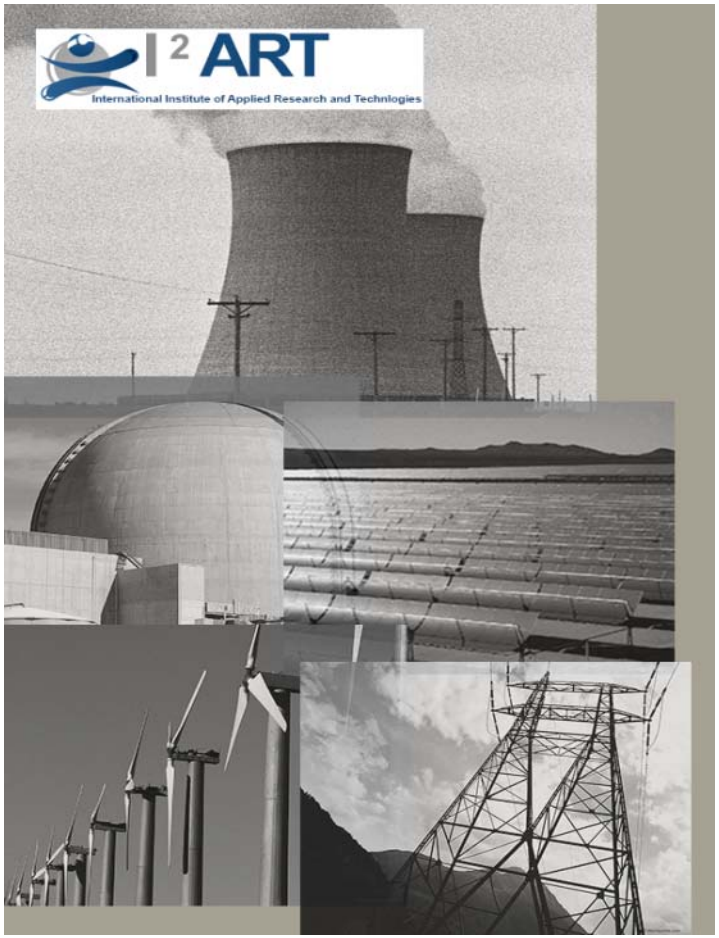


INTERNATIONAL INSTITUTE OF APPLIED RESEARCH AND TECHNOLOGY

I²ART

Topics

- I²ART- about us
- Our target groups and customers
- Research fields
- Our project experience
- Project proposals and new projects

I²ART about us

We are internationally recognized experts in delivering outstanding service assurance and integrated solutions. We enable our customers to launch successful services. We are bridging the gap between frontend research results and the practical applications in industrial and economic framework.

Many years of experience in smart grid applications – with any service grid –
- Electricity
- Water Supply
- Waste Water
- District Heating and Cooling Systems

Successful solutions for Smart City Demands
- Systems analysis tools
- Simulation of interaction process
- With existing solutions in different process layers

Bioenergy and environmental technology
- Process engineering developments
- Optimization with analysis of different process steps
- Implementation

Mobility and Automotive Systems
- Optimization of Production Processes
- Simulation of Production Technologies
- Waste Water
- Facility systems
- Implementation

Our target groups and customers

Identification of optimization potentials

Solving of complex problems

Industry

Public Administration

Scientific Community

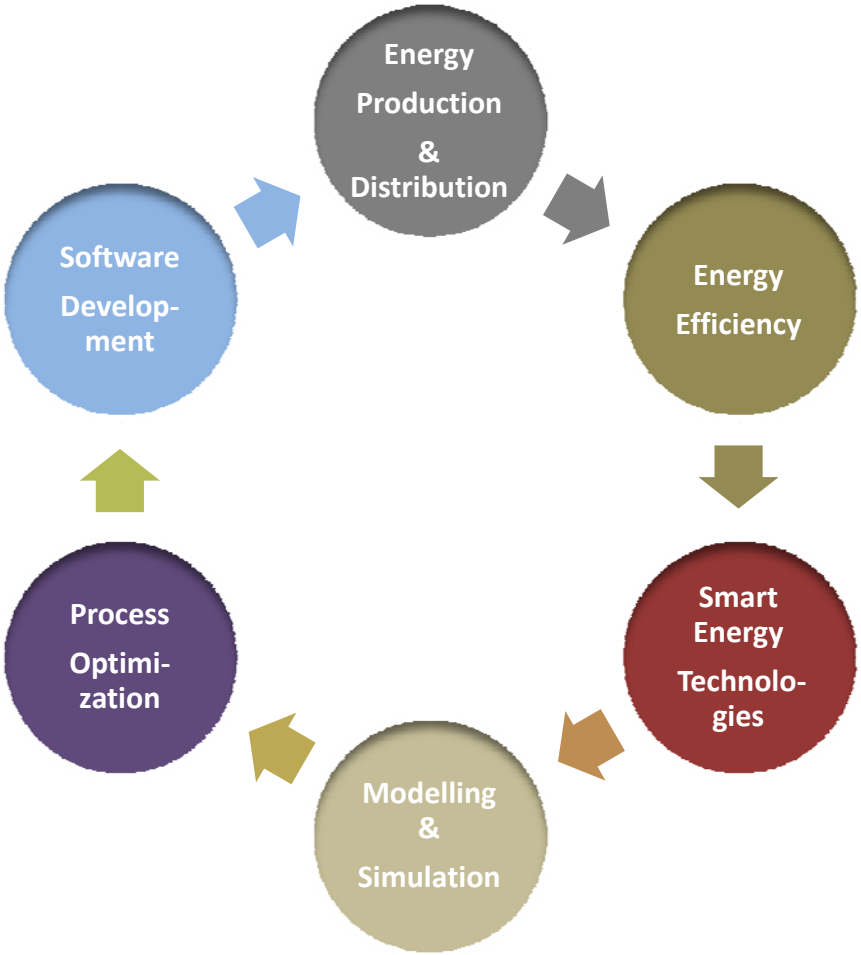
Systems Analysis

Simulation

Research

Software/ process Develop-ment

Research fields



I² ART
International Institute of Applied Research and Technologies

Research fields

Energy Production & Distribution

- Conventional Energy Sources
- Renewable Energy Sources
- Distribution Grid – Innovations
  - Demand Side Analysis and Automation
  - Supply Side Analysis and Automation
  - Integration of decentralized generation and demand control

Energy Efficiency

- Data base creation for energy saving technologies
- insulation in buildings for thermal purposes, acoustic insulation, fire insulation, and impact insulation
- the energy demands of heating and cooling systems
  - the heat transfer through the building envelope
  - insulating products with limited environmental impact
  - Life-cycle assessment (LCA)

Smart Energy Technologies

- Using less energy to provide the same service
- Smart energy and smart water grids
- Monitoring, measurement and control of smart units and appliances to develop new energy-efficient technology and to work with commercial partners to bring it to the marketplace

Modelling & Simulation

- Creation of physical and technical models
- Creation of process models
- Life-cycle assessment (LCA)
  - System Integration & Implementation
  - Electric vehicles

Process Optimization

For optimization of production and logistic process we will provide following process steps:

- Definition of process/Analysis of current situation
- Creation of process models
- Specification of improvements
- Evaluation of improvements scenarios
- Decision about implementation
- Implementation (possibly with additional software)

Software Development

- Computer cloud technologies
- Fuzzy logics and math
- Software and analytics
- Strong C++ programmers team
- Experience in Qt, Client-Server programming, UNIX
- Web technologies
  - PHP, Html5, CSS design, MySql, Postgre, Flash
  - Python, General Java, AJAX, Jscript, J2ee,j2me
  - Jbeans, Servlets, Applets, General ASP, VB.NET

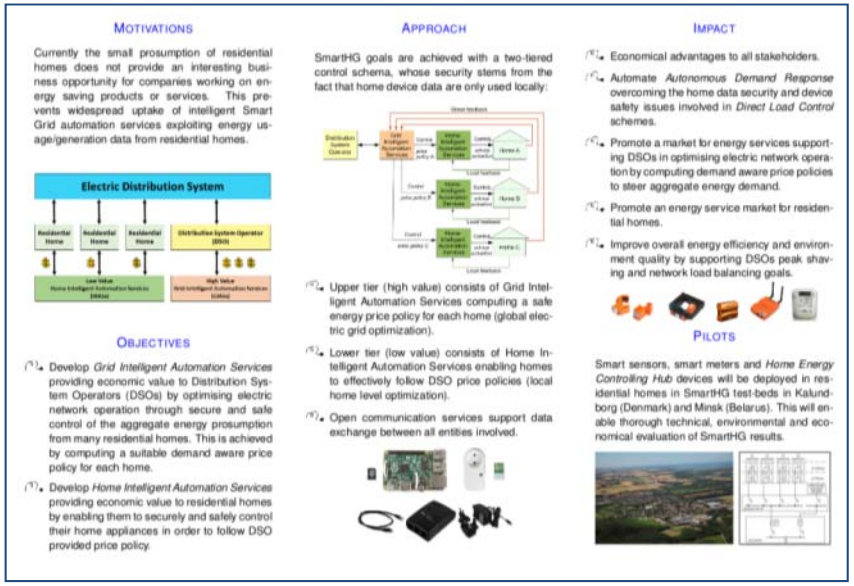
Our projects experience

- SmartHG international project
- Client-server automation supervising control system RealGaz
- GLE_GTS graphical libraries
- PV_Online project
- PageView project
- CompView (technology for the model create and control)
- Fuel Cells research
- The path modelling and optimization program project
- Fire propagation modeling
- Process optimization for automotive companies

SmartHG international project

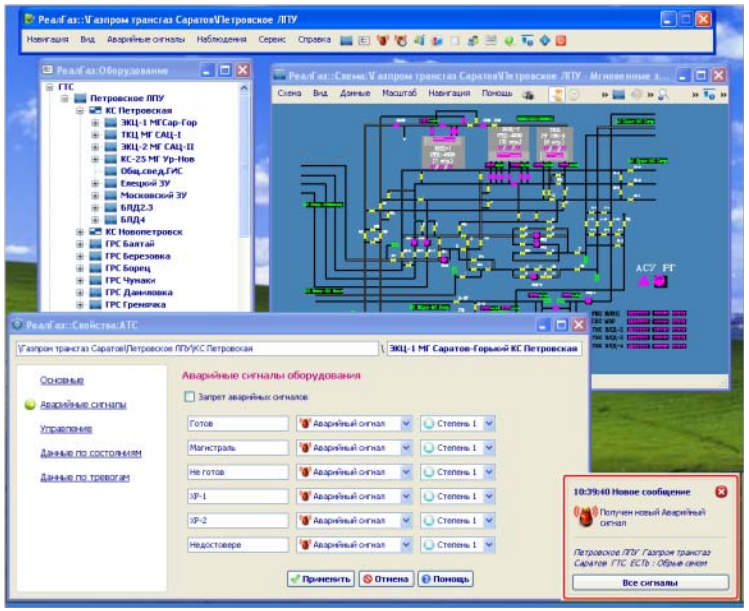
Currently going project.

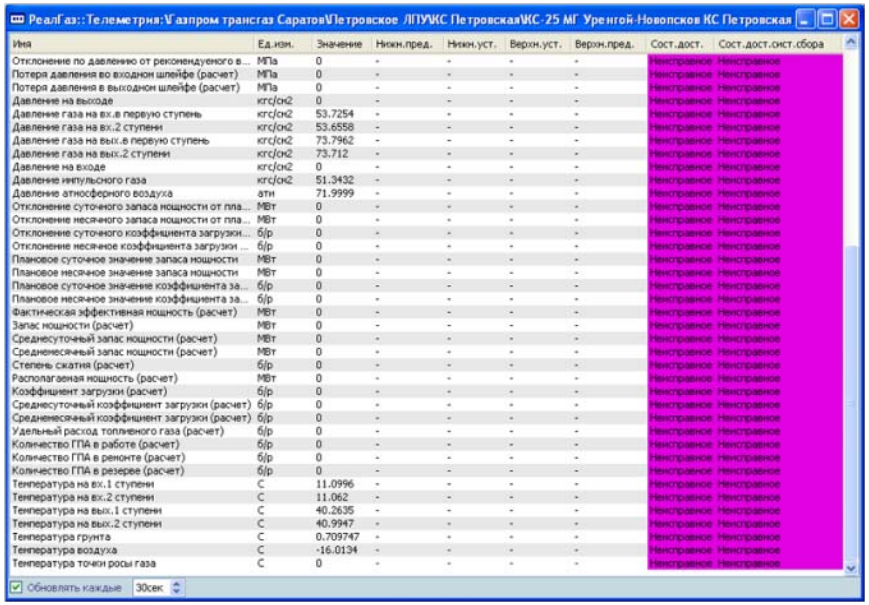
- The SmartHG is acronym of the project. Full name is Energy Demand Aware Open Services for Smart Grid Intelligent Automation.
- Project consortium consists of 11 international companies from several European countries.
- Project URL: http://smarthg.di.uniroma1.it/



Client-server automation supervising control system RealGaz

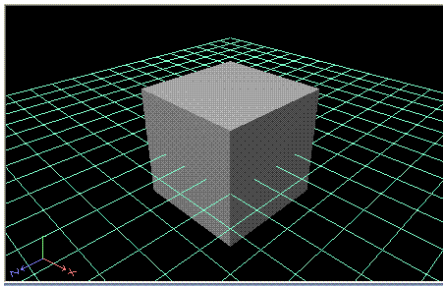
- The system was created in 2012 by order of GAZPROM-InformTransGas company.
- The system consists of several modules:
- SINFServer – Server module used for connection to real time SCADA DB – RTAP/GOFO2;
- Dispatcher – Multiplatform client module.
- Several internal tools library.
- The system intended to work under Unix-Solaris OS. The client modules may be used under Windows.
- Project URL http://informtransgas.ru/sp-realgaz.html



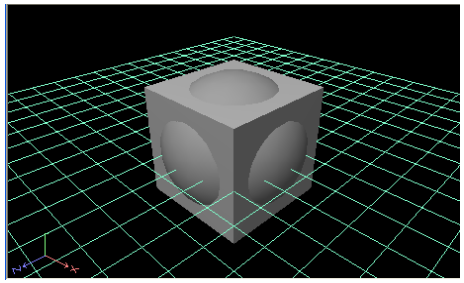


GLE GTS graphical libraries

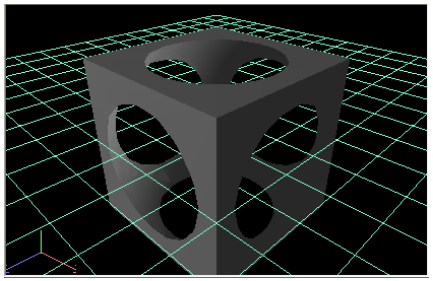
We have created new OpenGl based libraries to operate with 3D Constructive Solid Geometry on compound objects and to realize special 3D effects such as extrusion function for piping system visualizing and many more useful graphical actions.



