Georgian Technical University

Trends in Georgian Engineering Developments

Scientific activity in Georgia

Georgia is the country where reserchers traditionally and successfully were and are dealt with the problems belonged to different scientific fields. Among these scientific fields it is necessary to emphasize research activity in various engineering spheres, where the authority of scientists and appropriate research entities of our country are unshakably high for the modern scientific world.

At the present stage in the country are developing such important engineering fields of activity, as - information technologies, cybernetics and automatic systems, metallurgy and chemical technologies, nano technologies, biotechnology, machine building, aeronautics and astronautics, civil engineering and architect, communications, power engineering, transport, mining and geology, etc.

It is necessary to emphasize that engineering activity in the country basically is concentrated at Georgian Technical University, where beside of researchers from different departments, 14 scientific institutes and 51 centers of science are successfully performing various engineering activity.

Below, on the following slides are depicted some significant works done by the reserchers from the university.

MUSKHELISHVILI INSTITUTE OF COMPUTATIONAL MATHEMATICS

BASIC FIELDS OF RESEARCHES

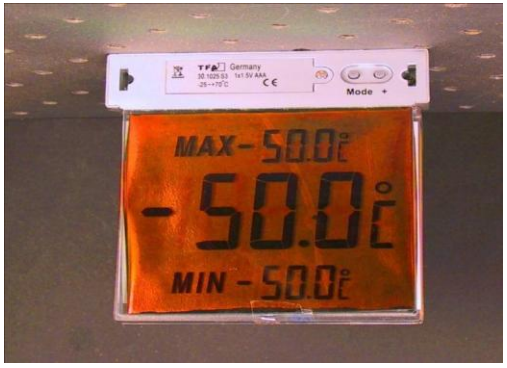
- Programming and Information Technology
- Computational Methods
- Fundamental and Applied Problems of Probability Theory and Mathematical statistics
- Functional Analysis
- Coding Theory
- Game Theory
- Operation Research
- Numerical Methods of Optimization Theory
- Approximation Theory

V.Chavchanidze Institute of Cybernetics

The main scientific activity of the institute is encompassed the following directions-

- ***Mathematical Cybernetics;***
- ***Stochastic Analysis and Mathematical Simulation;***
- ***Applied Pattern Recognition Systems ;***
- ***Coherent and Quantum Optics;***
- ***Optically controlled Anisotropic Systems;***
- ***Bio cybernetic Systems;***
- ***Computer Engineering Elements and Nano materials.***

The device for measurement of statistical characteristics of electromagnetic waves distributed in random environment



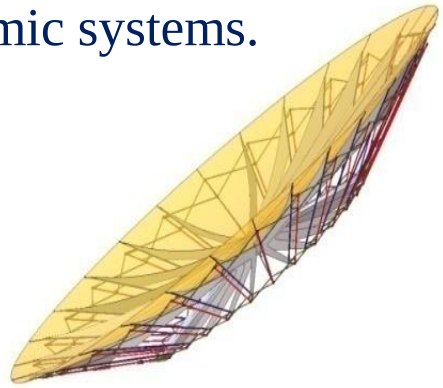
Liquid cristal display needing no internal illumination

Lazer canceroscop for cencer diagnoses

Institute of constructions, special systems and engineering provision

The main research area of the institute concerns to design and realization of orbital and earth engineering complexes and means of cosmic systems.

One of the remarkable work done by the institute is creation of original scheme of unfolding space reflector with new type of actuators. Besides, design and build up of pilot samples of reusable rapidly assembled steel bridges in extreme situations are successfully performed. The constructions developed at the institute are based on using the theory of transformable engineering systems.



New scheme of Unfolding space reflector

Reusable rapidly constructed steel bridge

Unfolding single-span reusable bridge (L = 48 m)

Water Management Institute (WMI)

Main fields of activity of the Institute

- Development of methods ensuring safety of water management of hydro melioration units and environment;
- Study of natural disasters and elaborations of recommendations to prevent them;
- Assessment of water resources and exploitation of hydro technical constructions;

For modeling of mudflow and erosional processes and soil mechanics the Institute possesses with different laboratories.

www. gwmi.ge

Institute of hydrogeology and engineering geology

The institute is engaged in fulfillment of following scientific works:

- Investigations of underground waters as resources of drinking water supply and distribution;
- Hydrogeology and hydro geochemistry of mineral waters deposits;
- Estimation and prediction of risk-factors of geodynamic processes;
- Elaboration of new technologies for extraction of precious and rare metals from mining industry wastes;

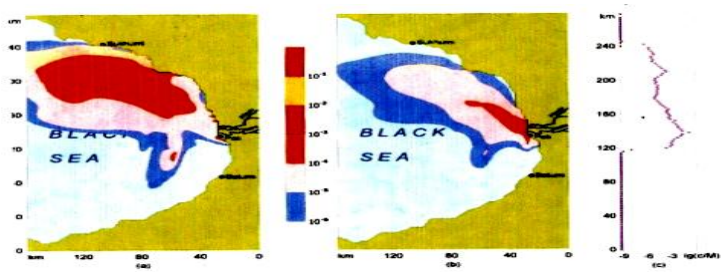
Laboratory of soil mechanics

Utsera mineral water source

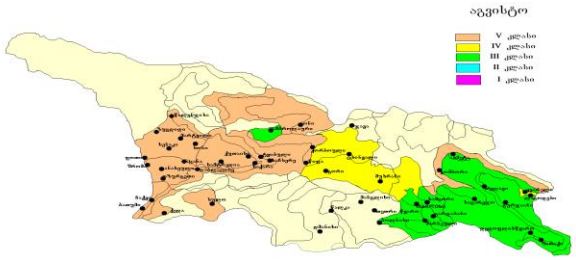
Institute of Hydrometeorology

Basic fields of research activities

- Creation of data bases of hydro meteorological states of Georgian regions.
- Forecast of ecological consequences of accidental oil spill in sea waters
- The flood risk assessment and integrated management in Georgian river basings.
- Petrol deparafinization and minimization of harmful substances by use of Georgian natural resource-clinoptilolite.



