mathrm{m}$

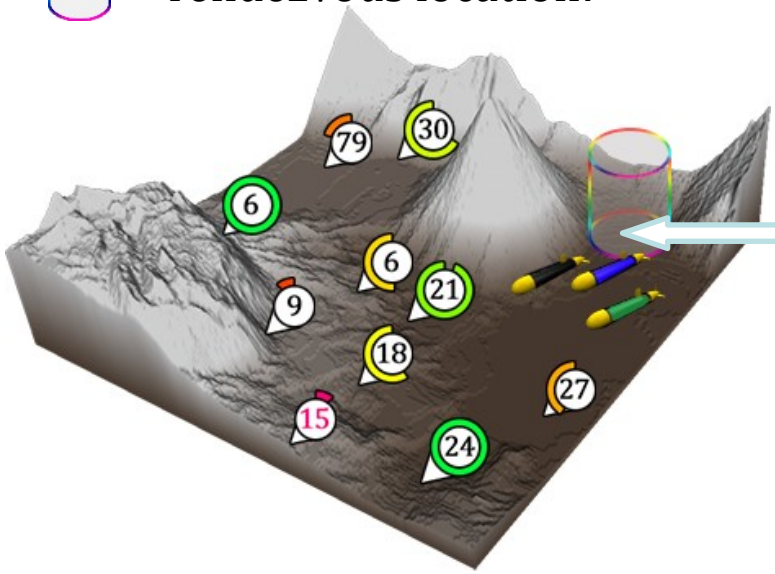


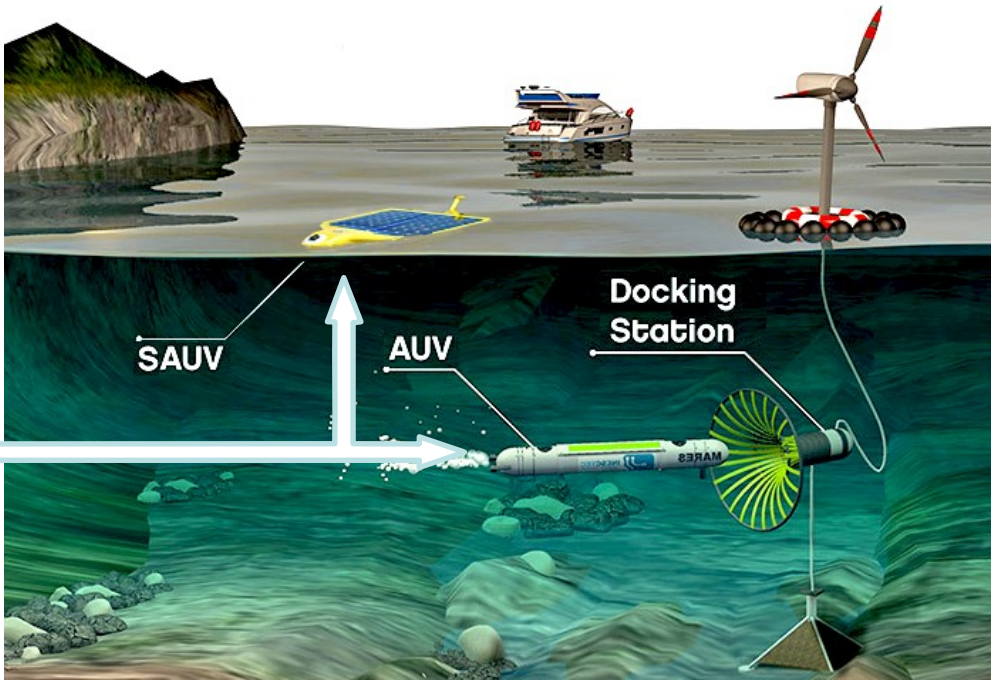
AUV Group Routing Under Continuous Rotation

- There is a big set of spatial points to be inspected (single-time or periodically);
- A group of vehicles is working to achieve well-timed inspection of all the points;
- Each vehicle in the group differs by its cruising speed and the battery capacity;
- Vehicles have to *recharge their batteries* periodically.

– mission points (locations).

– rendezvous location.

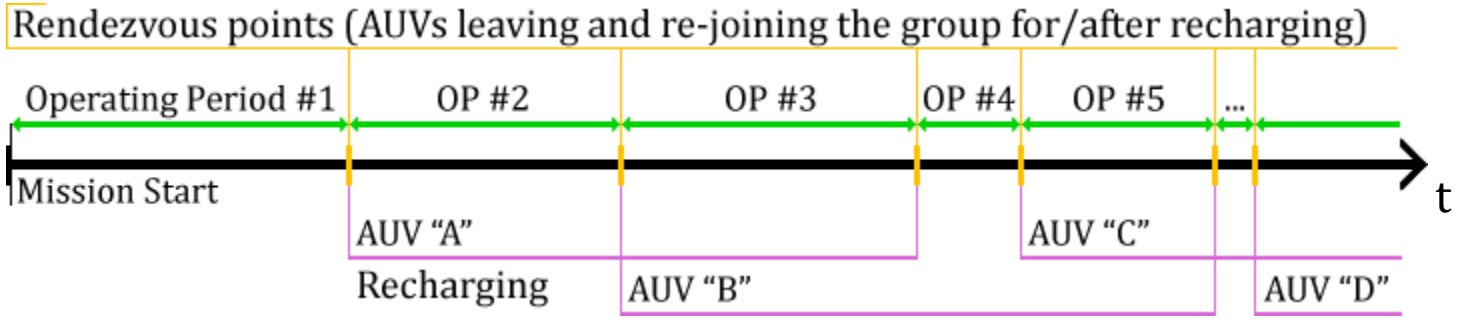




Two-level Control System

I. Upper-level mission planner: simple on-line mission decomposition to provide both regular communication sessions and computational load reduction.