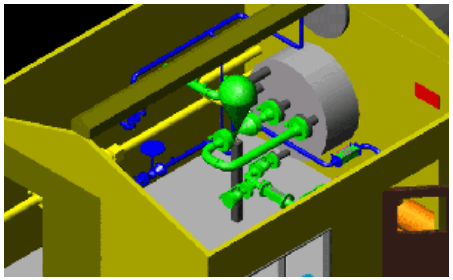
P1. The main Cube object

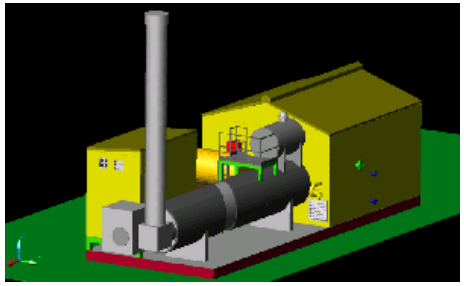


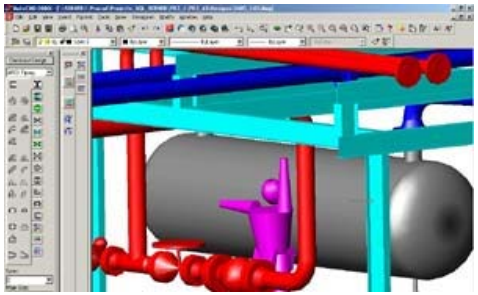
P2. The second Sphere object is added



P3. The resulting subtracted compound object. This makes Cube minus Sphere constructive geometry subtraction operation.



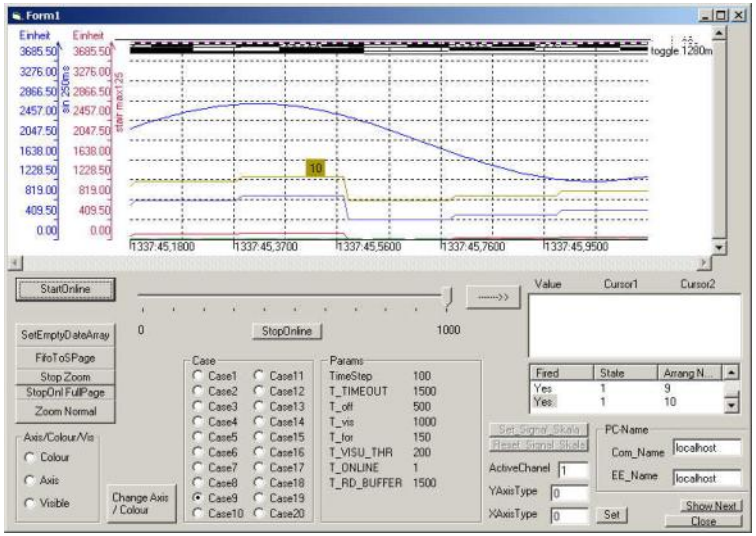


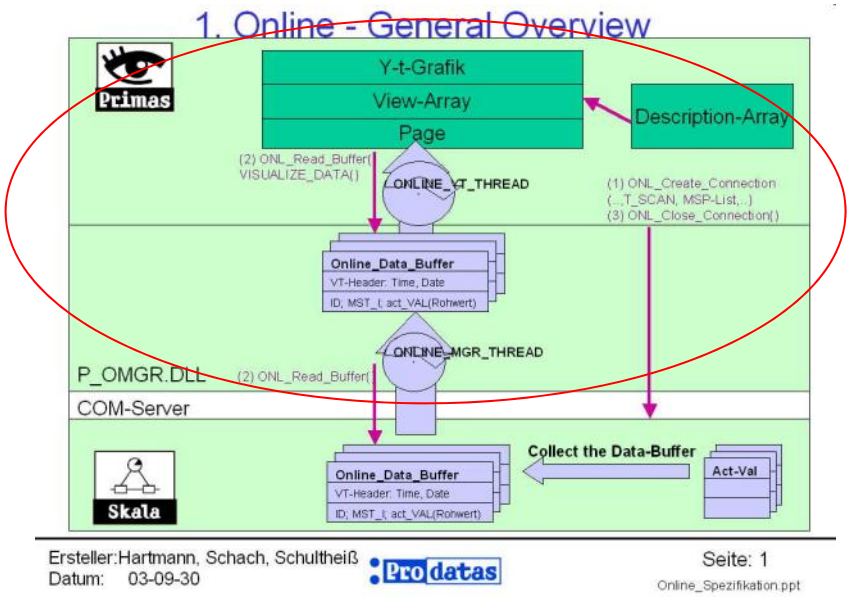


Several examples of program products that use our libraries are shown at this pictures.

PV Online project

The project is realization of several multiprocessing OCXs and appropriated environments. It had finished on 2003. The main aim of the project was creation of DCOM linked OCXs to show huge data flows online.





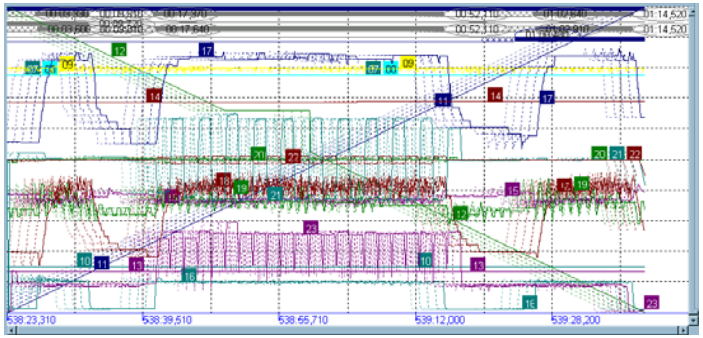
PageView project (1)

Overview

This project was long time project. It had started in 1995 by order of Mercedes-Benz, Germany. The intermediate customer was Prodatas Gmbh, Germany. The main point of project was the visualization of huge volume of data. The project was created on Visual C++ 4,5,6 versions. Up to 10 programmers were involved in works under this project.

The Visualization and computing of huge array of data

The technology completes of several OCXs with special functions inside.

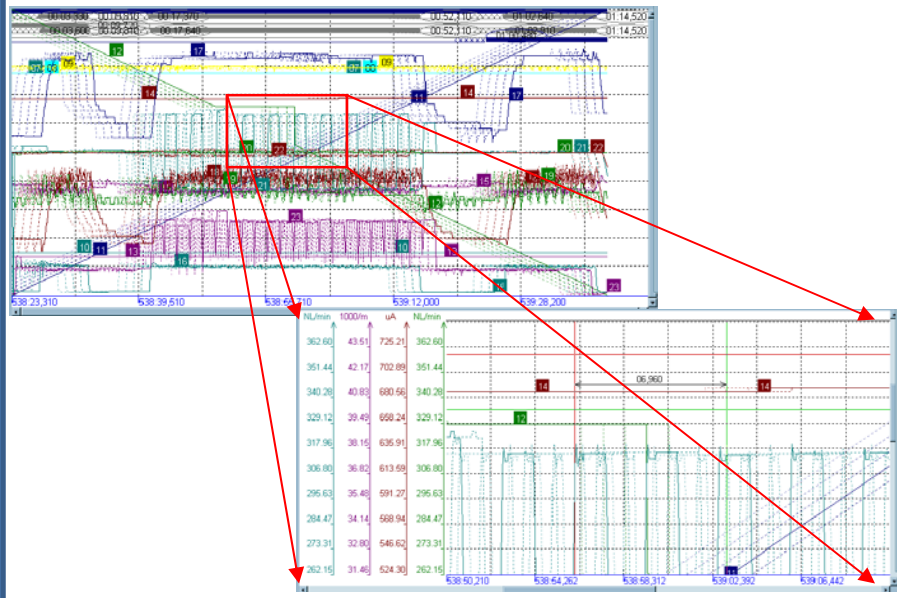


The technology permits:
To visualize and compute of huge volume of data (more then 100 billions of values in several formats) with high performance. The special computing methods are using to grow performance;
To zoom the data through computing zooming too far in deep;

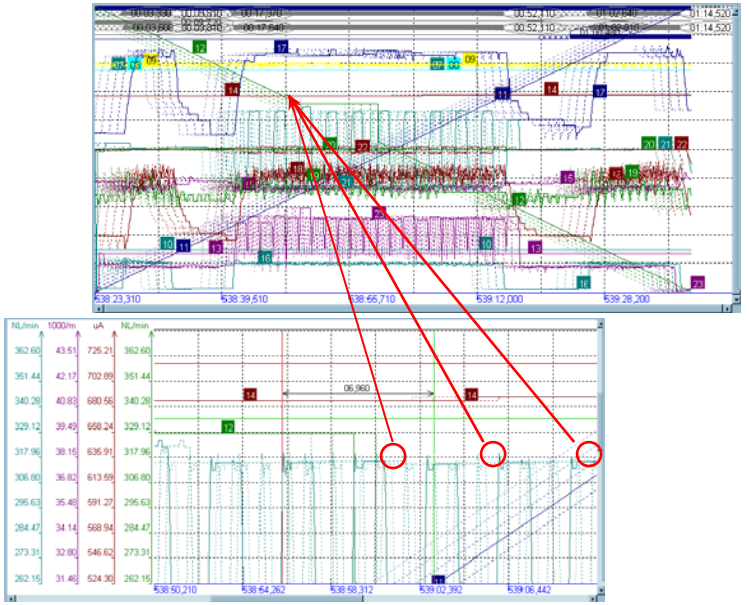
PageView project (2)

The technology permits:

To visualize and compute of huge volume of data (more then 100 billions of values in several formats) with high performance. The special computing methods are using to grow performance;



To zoom the data through computing zooming too far in deep



The selective visualization of data with special statistic methods

To do the special recompile of data; to make the reverse data depends; to do the flexible tuning to data formats. To use a lot of data formats such as ODBC, DAO, ADO, XML and more; to make multi-channel data access.

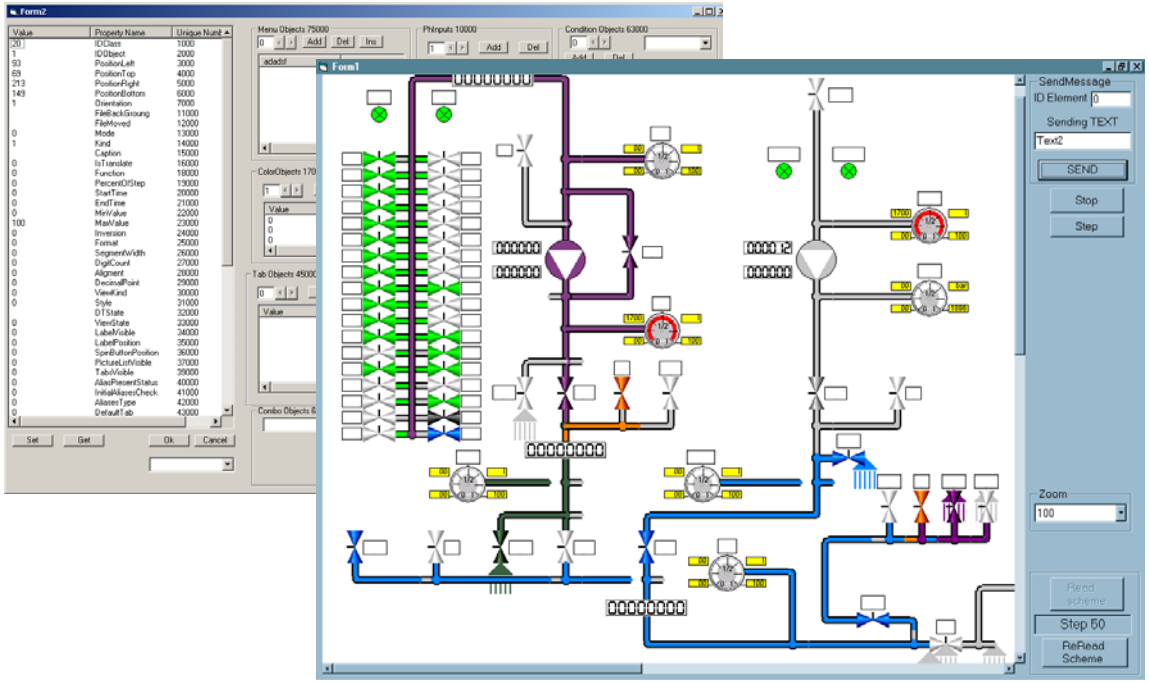
CompView (technology for the model create and control) (1)

Overview

The main aim of the project was the technological scheme creation, edition and modeling on big volume of real data in offline and online modes. The project was created on Visual C++ 4,5,6 versions. Up to 10 programmers were involved in work.