Dynamic model of spreading of accidental oil spill brought out by R.Rioni to the sea surface



Zoning of the territory of Georgia according to intensity of droughts (July, August)

The flood risk assessment and integrated management

Engineering Institute of Membrane Technologies

Major directions of scientific-research and test-and-design works:

- Food production - purification-clearification, concentration, cold sterilization and stabilization of wine, beer, juices and other liquids;
- Municipal engineering - running water purification and water supply;
- Pharmaceutical industry - purification, concentration and sterilization of biologically active water solutions for preparation of different medicines;
- Medicine - filtration and sterilization of water and dialysis solution for artificial kidney unit.

Scientific production association – “Analytical Instruments”

“Analytical Instruments” is engaged with project development, design and manufacturing of different analytical instrumentations and automated information-measurement systems.

At the moment, in terms of scientific elaborations institute manufacturing the folowing devices:

- Conductivity meter CEL-1M2 for measuring the specific electrical conductivity of any solutions;
- Apparatus for local renal hypothermia. Would be used in surgical urology;
- Ion meter for measuring of different ions of oxidation-reduction potentials in various solutions;
- PH –meter for measurements of hydrogen ions and oxidation-reduction potentials in water solutions Would be used in field conditions.

PH –meter

Republican center of structural researches

The major scientific activity of the center was and is concerned to fundamental researches of structural-phase conversion of condensed environment, to creation of new scientific methods of research and new technologies (including nano-technologies) scientific grounds for production of new constructional and fundamental purpose materials and items needed for contemporary technique.

Republican center of structural researches

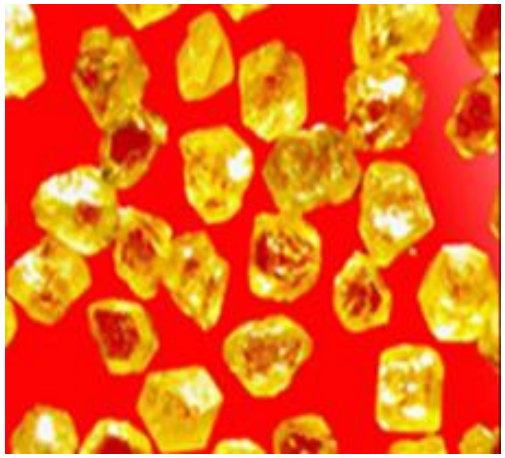
On contemporary stage the center performs the following scientific and applied works:

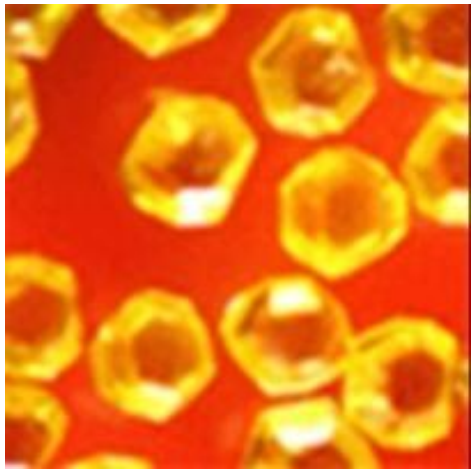
1. Creation of nano-crystalline scintillation materials, powders and solid samples;
2. Nano-crystalline hard alloys and billets cutting tools, wear-resistant machine parts and plates of bullet-proof vests.
3. Technology development of nano-crystalline composite materials production.

Scientific center of diamonds and composite materials

Actual scientific-research works:

The major scientific activity of the center is development of new innovation technologies for diamond synthesis by the spontaneous crystallization method in the high pressure and high temperature conditions.



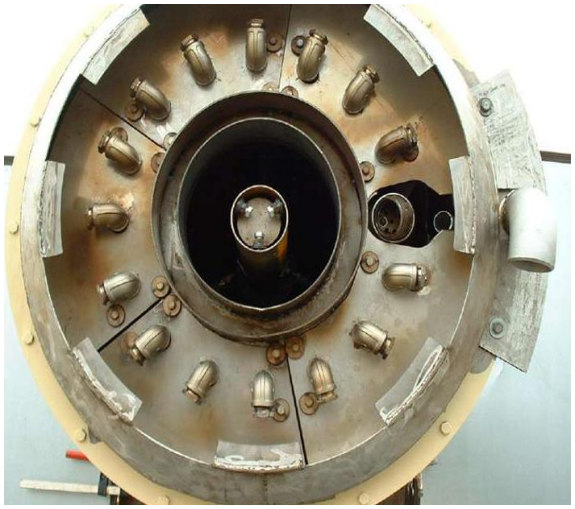


Scientific-educational laboratory of high temperature thermo-energy plants

Elaboration of heat-power device working on low quality fine fractional local coal.