II. Lower-level route planner: static group routing to handle graph search constraints and carry out the task assignment.



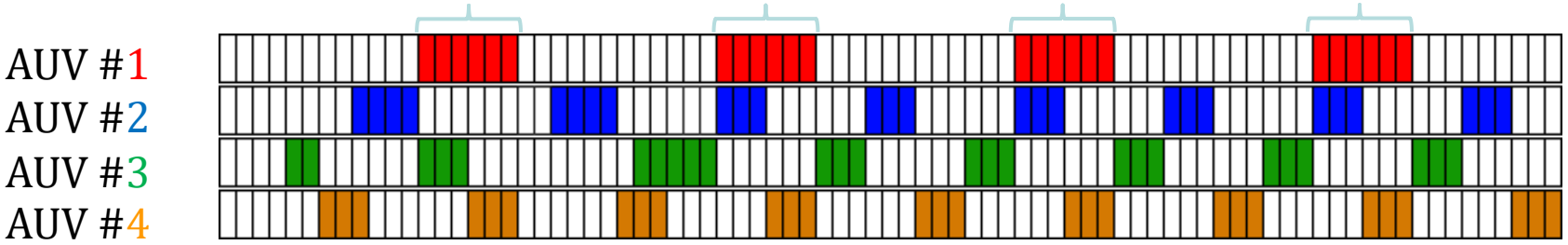
Each group of rendezvous includes

- Gathering all working AUVs (except currently charging) at the specified location;
- Establishing common information space;
- Updating mission conditions due to the both expected and unexpected changes;
- Actualization of the current group state;
- Adjustment of the current group strategy (replanning) if needed;
- Exchanging the best found solutions within the group (decentralization).

Upper-Level Dynamic Mission Planning

Matrix representation of the group rotation schedule:

Includes both traveling & charging time (*considering both AUV's speed and charging speed*)



– time segment: – vehicle is working; – vehicle is charging (or traveling).

The effectiveness of the group schedule is ensured by:

a. Keeping all vehicles in good working order (well-timed recharging);
b. Excluding simultaneous charging of big number of vehicles;
c. Excluding simultaneous charging of the fastest vehicles in the group;
d. Minimizing rendezvous' frequency where possible.

Genetic algorithm is a simple, fast and scalable approach allowing quick and effective re-planning.

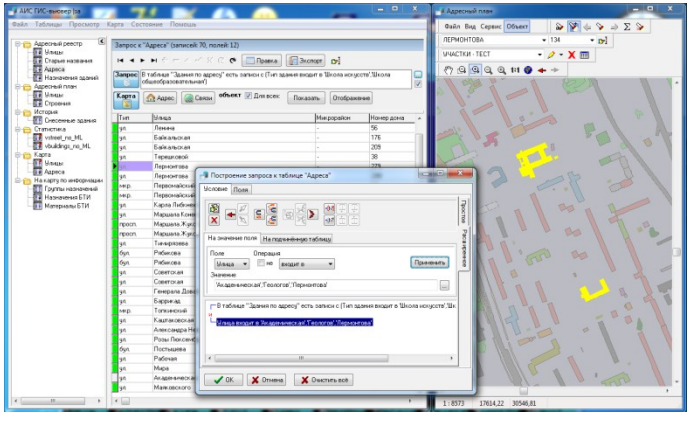
INFORMATION AND COMPUTING TECHNOLOGIES

Information and Computing Technologies developed by ISDCT SB RAS

- Geoinformation;
- Web;
- Cloud;
- Image analysis and processing;
- Processing unstructured data;
- Processing Big data;
- Solving the multi-criterial choice problems;
- Intelligent agents for distributed computing in the Internet;
- Synthesis of parallel programs for computer clusters;
- Intelligent processing of spatial data;
- Specifications for data processing automation and the synthesis of application systems;
- OLAP analysis;
- Intellectualigent software;
- Mathematical and information modeling.

Technology automating the development of information systems

- Automation technology and tool system for creating database applications with GIS functionality based on declaratives specifications:
  - Automated information systems for local governments;
- Methods for automating the development of applied information systems based on the Model Driven Architecture:
  - Expert Systems for technogenic and natural safety;
  - Population cancer register.
- GIS-technology:
  - Integration of database and GIS;
  - Creating geoportals to support interdisciplinary research;
  - Creating a municipal GIS;
  - Creating geodata services.