Technology description

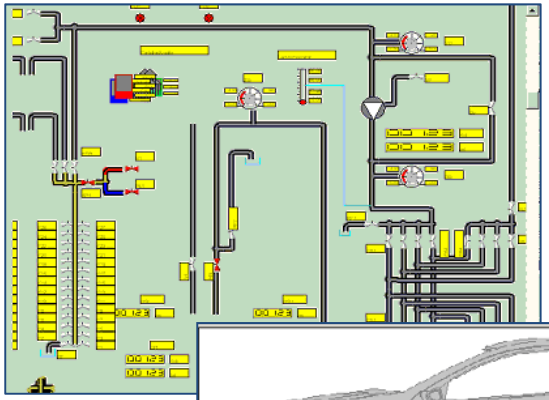
This is full closed and ready-made programming technological cycle of scheme edition and dynamical data visualization in real-time mode. A lot of properties for each scheme object are using.



CompView (technology for the model create and control) (2)

Object Editor

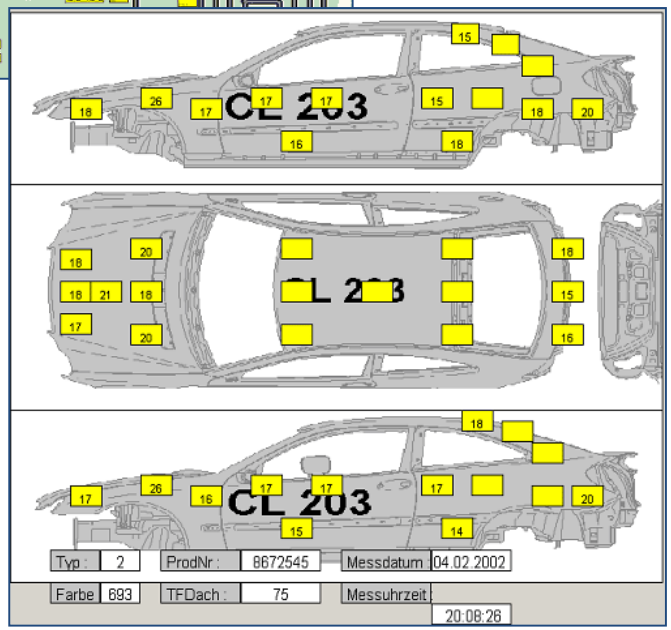
The powerful build-in editor of objects permits the almost of all modern existed editing features.

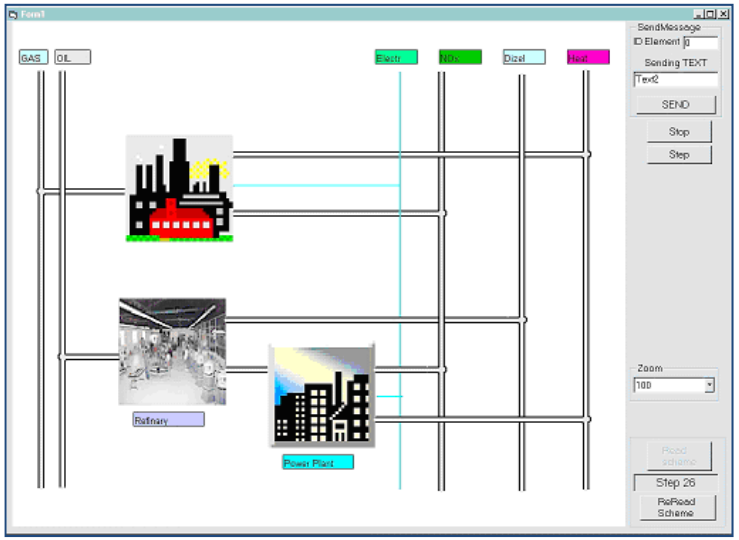


Wide area of applications:

For car building technology

For energy-economy analysis of regions





Fuel Cells research

We have now new technology for CVD growth of carbon nanotubes filled by Pt (or Ni) on stainless steel bipolar electrodes for PEM fuel cell (now 100 mm diameters with plan - up to 200 mm next 6 months). Also we start technology research on high temperature solid oxide electrolyser (SOEC) and SOFC with forming electrolyte by plasma. Current targets - 10 kW PEMFC and 10 kW SOEC to end of year and large scale nanocatalysts production on base of carbon nanotubes (carbon SWNT) in CVD reactor.

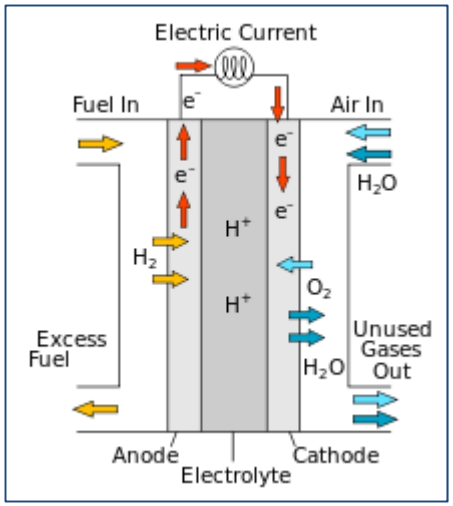
PEM - proton Exchange membrane

SOFC - Solid Oxide Fuel CellS

OEC - Solid Oxide Electolyser

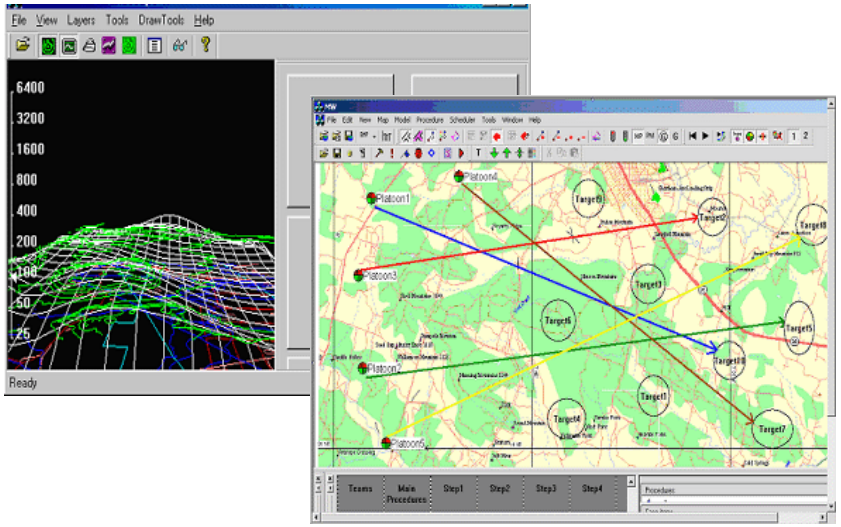
CVD - Chemical Vapour Deposition

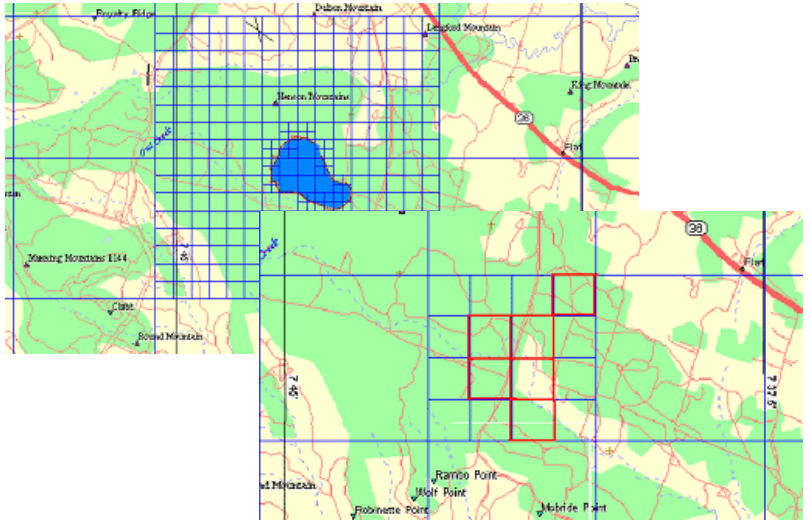
SWNT - Single Wall Nano Tubes



The path modeling and optimization program project

The project was developed by order of Institute of Medical Cybernetics, MD, USA. The project includes of the several program modules. For instance the following program works with real geographic maps and has 3D Interface, OpenGL based.



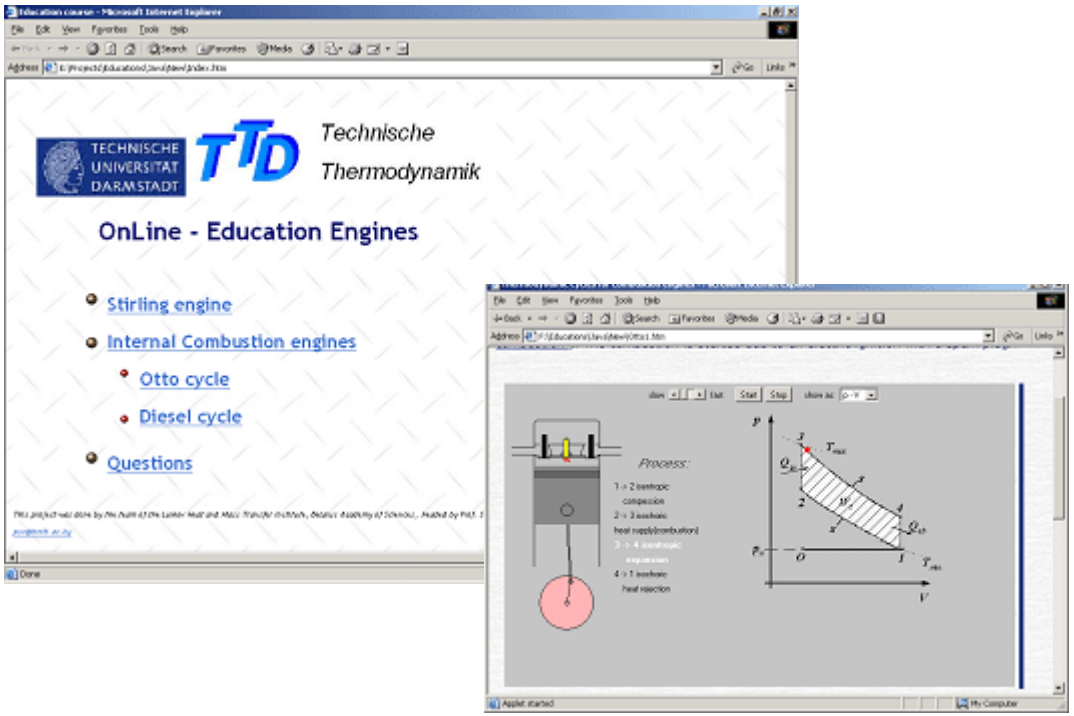


This program uses real geographic maps for modeling the behavior of groups. The path optimization is applied for operator help purpose.

The program can calculate several parameters of maps and areas.

Education html program TTD

It was developed by the order of Technical University of Darmstadt, Germany. The project includes of several dynamical elements on Java.