At the laboratory new technology of burning of low quality coal in boiled layers has been elaborated, which implies burning of solid fuel by usage of vibro-boiling process without preliminary treatment of fuel. The technology allows to use all kinds of low quality solid fuel with ecological demands taking in account.

Vibro-boiling process



The burner for industrial means with 10 megawatt output power.

Educational-Scientific Laboratory of High-Temperature Thermal Power Engineering Devices.

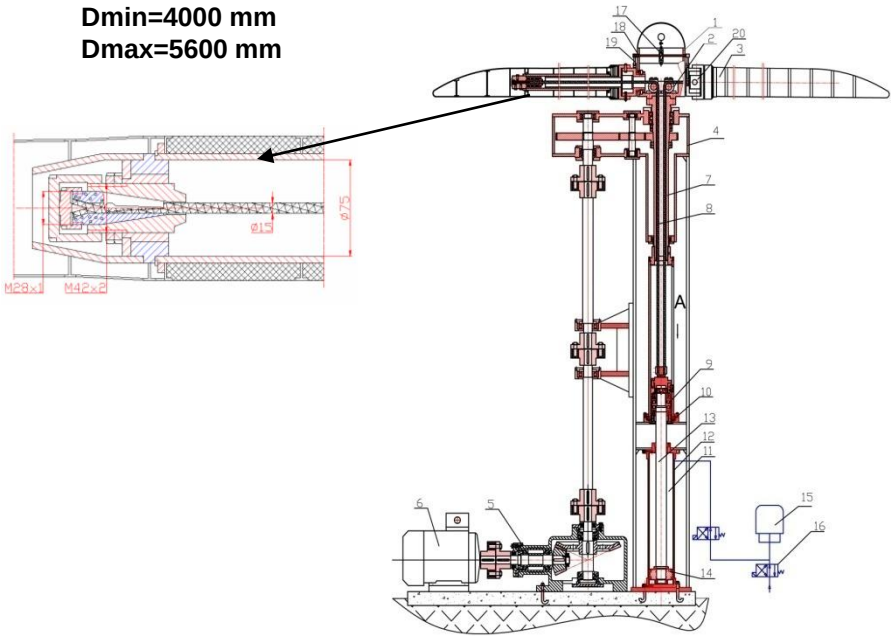
Dust-collecting filter

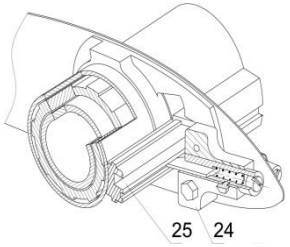
The laboratory has developed a new construction dust-catching filter for asphalt-concrete plants for filtering of inert materials heating furnace exhaust with filtration coefficient of 0.995.

Transport and mechanical engineering faculty

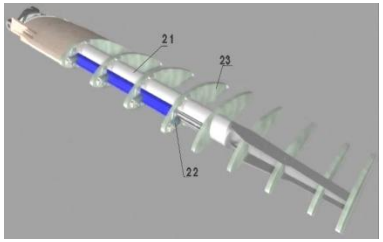
Variable-Diameter rotor with centrifugal forces compensation mechanism

Dmin=4000 mm
Dmax=5600 mm





Blade movable part with the blade twist change mechanism



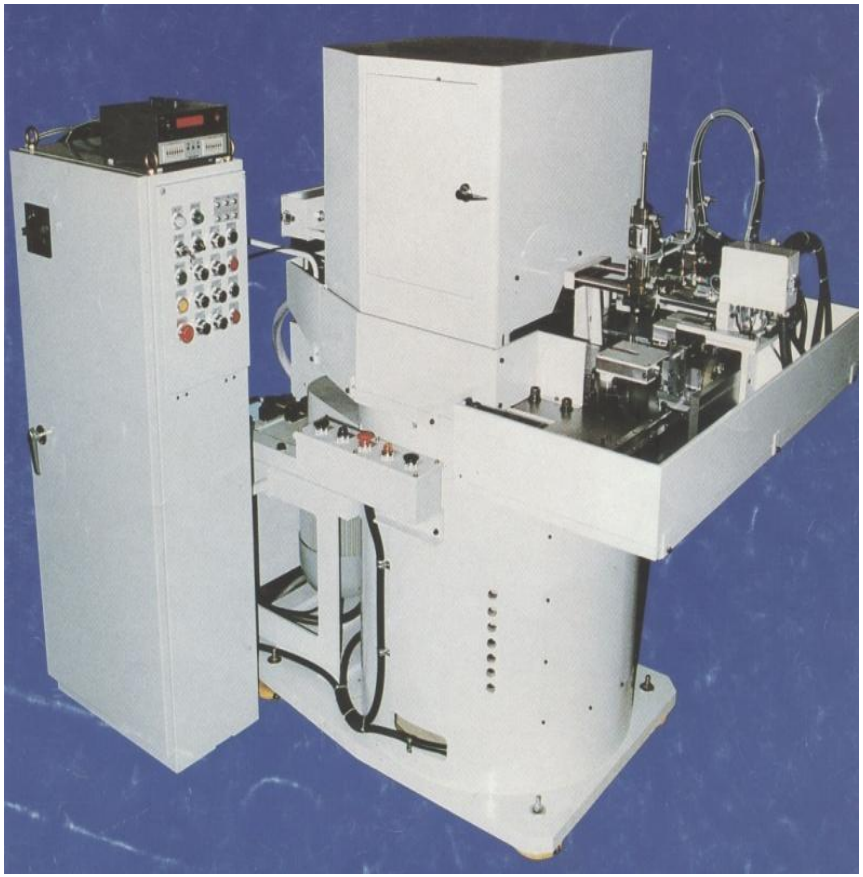
The researches have are mainly devoted to the creation of prop-rotor with variable geometry, which is intended to be mounted on aircrafts with vertical take-off. The design is made in cooperation with BOEING company.