Matrosov Institute for System Dynamics and Control Theory
of Siberian Branch of Russian Academy of Sciences

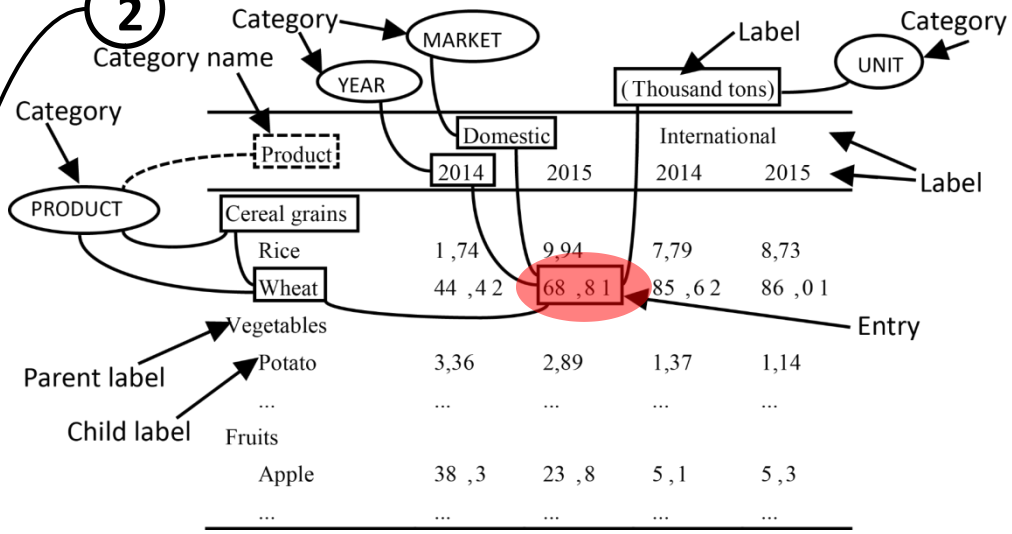
Information Technologies for Rule-Based Data Transformation from Arbitrary to Relational Form

1

(Thousand tons)

Product	Domestic		International	
	2014	2015	2014	2015
Cereal grains				
Rice	1,74	9,94	7,79	8,73
Wheat	44,42	68,81	85,62	86,01
Vegetables				
Potato	3,36	2,89	1,37	1,14
...	...	...	...	...
Fruits				
Apple	38,3	23,8	5,1	5,3
...	...	...	...	...