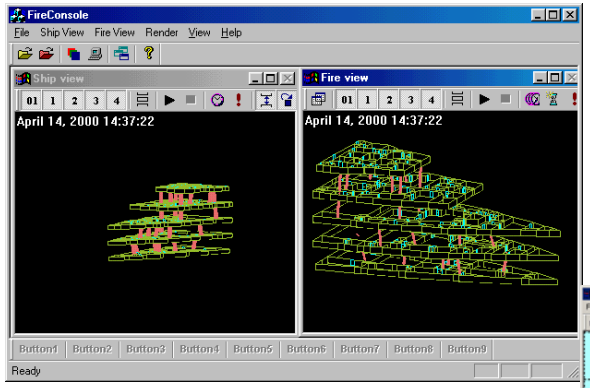


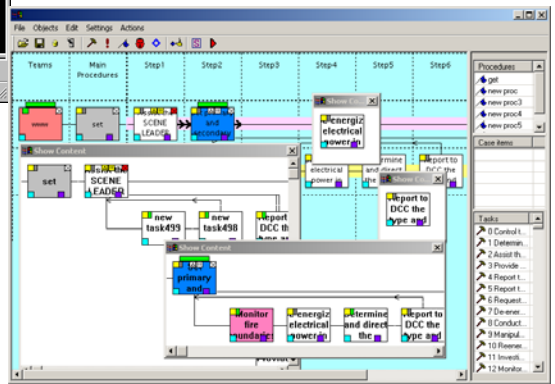
Fire propagation modeling

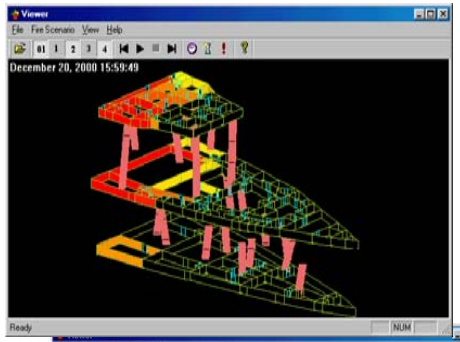
Set of programs for fire propagation modeling and for control of resource of fire fighting teams on ships

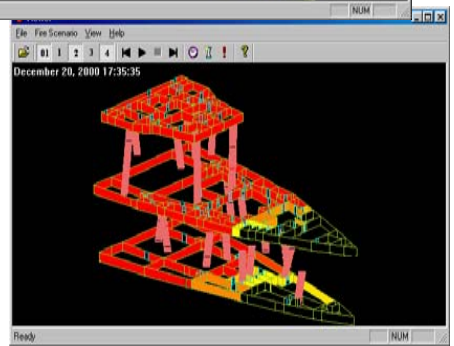
The set includes 9 programs with the elements of artificial intellect for prompt to operator the optimized solutions. Programs have the 3D user interface and use COM-DCOM links for synchronize internal processes.

For edit sequence of fire fighting teams tasks the powerful graphical internal editor is used. In additional the program set includes big database of resources. The behaviour of emergency teams are modelled and controlled by the several tasks type such as simple task, procedure, case module, branch, call back processes and more. For convenient modelling the scenarios of procedures are presented. Real-time visualization of processes is usefully for operator's work.









Project duration about 3 years.
Up to 15 programmers were involved in works. C++ 5,6 language.
Window based operation system.

Process optimization for automotive companies

Steps

- For optimization of production and logistic process we provided following process steps:
- Analysis of current situation
- Creation of process models
- Specification of improvements
- Evaluation of improvements scenarios
- Decision about implementation
- Implementation

Results

- Implementation of lean methods for transparency and efficiency
- Reducing of production and delivery time
- Reducing of line side stock
- Improvement of production and logistic processes
- Reducing of production and logistics costs



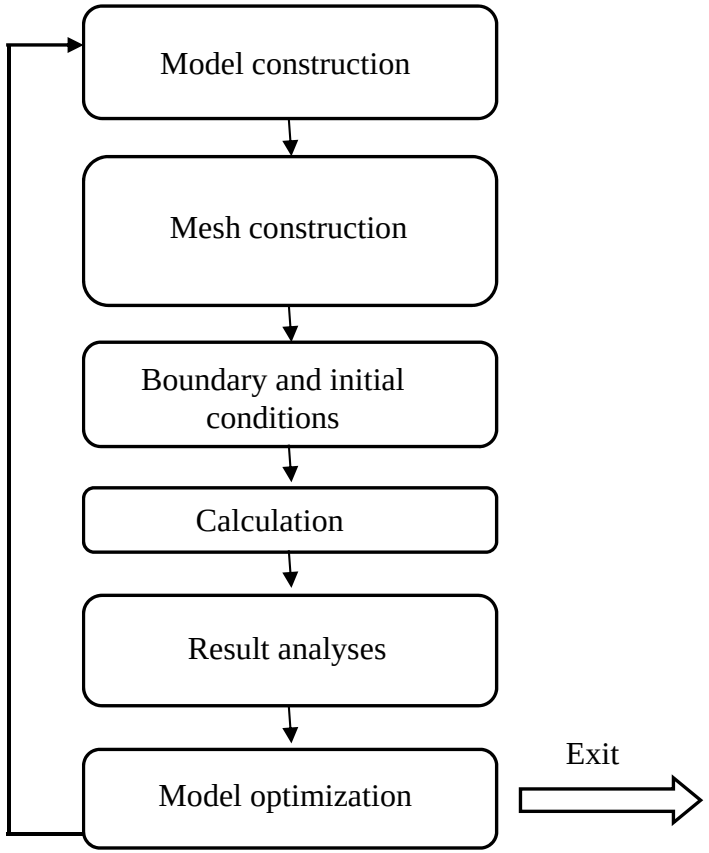
Computational FD/H&MT*:

models, methods, and software

Application software is a powerful forecasting system:

- object-oriented (to users)
- with a graphical user interface (GUI)
- with modern mathematical models
- with approved reference information databases

Application software examples	
Problems	Software
Fluid dynamics, Heat & Mass Transfer	Ansys Fluent, OpenFoam, Code Saturn, IES VE
Energy Saving	IES VE, Energy Plus, ESP-r, VABI Elements
Engineering Equipment Design	MatLAB Simulink, TRNSYS, IES VE, Energy Plus
Acoustics	DIRAC, Ansys Fluent
Heat&Mass Transfer in Solids, Structural Mechanics	Comsol, BSim, Delphin 5, HAMLab



*fluid dynamics heat and mass transfer

Computational FD/H&MT*:

our solved tasks

Bus aerodynamics simulation

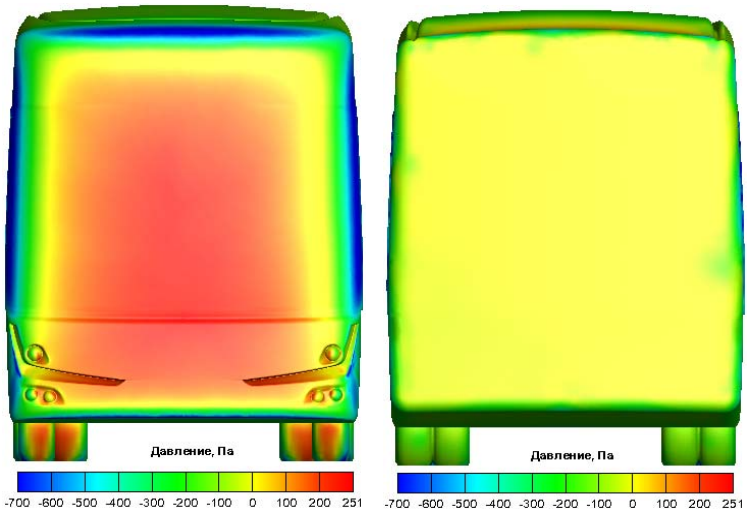
- 3D problem using the CAD model close to a real bus
- Steady RANS equations, SST–*k*–ω turbulence model, upwind scheme, SIMPLEC algorithm.
- Used software: Ansys Fluent 14.5

*fluid dynamics heat and mass transfer

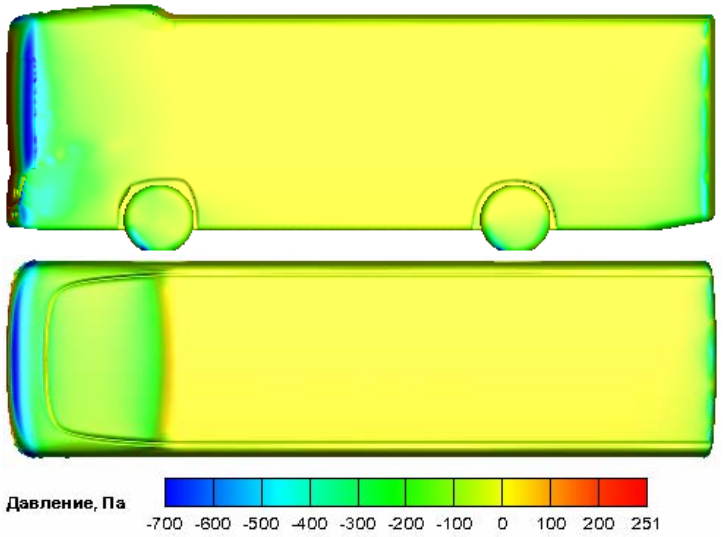
Computational FD/H&MT*:

our solved tasks

Bus aerodynamics simulation



Pressure distribution



	F_p, N	F_f, N	F_X, N	C_p	C_f	C_X
Rear wheels	69.70	3.75	73.45	0.024	0.0013	**0.0253**
Front wheels	9.10	2.00	11.10	0.003	0.0007	**0.0037**
Bus surface	1058.4	86.3	1144.7	0.361	0.0294	**0.3904**
Total	**1137.20**	**92.05**	**1229.25**	**0.3880**	**0.0314**	**0.4194**

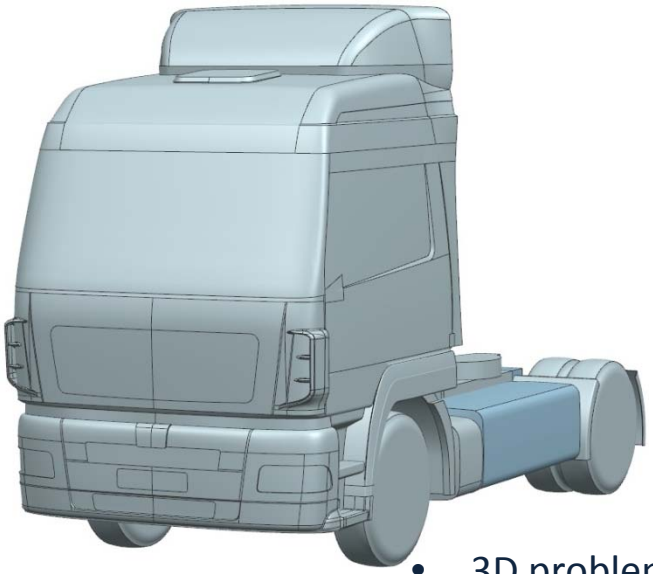
Pressure force F_p, friction force F_f, total force F_X, pressure coefficient C_p, friction coefficient C_f , and total coefficient C_X at a velocity of 90 km/hr

*fluid dynamics heat and mass transfer

Computational FD/H&MT*:

our solved tasks

Truck aerodynamics simulation



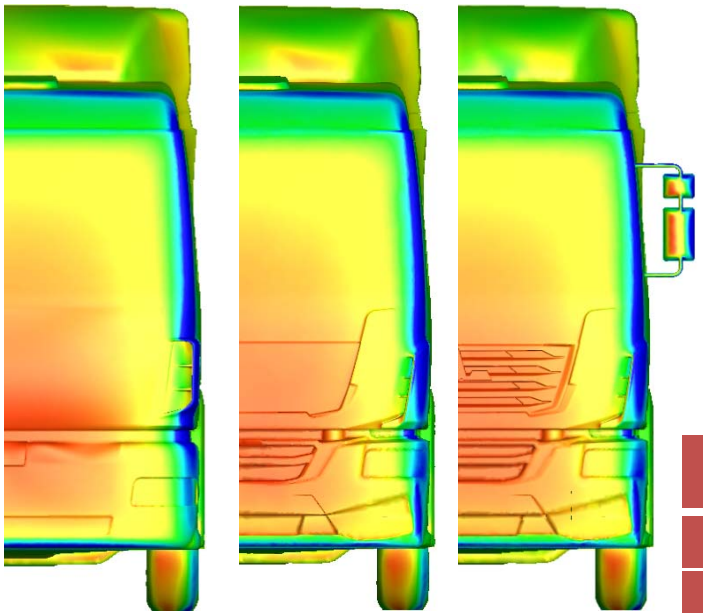
- 3D problem using the CAD model close to a real truck
- Steady RANS equations, SST–k–ω turbulence model, upwind scheme, SIMPLEC algorithm.
- Used software: Ansys Fluent 14.5

*fluid dynamics heat and mass transfer

Computational FD/H&MT*:

our solved tasks

Truck aerodynamics simulation



Pressure distribution at the front surface of serial and new cabins (w/o and with rearview mirrors)

Aerodynamic drag force and drag coefficient of serial and new truck cabins

	F_t, N	C_t
Serial cabin (S = 8.642 m²)	499.5	0.151
New cabin (S = 8.686 m²)	531.4	0.163

Aerodynamic forces for new cabin

cabin element	F_p, N	F_f, N	F_t, N	C_p	C_f	C_t
deflector	-37.5	0.4	-37.1	-0.0108	0.00012	-0.0107
radiator grille	227.3	0	227.3	0.0663	0	0.0663
rearview mirrors	59.6	1.2	60.8	0.017	0.00035	0.0173
bumper	267.1	1.7	268.8	0.0779	0.00049	0.0784
total cabin	684.8	19.0	703.8	0.1997	0.00553	0.205