The scheme has been approved and registered by the European Patent Office

Transport and mechanical engineering faculty

Technology of fine treatment of super hard and brittle hard treated nonmetallic materials

At the department of machine building, the technology of fine treatment of super-hard and brittle hard-treated nonmetallic materials have been developed, the patent of which in the second part of the eighties was sold to Germany and Japan. On the basis of this technology at contemporary stage is being developed in cooperation with the James Morris Liverpool Technological University.



Fine grinding machine

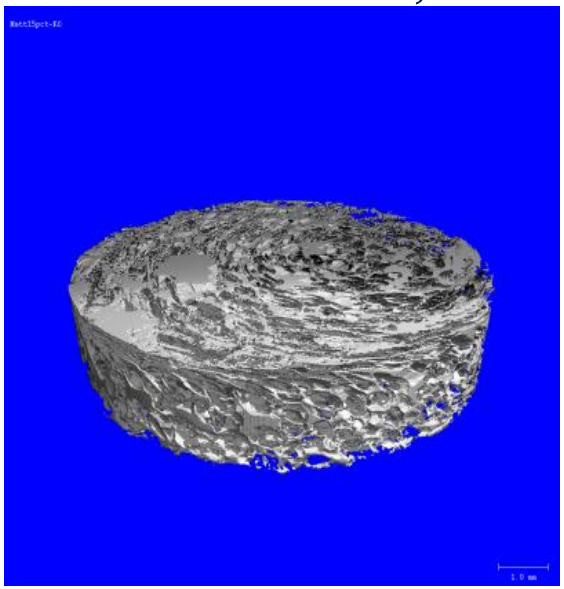
Center of fiber reinforced composite materials

By using of corrosion-resistant fiber-glass and locally manufactured basalt fiber as concrete reinforcement element an original technology is worked out, which is used for production of elements of building constructions, ornamental elements of exterior facade and interior of buildings, parts of drainage and sewerage system.

Research Center for medical polymers and biomaterials

In the centre wound dressing (artificial skin) “PhagoBioDerm” has been elaborated. It is composed on the basis of original biodegradable polymer and contains a complex of bacteriophages and other bactericides, as well as pain killer and enzymes. “PhagoBioDerm” shows a high bactericidal and anti-inflammatory activity.

Another achievement of the center is production of medical bactericidal glue GF-6 (spray). Represents a solution of original biodegradable polymer in ethanol. Contains silver sulfadiazine and other powerful bactericides. Very effective for both in-patient and out-patient treatments of burns, infected wounds, etc.



Faculty of chemical technologies and metallurgy

Technology of synthesis of paints, pigments and artistic enamels is developed on the basis of using strong structure acceptor minerals.

Faculty of chemical technologies and metallurgy

One of the main scientific field of activity of the faculty is improvement of manganese ore dressing process. By the scientists of faculty have been developed, as high (P-0,35%) as well low (P-0,20%) phosphoric silicon manganese's (Mn 75%) production technology.

The basis of mentioned technologies is the special-product, which represents mixture of rust of such elements as - manganese, siliceous, calcium, magnesium, iron, phosphorus and others, which as an additive mixing with batch.

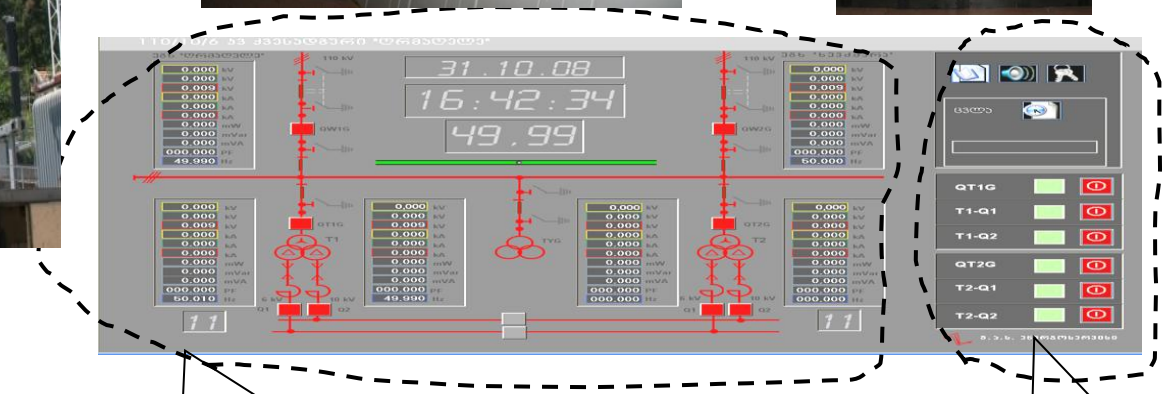
The mentioned technology is supported with two sold patents P 3370 and P 3841. Received product is widely used in metallurgical manufacture.