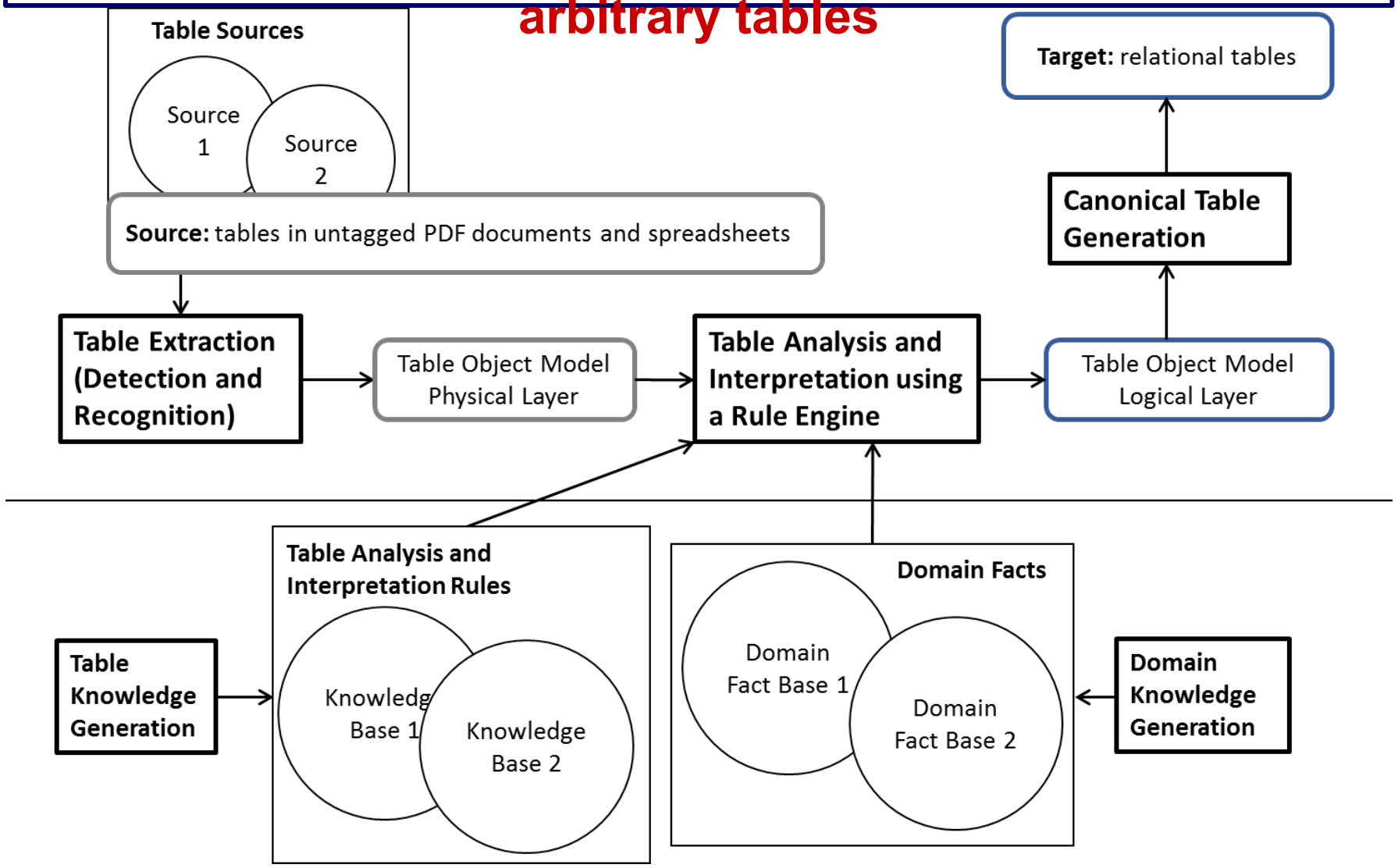
2



3

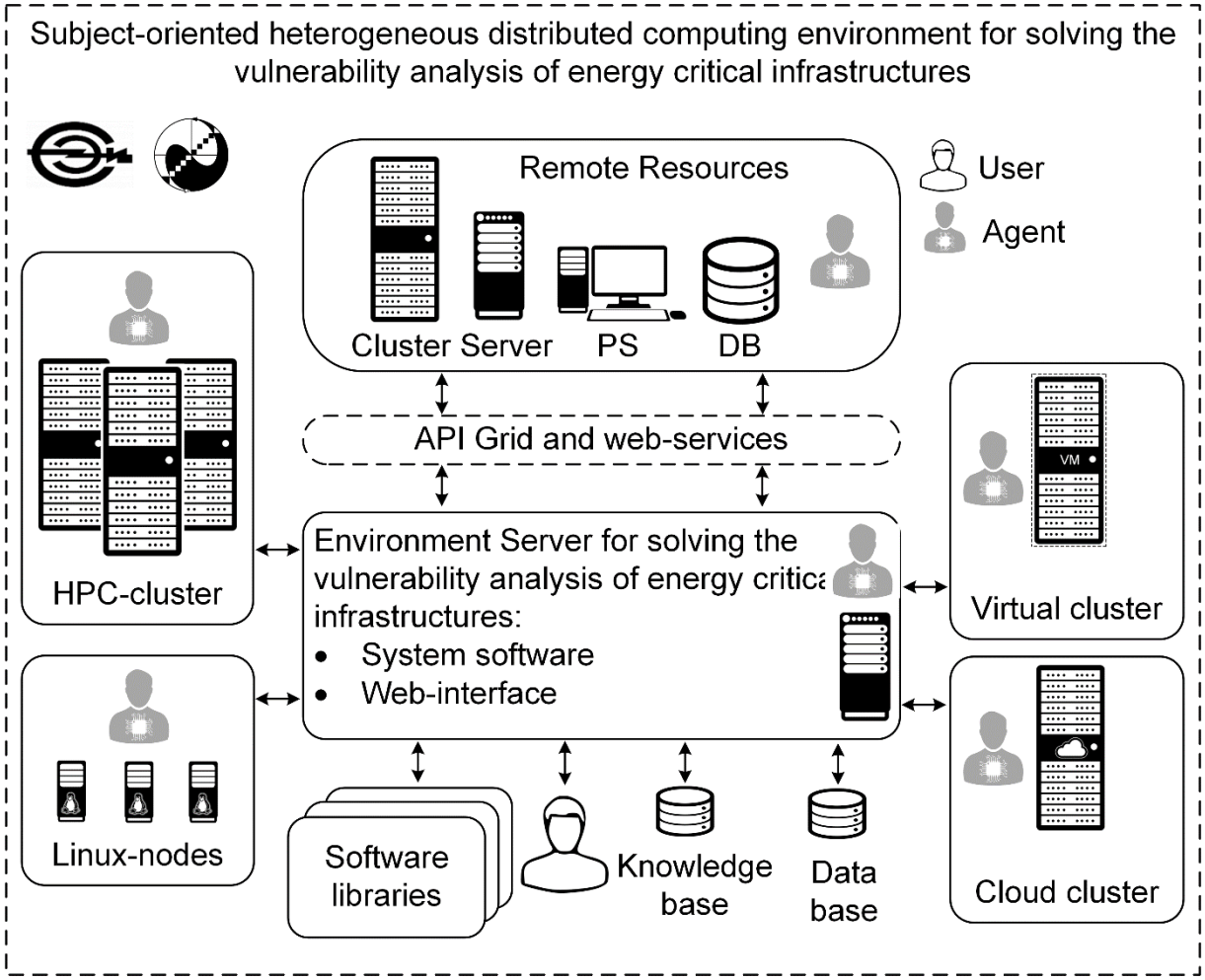
DATA	YEAR	MARKET	PRODUCT	UNIT
1,74	2014	Domestic	Cereal grains | Rice	Thousand tons
9,94	2015	Domestic	Cereal grains | Rice	Thousand tons
7,79	2014	International	Cereal grains | Rice	Thousand tons
8,73	2015	International	Cereal grains | Rice	Thousand tons
44,42	2014	Domestic	Cereal grains | Wheat	Thousand tons
68,81	2015	Domestic	Cereal grains | Wheat	Thousand tons
...	...	...	...	...
5,3	2015	International	Fruits | Apple	Thousand tons
...	...	...	...	...