*fluid dynamics heat and mass transfer

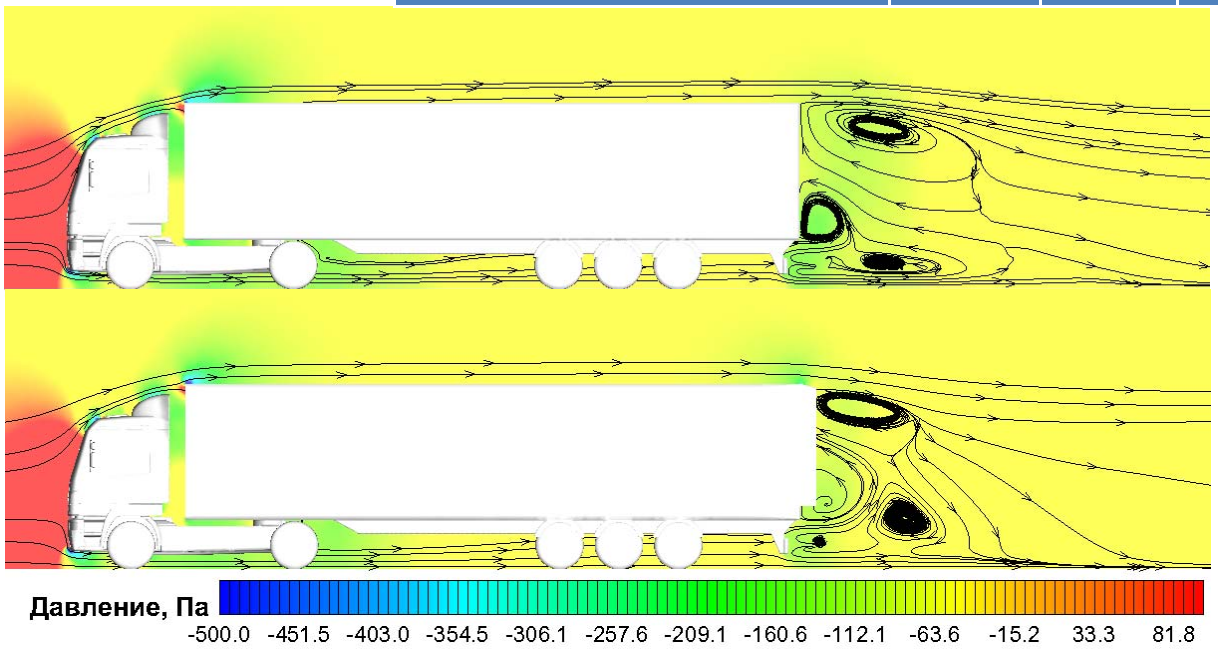
Computational FD/H&MT*:

our solved tasks

Truck aerodynamics simulation*: *rear flap influence

Rear flaps decrease truck drag by 6.4%

	F_p, N	F_f, N	F_t, N	C_p	C_f	C_t
Truck w/o flaps (S = 10.62 m²)	2337.6	127.2	2464.8	0.575	0.031	**0.606**
Truck with flaps (S = 10.81 m²)	**2215.1**	**133.3**	**2348.4**	**0.535**	**0.032**	**0.567**



Pressure distribution and streamlines

*fluid dynamics heat and mass transfer

Computational FD/H&MT*:

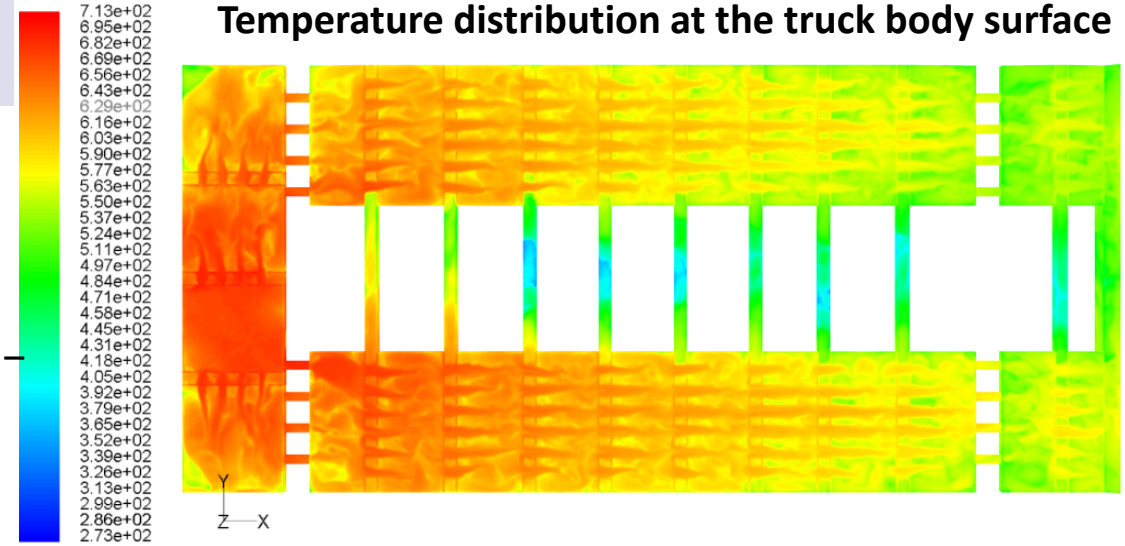
our solved tasks

Heating a truck body by exhaust gases

1. Conjugate problem of heat transfer from exhaust gases to the truck body surface.
2. Used software: Ansys Fluent 14.5

Input gas temperature – 713 K,
Gas flowrate – 1700 kg/hr.
Gas temperature at the heating system exit of an empty truck body – 300°C ;
Pressure drop – 30 kPa;
Mechanical power loss – 19.2 kW

Temperature distribution at the truck body surface



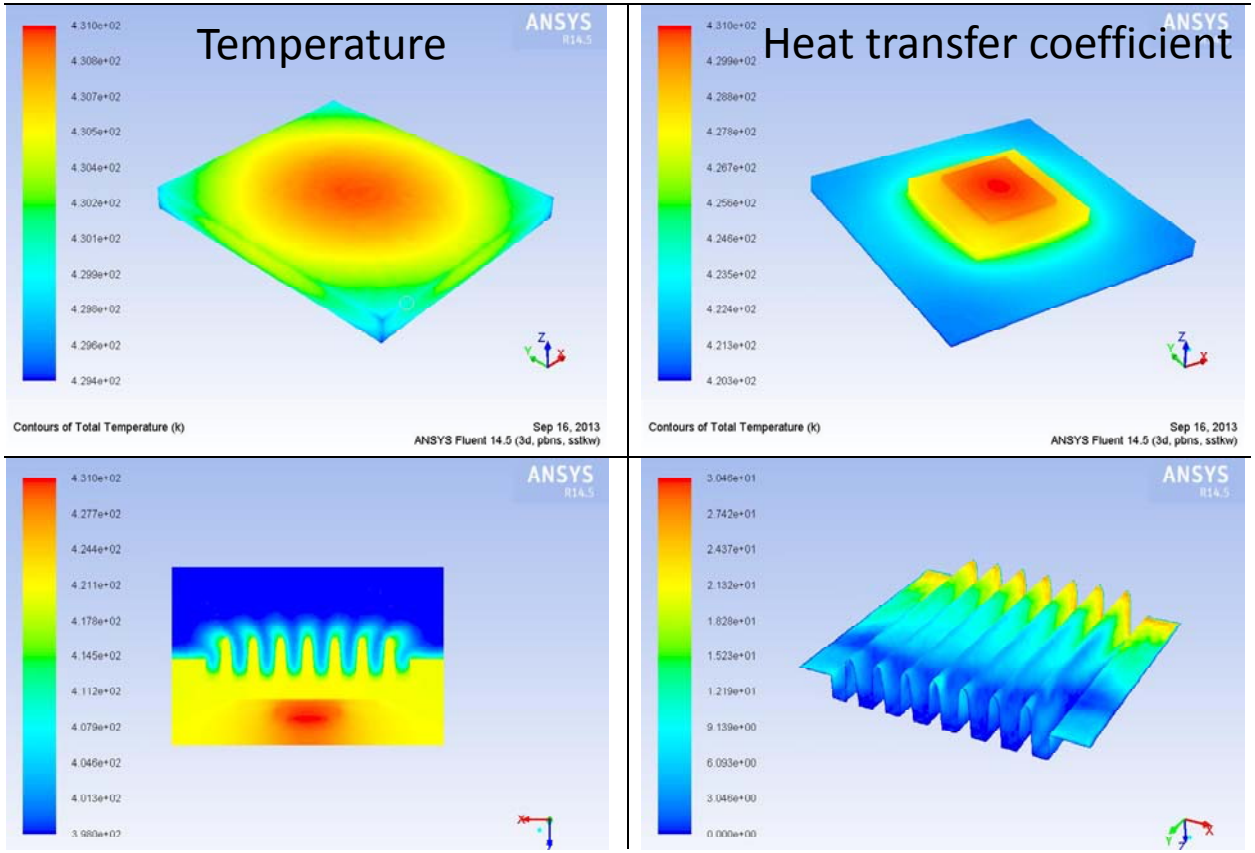
*fluid dynamics heat and mass transfer

Computational FD/H&MT*:

our solved tasks

Thermal regime of control system microelement of car generator

Variant 1:
Copper – 7x7 mm,
copper
λ=150 Wt/(m K),
adhesive
λ=0.88 Wt/(m K)



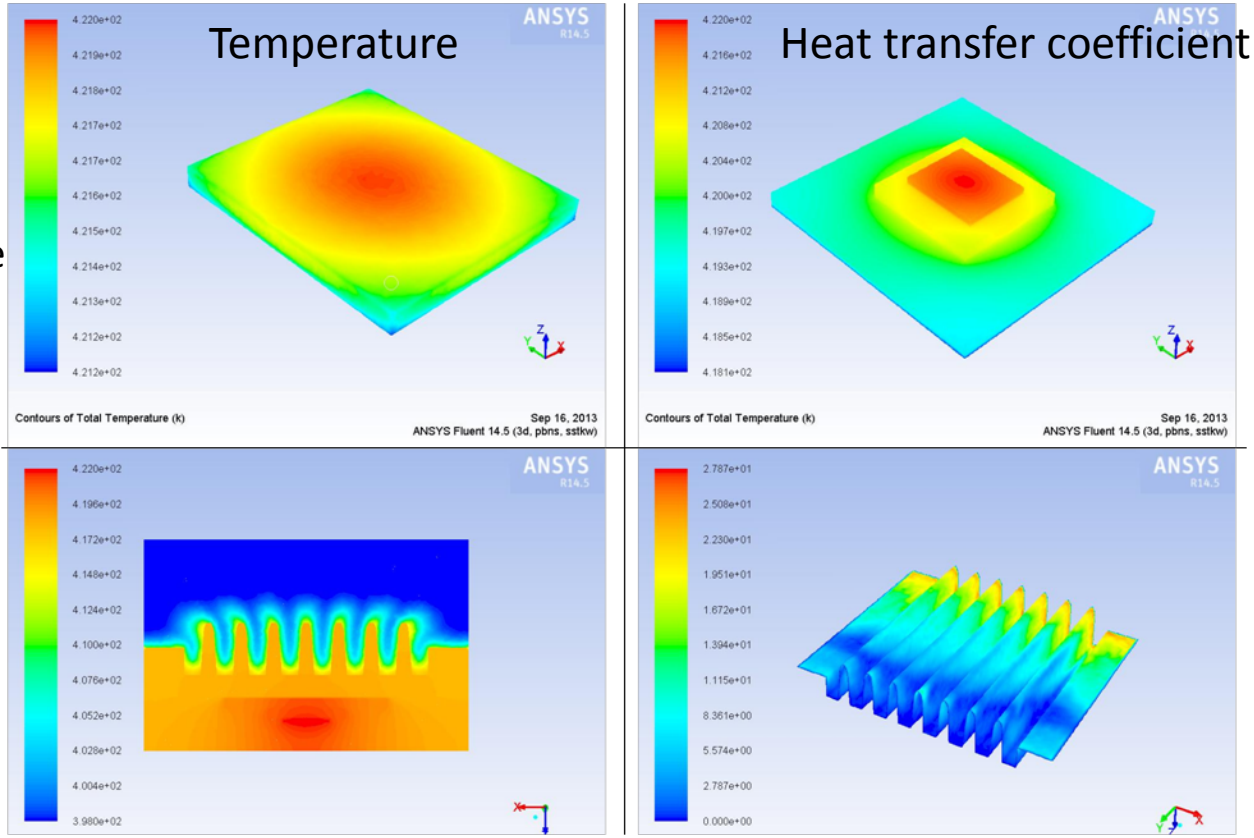
*fluid dynamics heat and mass transfer

Computational FD/H&MT*:

our solved tasks

Thermal regime of control system microelement of car generator

Variant 2:
Copper – 7x7 mm, change in ceramics Al_2O_3 to Al with grade AD0 (ρ=2710 kg/m^3, λ=202.4 Wt/(m K), c_p=930 J/(kg K)); copper λ=380 Wt/(m K), adhesive λ=1.68 Wt/(m K)