Faculty of informatics and control systems

Main activity of researchers that working in the fields of control systems and informatics are pointed at creation of control systems for different engineering objects and composition of software for different purpose.

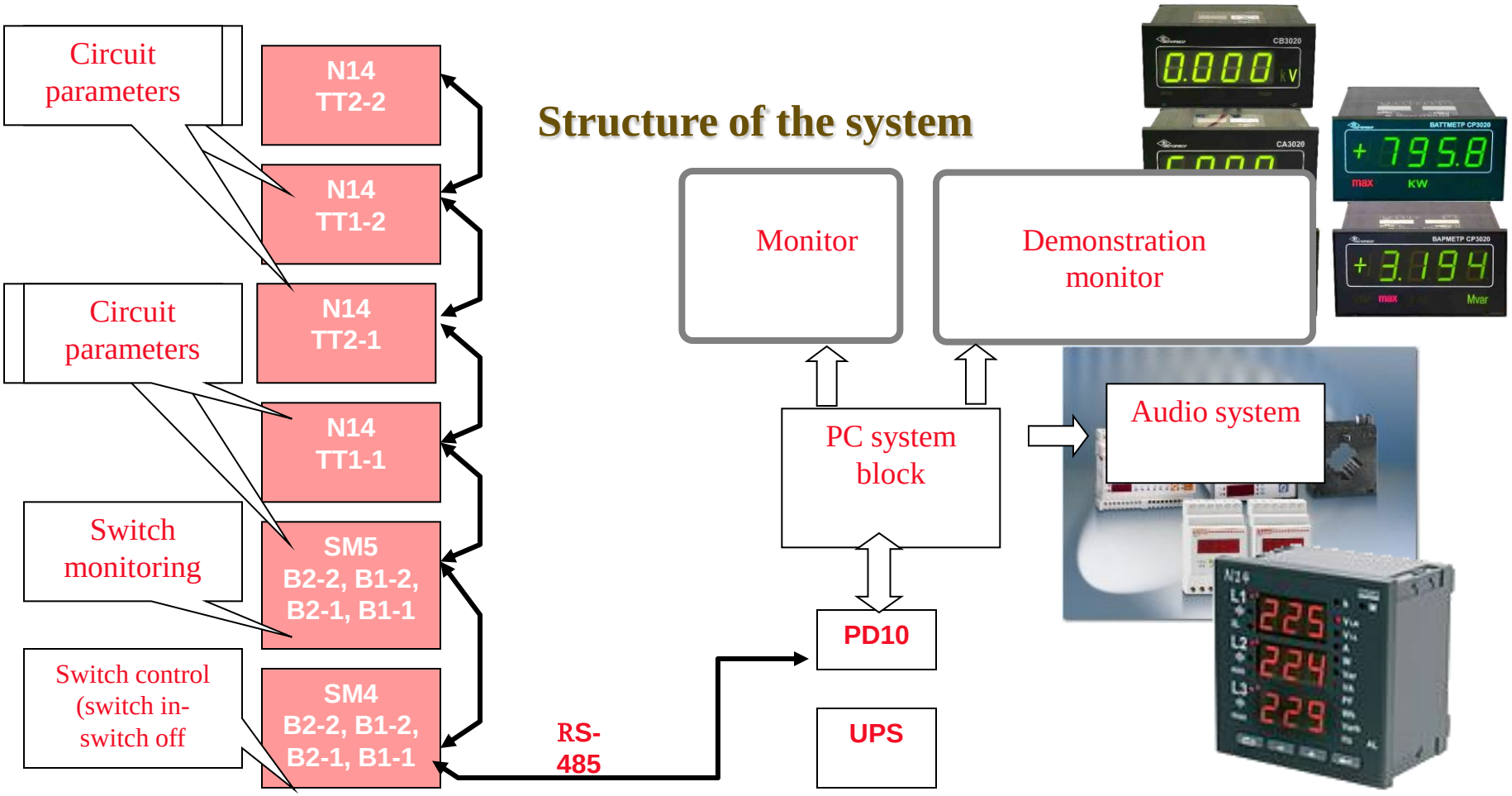
System of control of electric parameters of high voltage substations

The system provides measurement, monitoring and optimization of output electric parameters of high voltage substations, passing feeder computer control of switches and other electric means.