Rule-based data transformation and extraction from arbitrary tables



Matrosov Institute for System Dynamics and Control Theory
of Siberian Branch of Russian Academy of Sciences

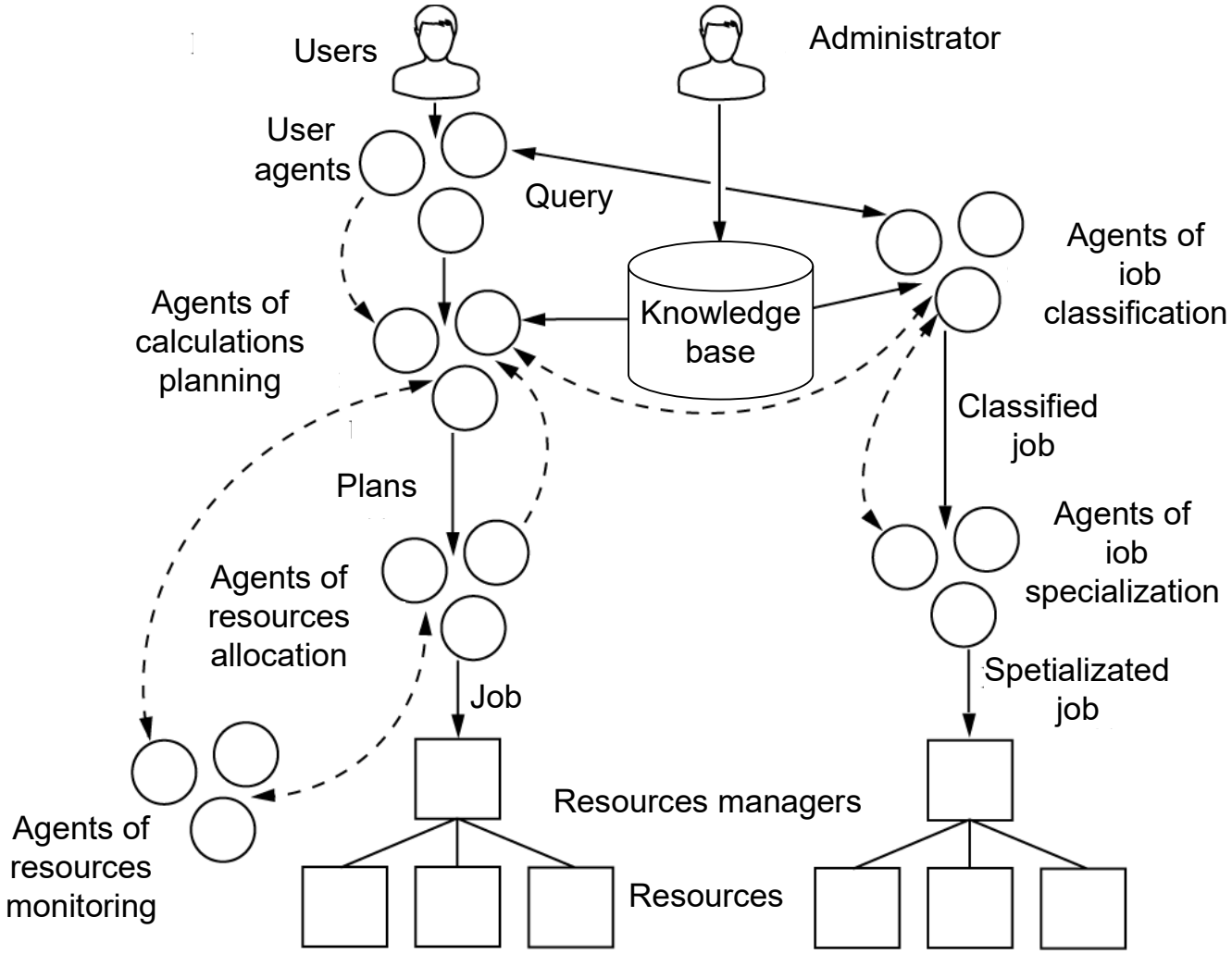
Technology of development and use of object-oriented computing environments



We propose a new technology of development and use of object-oriented heterogeneous distributed computing environments that integrate Grid and cloud computing.

We created the specialized environment for solving the important practical problems of the development direction study in the energy sector.