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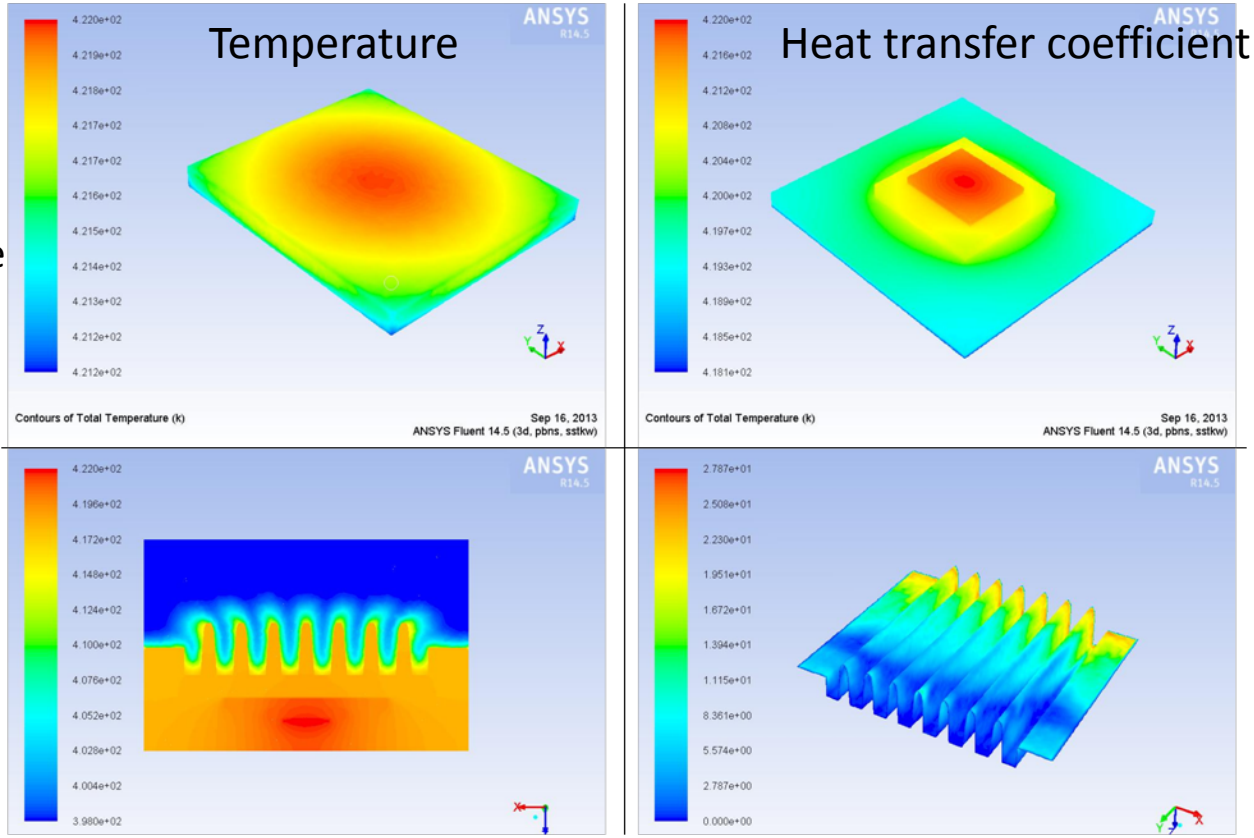
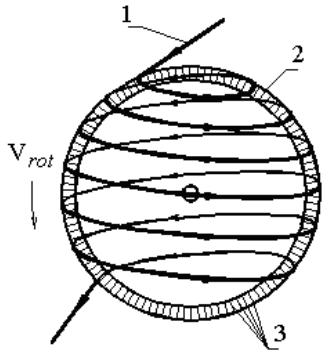


*fluid dynamics heat and mass transfer

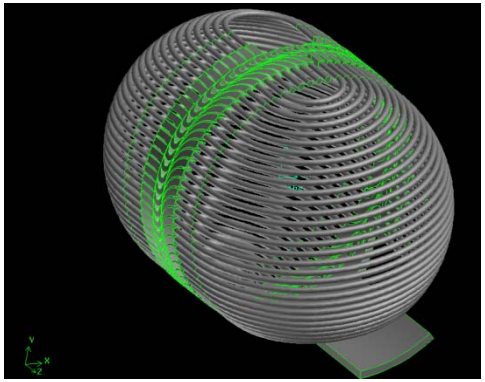
Computational FD/H&MT*:

our solved tasks

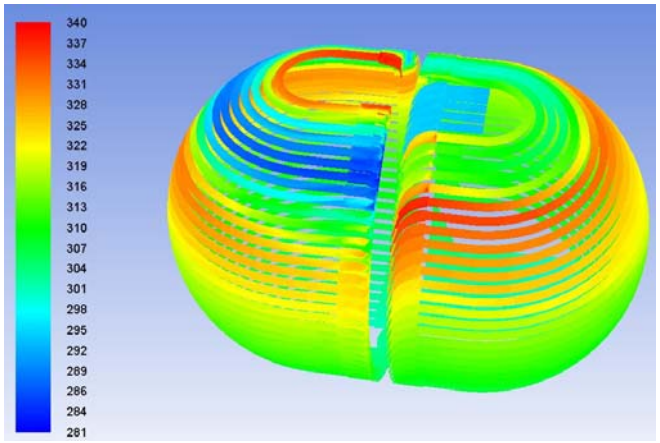
Energy saving device 'Turbosphere' for electricity production



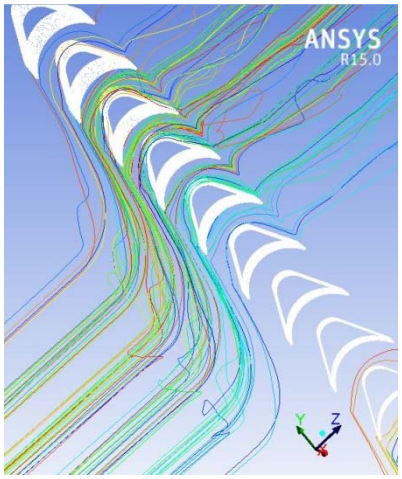
- 3D problem using the CAD model close to a real device
- Unsteady RANS equations, SST–*k*–ω turbulence model, upwind scheme, SIMPLEC algorithm.
- Used software: Ansys Fluent 15.0



CAD-model 'Turbosphere'



Temperature distribution in the gas pipeline



Streamlines near blades

*fluid dynamics heat and mass transfer

Project proposals and new projects

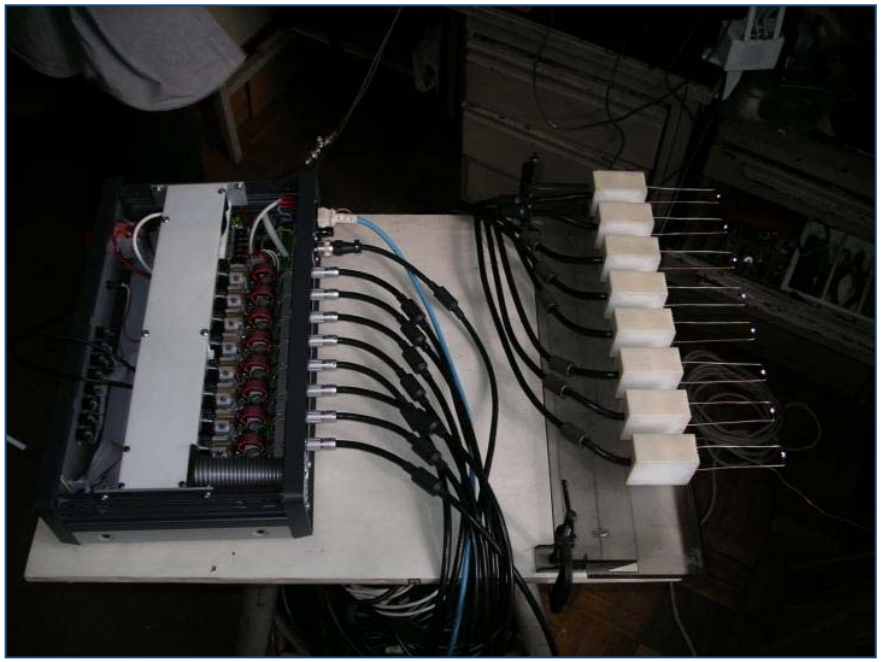
- Eight-channel arc generator
- Multichannel Spectral Pyrometer
- Synthesis gas production
- Roll-to-roll graphene coating production
- Water-fuel emulsion
- Smart water grid
- Energetic interactive computer system
- Building platform Techdom
- Human body thermoregulation/ heat & moisture transfer in clothes
- Optimisation of vehicle control system
- Heat transfer optimization for heat exchanger elements
- Heating glass covers and window glazing

Eight-channel arc generator (1)

Present experimental model of high-voltage radiofrequency(RF) generator is an original multichannel high frequency solid-state source of sinusoidal-like voltage composed of Main Unit and High Voltage Transformers. This device works in two main, automatically switching modes: fire, with high output voltage, proceeding up to breakdown of discharge gap and limit, during discharge burning, with limited output current/power.

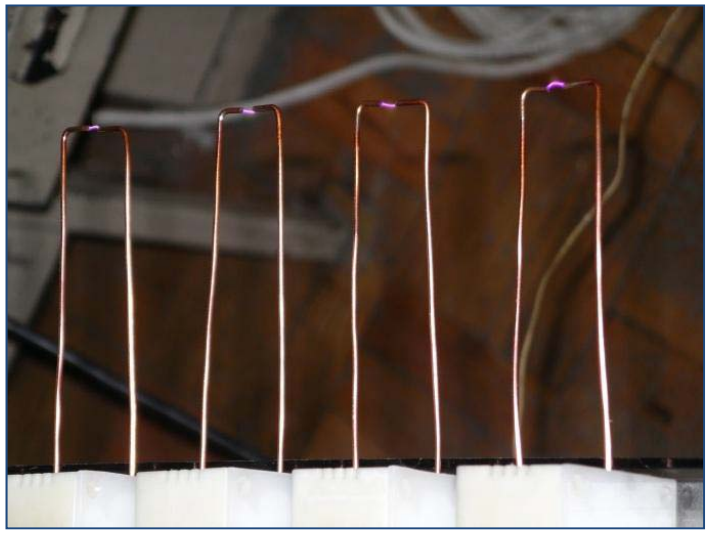
Main features:

Conversion frequency 0.8-1.2 MHz;
Output voltage amplitude:
up to 25 kV(fire mode);
200-2000 V(limit mode).
Output power(limit mode, each channel) – 100-150 W, duty cycle up to 40%;
Conversion efficiency(limit mode) – 0.7-0.9;
Discharge gap – 1 - 5 mm(at atmospheric pressure, recommended);
TTL/CMOS compatible control inputs.



Eight-channel arc generator (2)

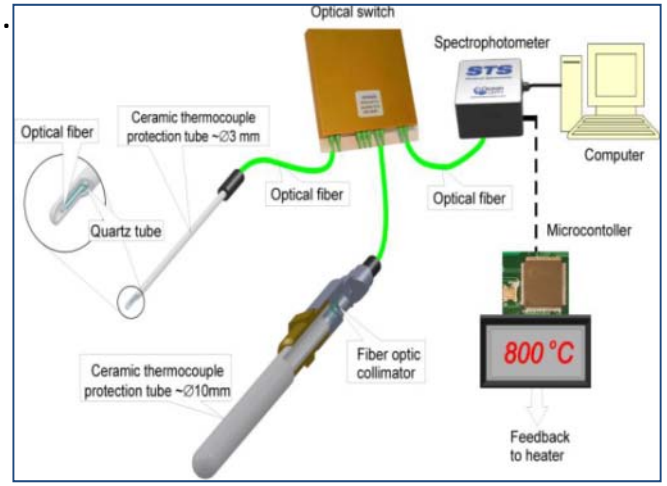
Such generator can be successfully used in many applications, partially it is practically ready device to perform internal combustion engine ignition. As compared with regular ignition systems, this device does not include any energy storage like big enough inductance or capacitance due to it is ready to produce an arc/spark at any time. The discharge duration, which amounts to1-1.5 ms conventionally, is also practically unlimited, over the range from several microseconds to tens milliseconds, about 4 orders width. Eight independently controlled channels give the opportunity to serve up to 8-cylinder engine precisely.



Multichannel Spectral Pyrometer (1)

MultiChannel Spectral Pyrometer (MC-SP) is designed to replace traditional temperature sensors as thermocouples, thermoresistors etc. for high(> 600 oC) temperature areas in presence of strong electromagnetic fields; application examples are: microwave heating, high voltage equipment, intensive electromagnetic interference (EMI) environment and so on. Optical system of Spectral Pyrometer collects light irradiation from the bottom of standard Ceramic Thermocouple Protection Tube, transfers it by fiber optics to MEMS (microelectromechanical systems) –based multichannel optical switch and then into a spectrophotometer. The temperature is defined as a parameter of the detected spectral distribution in visible/near-infrared range by direct fitting the data of the spectrophotometer to Planck's law.

This design of MC-SP allows measured the temperature profiles (up to 24 or more measurement points) in the temperature range 600 oC - 2300 oC with accuracy of 1%, to keep the calibration parameters over long time of operation.