Faculty of informatics and control systems

Monitoring of power supply system for enterprises



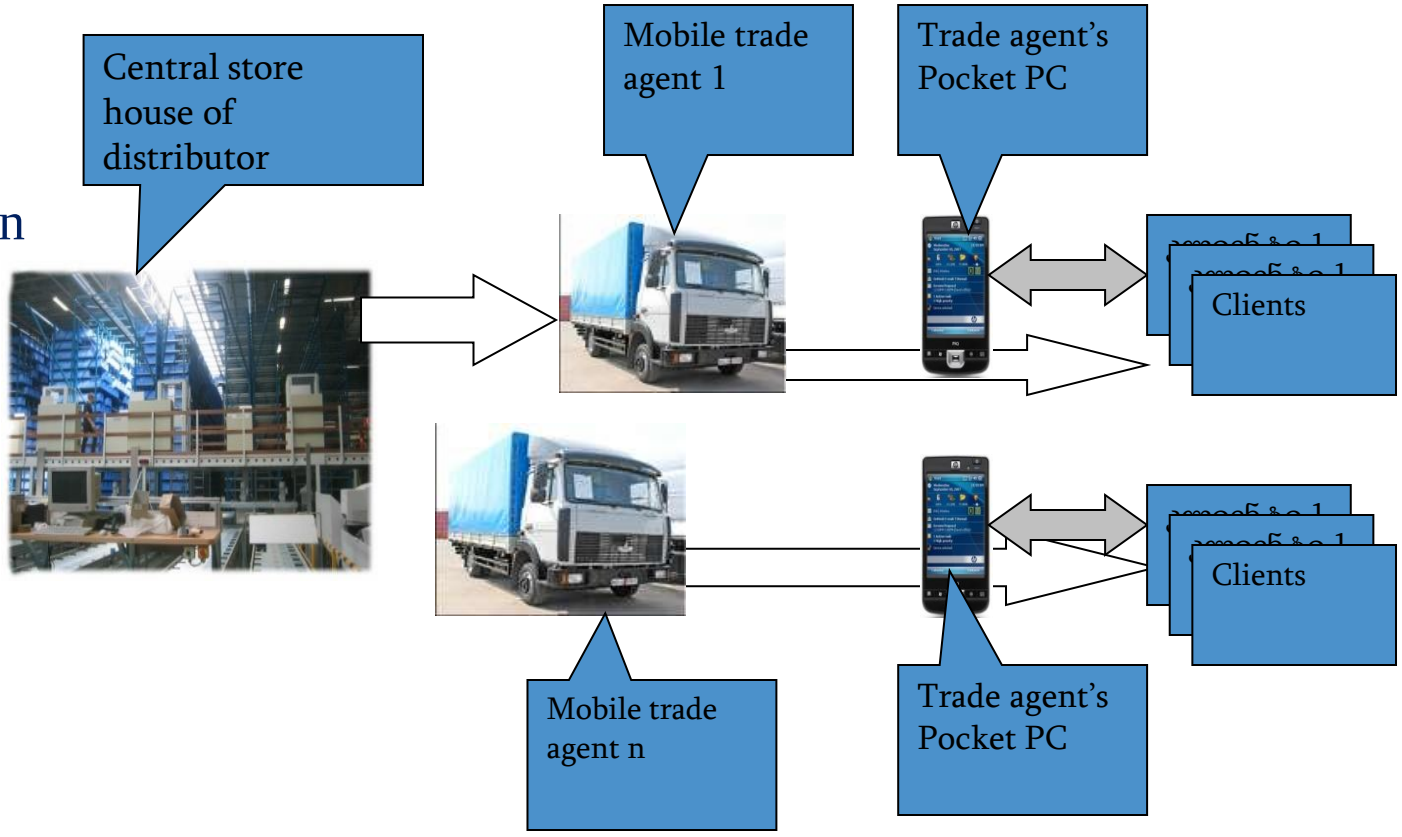
Faculty of informatics and control systems

Computer-aided system of distribution

The created system significantly increases the accuracy of accounting and decreases time of balance making. Pocket PC interface is in Georgian.