Multiagent Control of Distributed Computing



THE INTERNATIONAL COOPERATION

As of 2018 joint research and scientific events are conducted with scientific and educational organizations from nine countries:

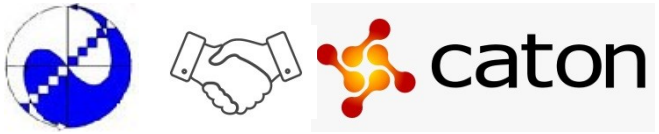
- Institute of Mathematics of Mongolian State University;
- Institute of Mathematics of the Academy of Sciences of the Czech Republic;
- Institute of National Development under the Administration of the President of Mongolia and the IAS;
- Institute of Mathematics of the University of Seville (Spain);
- University of Sagna (Italy);
- Institute of Automation of the Academy of Sciences of Heilongjiang Province of China;
- Pristina University in Kosovo Mitrovica (Serbia);
- School of Business of Mongolian State University;
- Institute of Geography and Geoecology of the Academy of Sciences of Mongolia;
- Mathematics Institute of the Srpsk Academy of Science and Intelligence (Belgrade, Serbia);
- Institute of Mathematics of the Vietnam Academy of Science and Technology;
- Centro de Investigacion Cientifica y de Educacion Superior de Ensenada (CICESE, Mexico);
- K.N. Toosi University of Technology (Islamic Republic of Iran).

Joint projects with the institutes of the National Academy of Sciences of Belarus, the Academy of Sciences of Mongolia, the Academy of Sciences of Vietnam.

- **Model of spatial data infrastructure of scientific institutions in Mongolia.**
- **Mathematical modeling and information technologies in the tasks of assessing and predicting the health of the population of the city of Ulan-Bator, depending on social, environmental and economic factors.**
- **Creation of a unified information and telecommunication network of scientific institutions in Mongolia.**
- **Simulation of atmospheric pollution in Ulan-Bator, depending on the emissions of industrial enterprises and vehicles, the creation of a software package based on GIS technologies.**
- **Design of highly specific low-molecular-weight inhibitors of tick-borne encephalitis virus replication using specialized computer infrastructure and screening of in vitro activity "(joint project with NAS of Belarus).**
- **Development of models, methods and algorithms for assessing the state of plant communities in the forest-steppe and steppe zones using space monitoring data (joint project with NAS of Ukraine).**

Сотрудничество с научно-исследовательскими организациями Китая

- An agreement was concluded with the Institute of Automation of the Academy of Sciences of Heilongjiang Province to exchange experience in the development of intelligent decision support systems at the municipal level.
- An agreement was concluded between ISDCT SB RAS, Northwestern Politechnical University of Marine Science and Technology and Caton Global Technology Co., Ltd. (Beijing, China) on joint research and development in underwater acoustics and optics, new technologies, models and algorithms, as well as specific devices for underwater robotics.



As a result of cooperation with Caton Global Technology Co., Ltd, a contract was signed for the development of software for the Satelite AIS system, which allows processing of satellite signals received by the satellite, including in case of overlapping them for the purposes of river shipping management. At the first stage of the project, algorithms for processing AIS signals and separating overlapping AIS signals were developed at the ISDCT SB RAS.

Infrastructure

«Irkutsk supercomputer Center of SB RAS»

http://hpc.icc.ru

«Irkutsk Supercomputer Center of SB RAS» (ISCC) carries out the development, support and providing the collective use of high-performance computing resources for HPC.

ISCC – one of the leading supercomputing centers of the Federal Agency for Scientific Organizations of Russia.

Users of the center: **>150** employees of scientific and educational institutions of Siberia and the Far East, which perform calculations in areas:

- nano-industry,
- bioinformatics,
- genomics,
- energy security,
- gamma-ray astronomy,
- plasma physics,
- cryptanalysis,
- the study of complex information systems

and many others

«Irkutsk supercomputer Center of SB RAS»

http://hpc.icc.ru

Computer cluster «Academician V.M. Matrosov»

Pos. #26
Ed. #16
TOP-50 C.I.S.


СУПЕРКОМПЬЮТЕРЫ
TOP50

Вычислительный кластер "Академик В.М.Матросов" на базе
процессоров AMD Opteron 6276 2.3ГГц и сети InfiniBand
Института динамики систем и теории управления
Сибирского отделения РАН
занимает позицию
№ 26
в рейтинге ***Top50*** самых мощных компьютеров СНГ с результатом
по производительности на тесте Linpack
25.12 Tflop/s
16-ая редакция рейтинга Top50 опубликована на Международной научной конференции
"Параллельные вычислительные технологии (ПАВТ) 2012"
27 марта 2012 года
Примите искренние поздравления от составителей Top50!