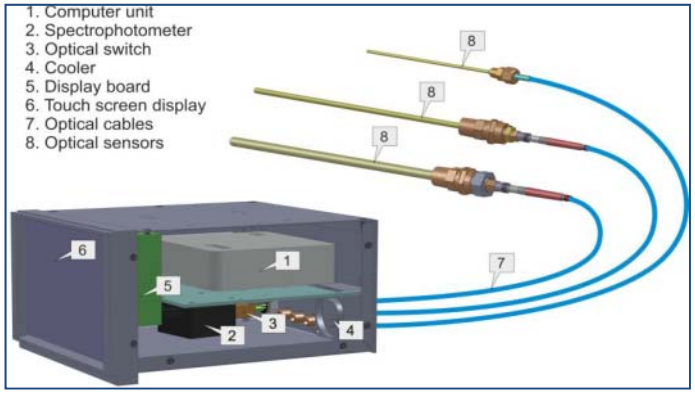
***Key distinctive features/advantages of MC-SP are*:**

- Be able to work where others cannot – at microwave oven, under high voltage potential etc.
- Long-term stability, the reading does not depend of optical signal amplitude and then from contamination/degradation/misalignment of optical parts.
- High temperature operation, upper bond is limited by protection tube material.

Multichannel Spectral Pyrometer (2)

Technical and economical advantages

- Be able to work where others can not – at microwave oven, under high voltage potential etc.
- Has the identical with industry standard dimensions/fittings of sensors.
- Long-term stability, the reading does not depend of optical signal amplitude and then from contamination/degradation/misalignment of optical parts.
- High temperature operation, upper bond is limited by protection tube material.
- Not subject to erosion – ceramic only immersed part.
- Multichannel PID (proportional-integral-derivative)– regulator could be included easily.
- At the same conditions, the cost of MC-SP may be compared with advanced thermocouple equipment.



Synthesis gas production (1)

The project idea is to use controlled process of the selective zone heating inside of catalytic reactor by microwaves (MW) instead of contact or contactless (radiation) heating through the reactor wall. Special designed multichannel fiber optic radiation pyrometer will be used to control temperature inside the reactor, in exchange for traditional thermocouples, which have strictly limited application area in presence of strong electromagnetic fields. Preliminary experiments showed the feasibility of microwave heating of the catalyst unit and demonstrated positive feature of this scheme to prepare synthesis gas. As an outcome of the project, fully innovative equipment which is not present for industry/market will be fabricated; it could be a subject for intellectual property (patents, publications and so on).

Catalytic partial oxidation (CPO) of methane and other hydrocarbons is an effective technology for the production of synthesis gas, which in turn can be used as hydrogen source for fuel cells, to develop gas-to-liquid technologies, as a protective atmosphere for thermochemical treatment of metal parts and so on. The standard approach is the external heating of catalytic reactor to achieve required operating temperature, typically about 1000oC. In these reactor designs, temperature heterogeneity in the catalyst affects the quality of produced mixture. Commonly used catalysts are porous medium (filling, mesh, and honeycomb).

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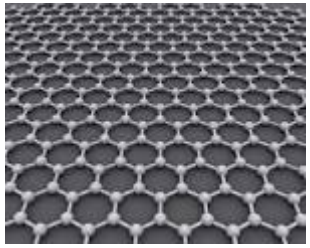
Roll-to-roll graphene coating production

Facility of atmospheric pressure plasmas for roll-to-roll graphene coating production

- In the frame of this project, the following scientific and technical objectives will be accomplished:
- Experimental research of MW/RF excitation, influence of plasma parameters at atmospheric pressure, sort of plasma gas and carbon containing additive for the synthesis of graphene flakes/sheets;
- Development of atmospheric plasma process to prepare/functionalization of roll materials surface before deposition (Specification of roll material will be agreed with Customer);
- Operating parameters optimization for graphene flakes/sheets synthesis and deposition;
- Analytical simulations and calculations for plasma experimental equipment using commercially available software;
- Development of technical documentation, Manufacturing, Installation,
- Test of Experimental setup for roll-to-roll graphene coating production
- (Roll-to-Roll Experimental Setup);
- Preparation and Test report of samples;
- Development of next R&D program, feasibility study for scaling up.



Why graphene?

- The unique graphene properties as the lightest and strongest material, conducting heat and electricity better than anything else mean that it can be integrated into a large amount of applications. The industry utilization supposes mass production of graphene sheets/flakes, one of promising ways is an atmospheric pressure roll-to-roll technology.

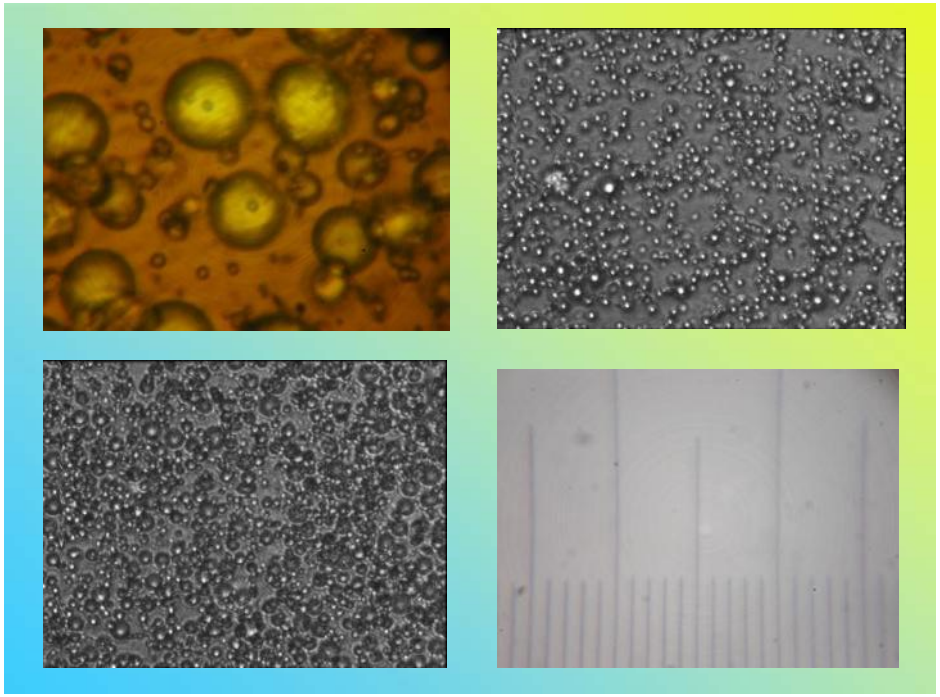
We propose to develop a method for the synthesis of graphene flakes/sheets in the gas phase using MW/RF plasma at atmospheric pressure with simultaneous deposition on the surface of roll material, eliminating a peel-and-transfer step that could damage the graphene layers. Carbon containing precursors (gas or liquid vapor) will be put using carrier gas flow, probably argon, into discharge zone where full or partial dissociation of molecules will be performed. Also all present particles could be ionized by collision with charge carriers – electrons and ions. The particles are moved by gas flow and leave discharge zone, the temperature decreases, association/recombination processes start, in gas phase, or directly on substrate surface. The result could be formation gaseous products only or deposition of solid, carbon-containing covering in form of soot or graphene flakes/sheets.

Water-fuel emulsion (1)

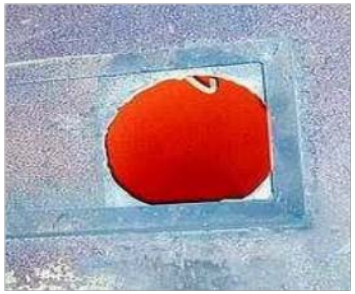
New technology for water-fuel emulsion production for power stations, industrial boilers and ship power installations (ship engines).

- The usage of water-fuel emulsions has a number of advantages: fast and practically total combustion of emulsion, low temperature of preliminary heating of emulsion, decreasing of output of poly-aromatics cancer components (more than 10 times), carbon monoxides (about 40%) and nitrogen oxides (10 – 15%) to the ambience.
- The usage of water-fuel emulsions on power stations allows substantially save fuel-oil with minimum reconstruction. The payback period of reconstruction is a few months.
- The ratio of water to fuel can vary up to 50%. Maximum economy and environment efficiency can be achieved on about 10 – 30% of the ratio.
- Successful usage of water-fuel emulsion totally depends on the quality of it preparation that are homogeneity and fine-dispersed structure.
- We developed the modern technology of water-fuel emulsion production which is based on effects of hydrodynamics cavitation and production of time sustainable and homogeneous fine-dispersed emulsions. The developed installation can produce up to 30 ton per hour of water-fuel emulsion.

Water-fuel emulsion (2)



Photos of water-fuel emulsion with different concentration of water – upper left has 17%, upper right has 25%, bottom left has 40% and bottom right is scale on 10 micron.



Combustion of standard fuel-oil and water-fuel emulsion

Smart water grid (1)

The water pollution by solid and liquid impurities leads to a change in its optical and dielectric properties. This changes the transparency, which can be controlled in the optical range at several wavelengths. Using of multiple frequency bands allow to evaluate the transparency of water in these bands, as well as to estimate the size of present in water solid micro impurities with the help of transparency. The use of method of capillary-waveguide resonance allows to detect the presence of micro impurities in the water, and to assess its purity. Thus in the range of 60 .. 68 GHz with this method may detect impurities with boundary concentrations of 0.1%.

To increase the purity of water is necessary to spend more time and money. However, to satisfy the different needs of different people need water with varying purity. The purest water should be drinking water and water for cooking. For household needs (washing dishes, laundry, cleaning, watering of the site), can be used water with less purification.

To create water with a set quality is necessary to develop the low-cost sensors that can be installed in consumer's apartments for continuous real-time operational control of incoming water to the apartment.

Because for water supply to the consumer needs to use a single system, providing them with water of different quality possible by using time division of drinking and industrial water with set of units of water treatment (filters, ultra-filtration membrane, reactors, etc.), while controlling the supply of water to each apartment. This allows you to use the new Smart Grid technology to provide each customer with water to a desired quality.

Smart water grid (2)

In this regard, considerable interests are the new Smart Grid technologies, which will take over the function of monitoring the health of users, water quality management, as well as transport and energy infrastructure in cities. Their development is directly related to the design and developments of intelligent sensors monitor the quality of incoming water to the consumer, which combine a number of qualities:

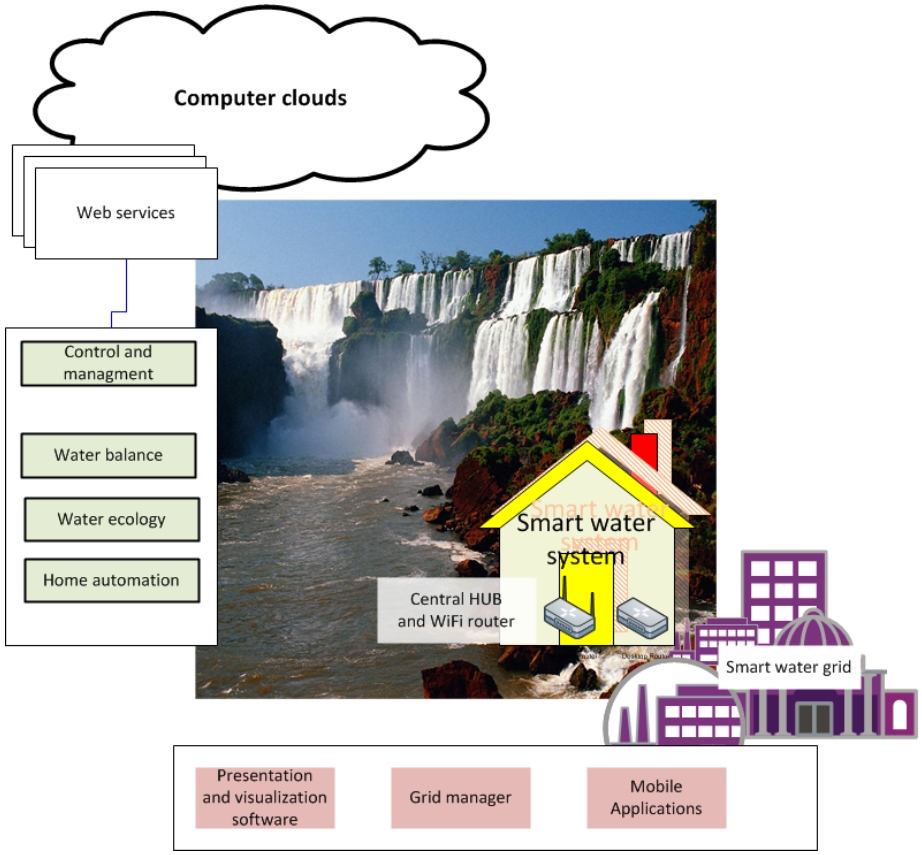
- Low cost and ease of use;
- Reliability of the information from the customer which it depends for its security;
- The possibility of continuous-time monitoring of water quality to the consumer;
- The ability to supply water to the consumer with the required quality and cost.

Leakage is a huge concern in areas of high water stress. Leaks not only mean lost water and revenue, they also increase water companies' energy bills for pumping and treating water that never gets used. Detecting and dealing with leaks is the problem to solve in the project and it is set to be a huge market.

Problems solved in the project:

- Minimization of the costs for providing consumers with drinking and industrial water.
- Fullest through phased water use from the moment of the first customers to the consumer and subsequent disposal or return of water to clean up and re-use.
- The development of sensors for water quality control to ensure the continuity of control in real time.
- The development of software tools for optimization of water resources control and supply of water to each customer with determine quality.