In 2007-2009 was implemented at several distribution companies

Consumers: distribution companies

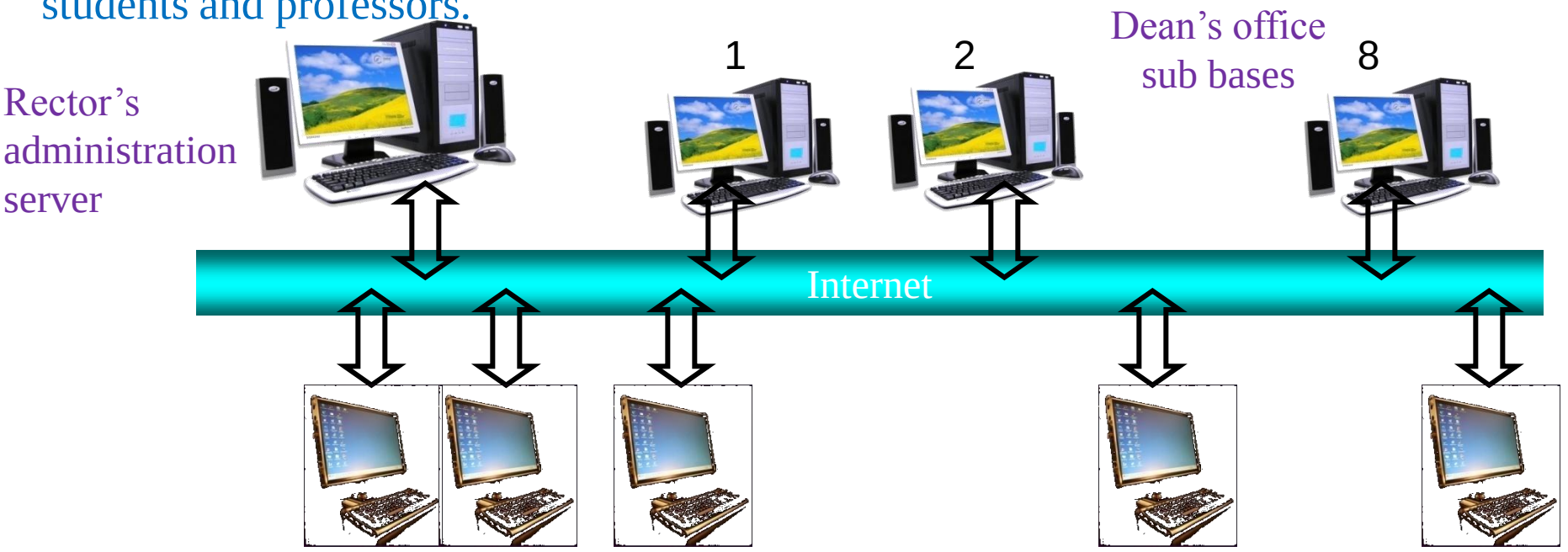


Faculty of informatics and control systems

Training process control systems at higher educational institutions

Function

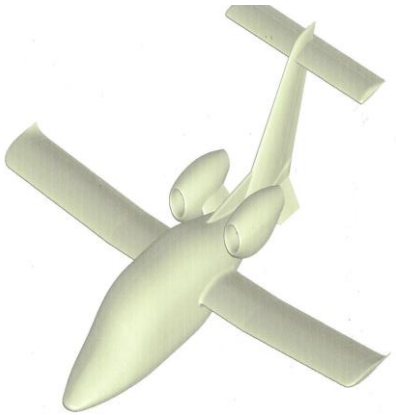
Weekly evaluation of students; monitoring of educational process management by training course leading professors; provision of students evaluation transparency; students evaluation according planned schedule for information of students and professors.

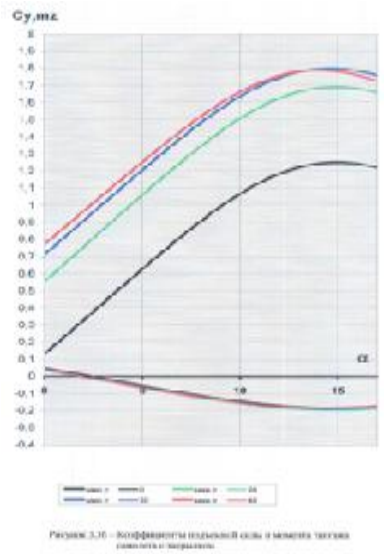


Scientific Engineering Center of Simulation and Control Systems

The research works done at the center

- Mathematical model and corresponding algorithm for calculations have been elaborated. which allowed to determine the wings profile of aircraft with maximum bearing strength and minimum resistance force coefficients.





- The problem of soft landing of aircraft had been solved. As the result had been find the moment of engine cut off, when aircraft will make smooth landing at the given place. Mathematical model has been created and the problem has been solved for pilotless aircraft.

- Constriction of adaptive wing with the variable camber tail part.

Faculty of informatics and control systems
Medical Technique and Technology Department

Resarchers of department are egaged in following scintific elaborations:

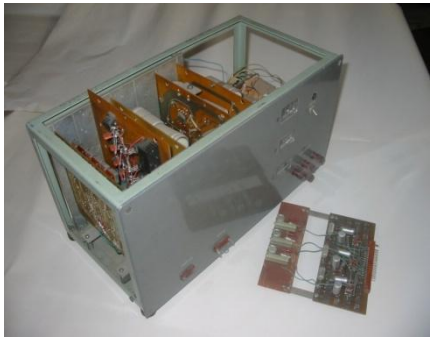
- Computer-Controlled System For Diagnosis of Vision Field

The system is elaborated for automatic control of the parameters of the field of eye vision.

The system consists the following basic modules:

- Perimeters Hemisphere;
- Module of control of the representation of stimulus;
- Module of the control of the patient's gaze;
- The diagnostic module.

The System allows to transfer the data of measurements to the patients centralized database.



- System for Compensation of Geomagnetic Storms

Control unit of magnetic storms compensation systems based on determination of constant component of geomagnetic field (GMF) is created.

The method enables to detect variations of constant component of magnetic field inside active volume caused by variation of ferromagnetic masses.

Faculty of informatics and control systems

Department of Physics

Lab of solid body physics

The laboratory is engaged in production of thin films of rare earth elements compounds and their complex research. Thin films of 15 new compounds have been received. Their electro-physical, galvano-magnetic, luminescence, optical properties are studied, parameters of zonal structures are calculated, the areas of their practical application are determined. At present the laboratory works on production of thin films of samarium, iterbium and disprozium sulphides and antimonids.

The samples of thin films of rare earth elements compounds

Original device for studying magnetic resistance and Hall effect.