Воеводин Вл. В.
Научно-исследовательский вычислительный центр МГУ имени М.В.Ломоносова

Шабанов Б. М.
Межведомственный суперкомпьютерный центр РАН

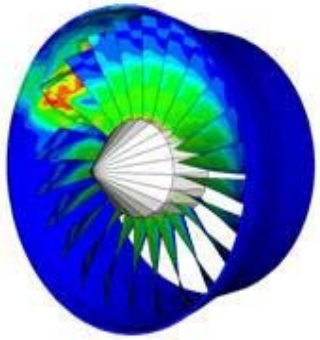
«Irkutsk supercomputer Center of SB RAS»

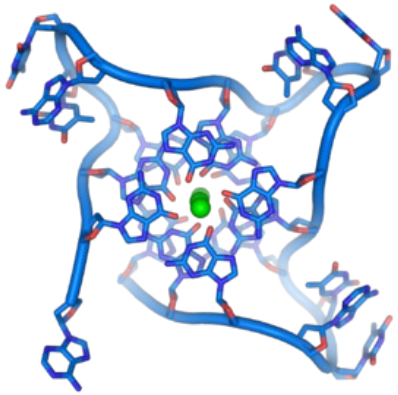
http://hpc.icc.ru

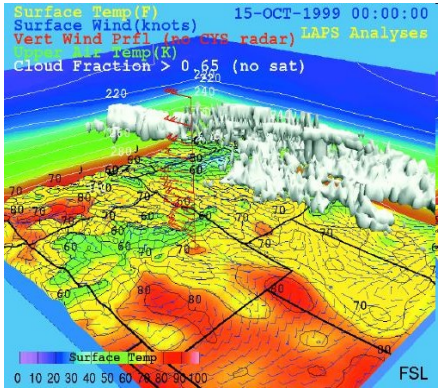
Possible areas for commercial use of high-performance computing resources of the Irkutsk Supercomputer Center:

- aircraft building and space
- motor industry
- power engineering
- metallurgy
- chemical industry
- pharmaceutics
- medicine
- exploration
- climate research
- traffic control
- environmental monitoring

etc.







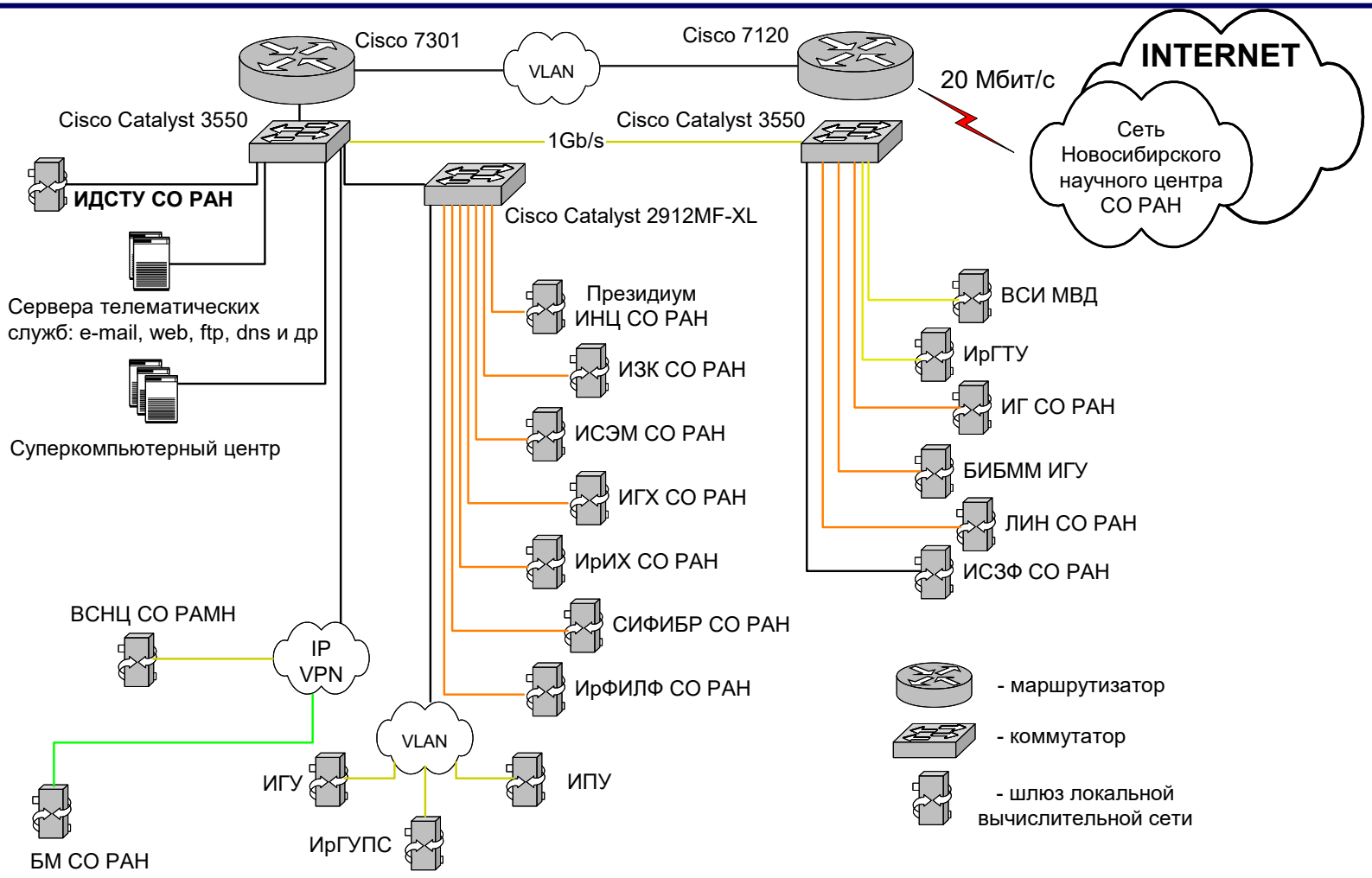
Shared Equipment Center of Integrated information and computing network of Irkutsk Research and Educational Complex