Faculty of informatics and control systems

Department of Physics

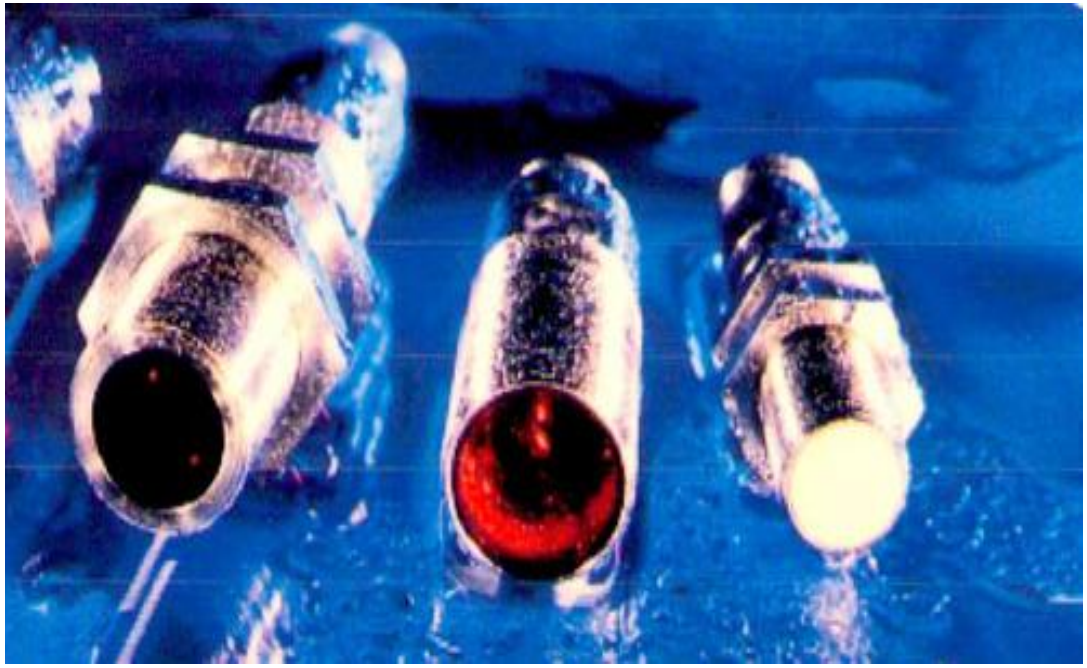
One of the main scientific field of activity of the department is:

Creation of novel sensors for nuclear radiation measurements

Devices are elaborated on the basis of :

- ❖ Semiconductor based materials for optical sensors;
- ❖ Radiation sensors elements based on A4, A3B5 and rare earth semiconductors.

Are elaborated new scheme of optical spectrum nanosensors for detection virus infections. Both devices are assigned for environmental monitoring .

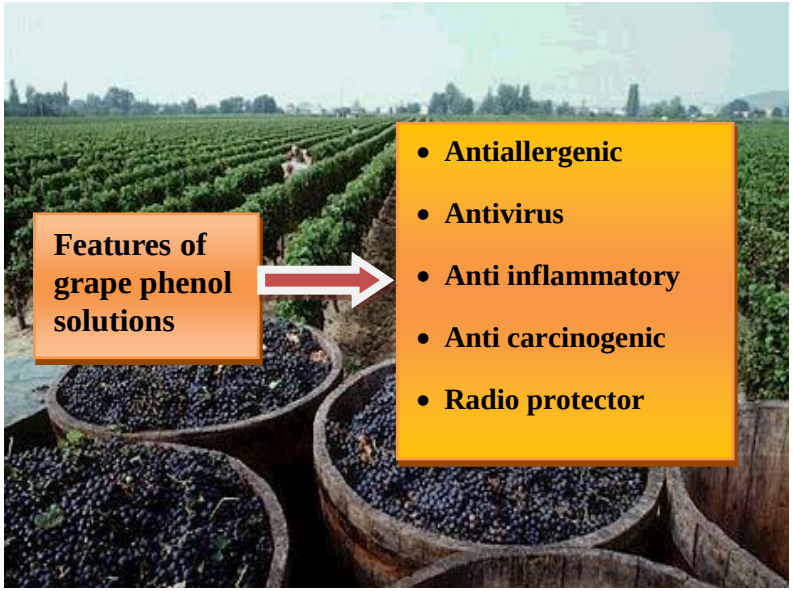


These smart sensors are intended to mount in different organizations as schools, universities, hospitals as well in various populous places.

Institute of food production

Scientists of institute work on generation new technologies used in food industry. Among diversity of researches done by institute can be allocated:

Vine industry. New technology of grapes processing is developed, which provides significant improvement of wine quality received from local grapes sorts and at the same time production of natural food dyes as a concomitant product;



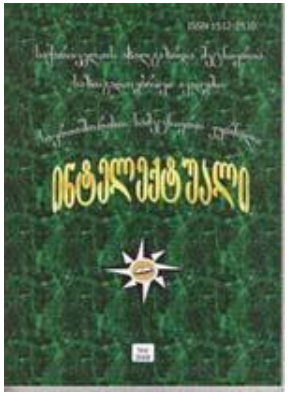
Pectin production. An efficient technology of production of organic thickener – pectin has been developed. Pectin can be produced from the following secondary raw materials: wastes of apple, grapes processing.

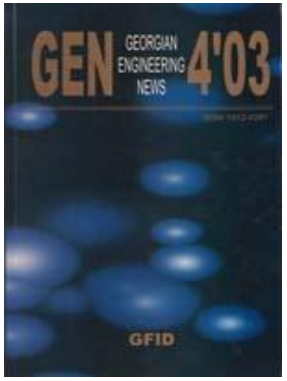
Bioengineering center

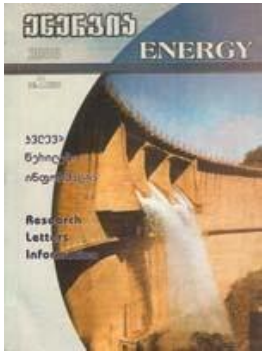
The researches at the center are dedicated to creation and implementation of bio-energoactivators, which enables – 2,5 -3 times increase ecologically pure plant productivity. The elaborated bioenergo activators enables to :

- **remarkably increase crop capacity**
- **speed up for several years fruit bearing**
- **reduce nitrates, heavy metals and radionuclide in agry-food products**
- **increase immunity and productivity of fowl and animals**

The scientific magazines issued at GTU







From 2001, in the GTU is factioning the electronic scientific magazine.
The electronic address is - http://gesj.internet-academy.org.ge

Thank you