Within the frames of the Complex Project related to informatization of science and education, Irkutsk Scientific Center (SB of RAS) has created An Integrated Information-Computing Network of Irkutsk Scientific and Educational Complex (IICN IRNOK), which has the main line throughput up to 1Gb/s,

presumes the access to Global Networks and also to the regional nodes узел of access to СПД (SB of RAS). There also are nodes of access for the networks of the Buryat Republic Scientific Center (SB of RAS), for Chita State Unioversity and for the ChIPREK (SB of RAS) (S.N.Vassilyev, I.V.Bychkov). IRNOK has an access to the Super-Computer Center.

Our Institute (ISDCT, SB of RAS) – within the frames of the Program titled «Information-Telecommunication Resources of SB of RAS» -- is involved in coordination of development of the inter-institute corporative telephone network intended for the institutes of Irkutsk Scientific Center (ISC) and in development of IP-telephoning. The Institute organized the transition of the telephone networks to standard of Avaya Definity presuming active application of the VoIP-technology. The Institute has organized the VoIP-switching the ISC telephone system to the Russian (Novosibirsk, Yakutsk, Tumen) and to international telephone lines.

Scheme of integrated information and computer network IRNOK



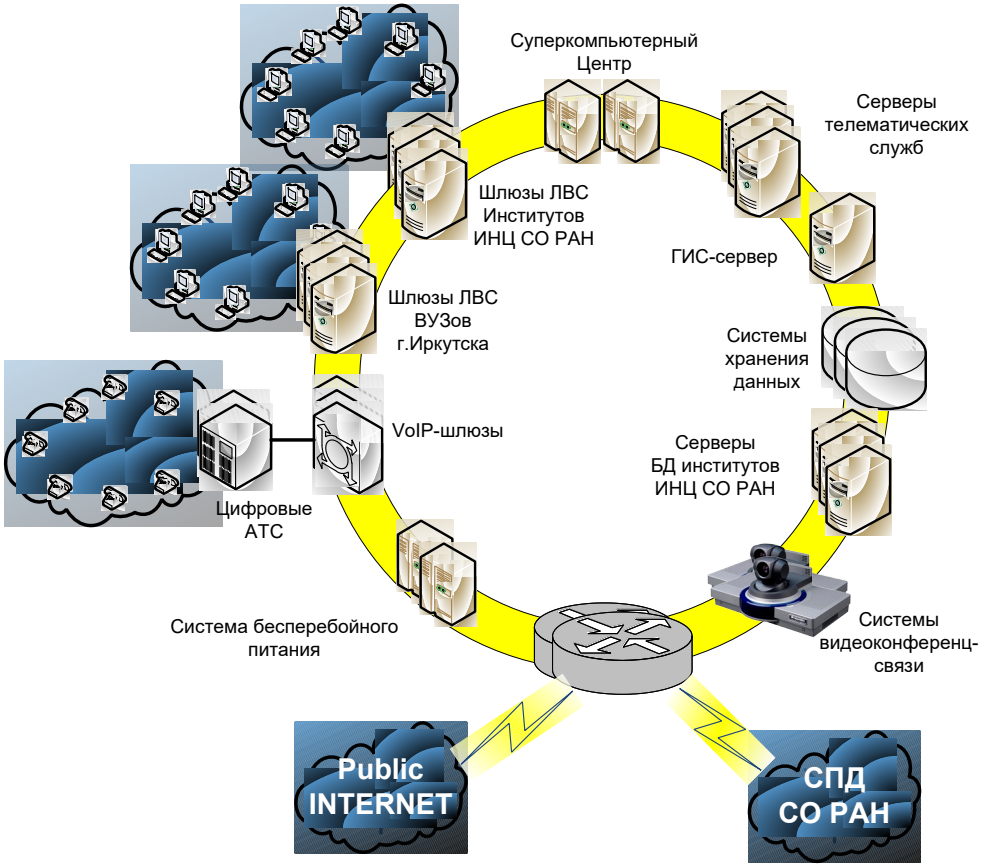
Одномодовая волоконно-оптическая линия связи (ВОЛС)

Многомодовая ВОЛС, 100 Мбит/сек.)

Витая пара UTP cat. 5, 100 Мбит/сек.

Медная пара ADSL, 8 Мбит/сек.

Irkutsk regional data center (data storage and processing center) and scientific infrastructure of spatial data ISC SB RAS to support interdisciplinary research



Integration and development of an integrated information network IRNOK, centralized storage systems, uninterrupted power supply to the central node IIVS, computing cluster of HPC systems, the unique information resources related to the research of Lake Baikal and the Baikal natural territory.