Smart water grid (3)



Experience of our team in creating such systems in energy sector can be successfully applied to create smart distribution systems and water consumption. The information about one of such international project with our participation can be briefly available on the project website: http://smarthg.di.uniroma1.it/

The picture above demonstrates short concept of such smart water management architecture. The system is based on modern web services technology and use computer cluster's systems to deploy services for wide web access for each smart home system. The management tool includes mobile systems to make remote control of whole smart hose

Recommendations

Focusing on optimization from the earliest stages will allow water utilities to more effectively deploy a smart water system. In addition, utilities deploying smart water technologies should involve customers from the earliest stages of planning and deployment. Finally, water utilities should plan for decreased departmentalization and an integrated system that maximizes information, through both information technology and operations technology.

Energetic interactive computer system (1)

Interactive computing system for decision support of long-term prognosis on energy sector development

Development of interactive computing system for decision support of long-term prognosis (further named SYSTEM) on demand in primary energy sources, electricity and heat energy and for optimal planning of putting into operation of energy units and for minimising of cost on electricity and heat energy production.

Project SYSTEM will develop an integrated interactive computing system for effective support of decision making for energy sector development based on systems analysis approach. 8

SYSTEM is an economic model generator for local, national or multi-regional energy systems, which provides a technology-rich basis for estimating energy dynamics over a long-term, multi-period time horizon. It is usually applied to the analysis of the entire energy sector, but may also apply to study in detail single sectors (e.g. the electricity and district heat sector).

The proposed project aims at providing a fully consistent framework for a secure energy provision, which is at the same time environmentally friendly and affordable. The conclusions of the project must result in policy recommendations for the Government to develop optimal energy system. Within the framework of the proposed project the technologies, actions, strategies and corresponding political decisions are analyzed and evaluated in accordance with the problem of reducing the energy intensity in the context of national energy system, ecology and social ambience that expects consideration of energy system as a whole, including all modern fuel-energy technologies of transformation, implemented in energy sectors.

Energetic interactive computer system (2)

Interactive computing system for decision support of long-term prognosis on energy sector development

- The SYSTEM will be ready to use on web distributed calculating technology such as cloud SaaS systems.
- The **strategic objective addressed by this project is to provide the Government with coherent guidelines and recommendations to optimise the future nature of energy provision and the electricity generation mix in the country so as to guarantee an *affordable, clean and reliable, i.e., 'sustainable', energy supply system.***

Techdom (1)

Expert system for building energy and technologies modeling and assessment [Techdom]

Development of integrated system based on physical and mathematical models of energy processes in buildings as a set of constructive 3D-elements with appropriate physical parameters and colour visualization for evaluation of real effects of technologies for energy-efficient buildings. Systems based on those models can serve as home energy controlling hubs that will collect real-time data on energy consumption data from smart household appliances and enable intelligent automation.

In many countries commercial buildings consume about 50 percent of their electricity demand, creating an incentive for utilities to encourage energy management technology and practices in those buildings. Therefore utilities should make technology investments that support business strategies and goals in energy efficiency, demand response, and renewable energy. Smart technology decisions must not only satisfy regulatory requirements but provide value to the business in the form of innovation, growth, or competitive advantage. This includes a wide range of products electricity utilities use to monitor and manage their grid infrastructure in a smart way, and an array of devices and control systems that permit commercial and residential customers to optimize energy usage.

Proposed project will contribute as well to the Energy-Efficient Buildings Initiative by developing management and control system, and decision-support system addressing the dynamics of energy supply and demand in neighbourhoods and extended urban/rural communities. This system will develop for optimizing usage of energy beyond the buildings, and they include the integration of renewable energy sources and the connection to the electricity distribution grid in order to take advantage of variable tariffs and diversity of supply.

Techdom (2)

•The Techdom Smart Energy Management System makes possible to measure, monitor and manage the local energy demand though intelligent control of energy consuming devices as well as distributed energy generating and storage installations. By collecting, aggregating and analyzing real-time or near real-time data from the devices, the system provides demand and generation forecasts and decision support. Based on individual contracts with the consumer/prosumer, determining flexibility load and control, a more reliable customer demand is achieved and enforced through intensive grid monitoring and automation.

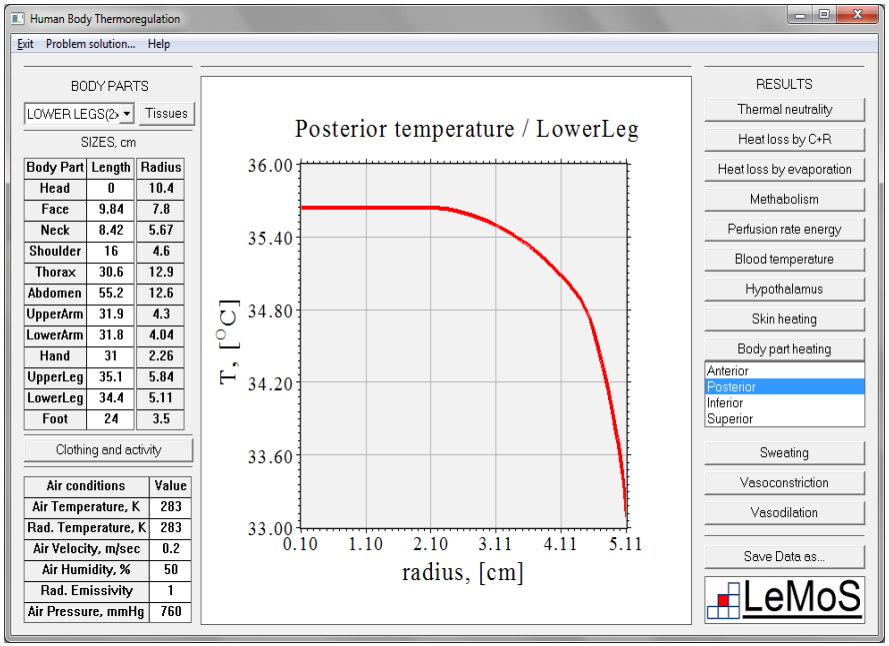
Techdom (3)

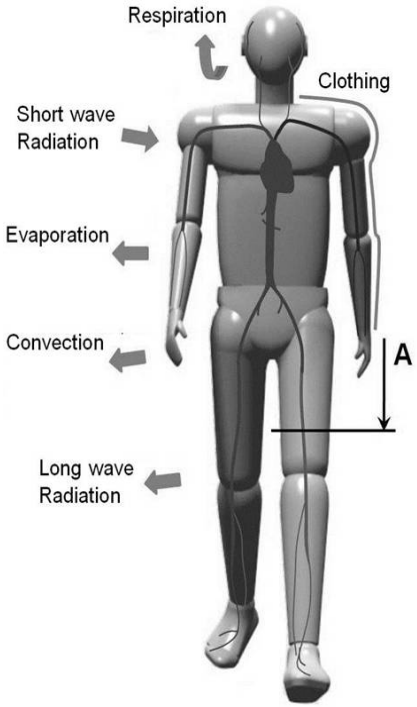
- The Decision Support Dashboard offers energy consumption and generation information (current and historical conditions) to Distribution System Operators (DSO) and Aggregators. Based on the information, the operator can decide on requesting load-shifting actions in critical parts of the power grid to prevent overloads. Upon receiving a request, the Aggregator uses the dashboard to estimate the possibilities of shifting load based on the grid structure and the contracts with households.
- One of the key enablers of a smart grid is the engagement and flexibility of the consumer. To create awareness of own energy consumption and motivate change in energy behavior, the Techdom consumer solution enables the costumer to follow the historical and current energy consumption of the households and selected devices and compare it with other households.

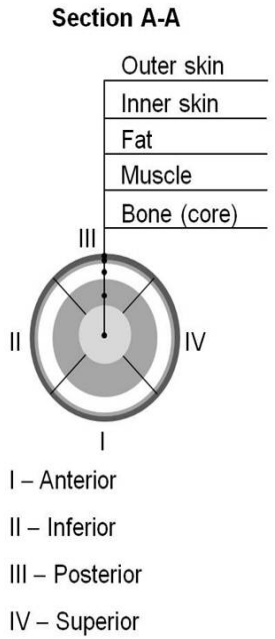
Computational fluid dynamics heat and mass transfer (FD/H&MT)

Human body thermoregulation/ heat & moisture transfer in clothes

Developing in-house software ‘Human body thermoregulation’ (Solver based on Fiala’s model, GUI for pre- and post-processing, material properties database)







Optimisation of vehicle control system

We created new methods for optimisation of vehicle driving and control. The methods based on using of modern smart technology

The implementation of this methods provides:

•Optimisation of energy using in vehicles

•Distance visualisation of parameters to the mobile gadgets iPhone, iPad, etc.

•Using of computer cloud technologies for collection of statistical data, visualisation and control

•Consideration of driver operation characteristics and driving control of vehicles by the different driving performance

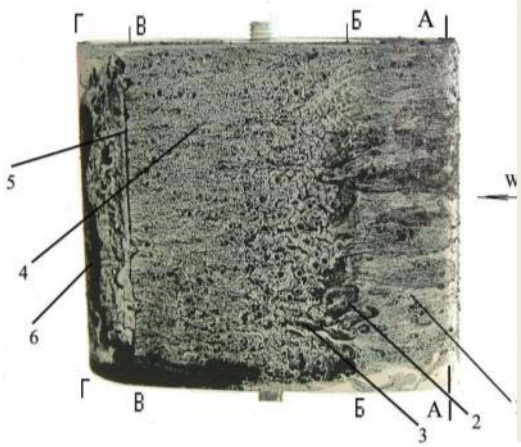
•Using of fuzzy mathematics for optimisation and speed up of decisions (decision support system-DSS).

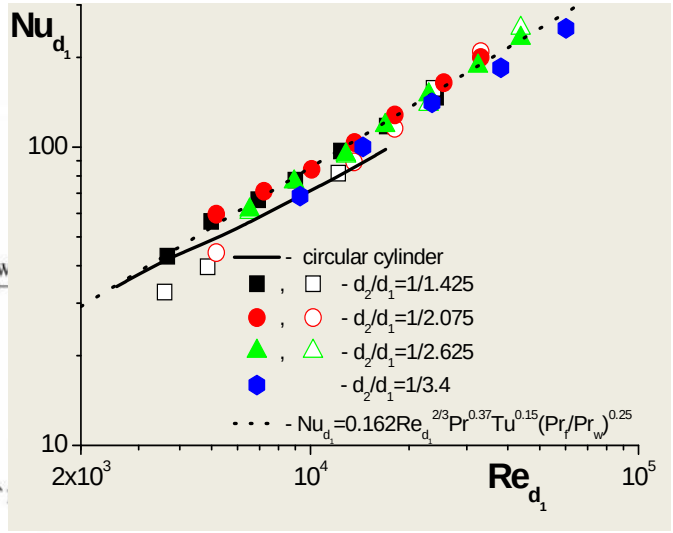
Additional we can provide by the development more options according customer requests. To example health control of drivers.

Computational FD/H&MT*:

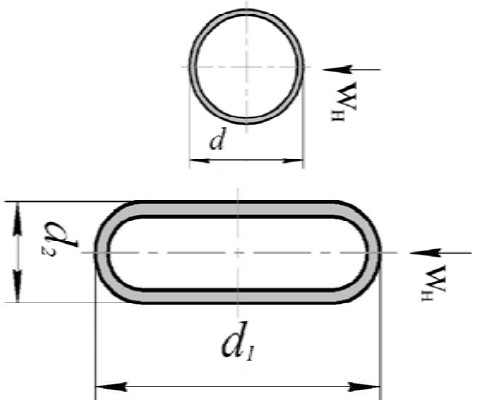
Heat transfer optimization for heat exchanger elements

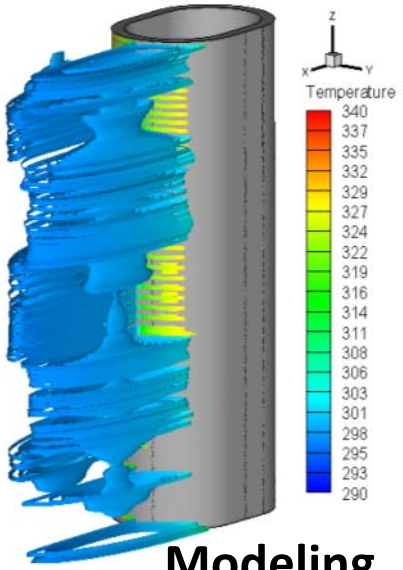
Experiment at Re=15 000





Comparison of oval-shaped cylinders with circular ones





Modeling

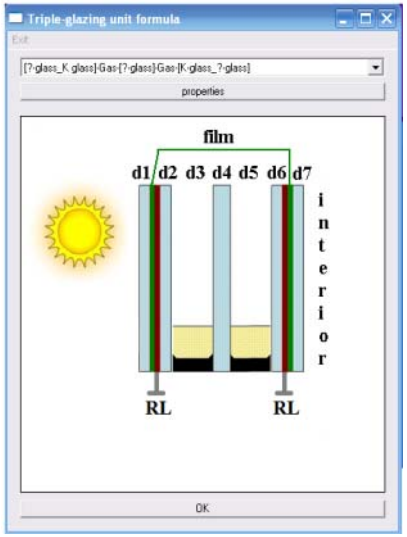
*fluid dynamics heat and mass transfer

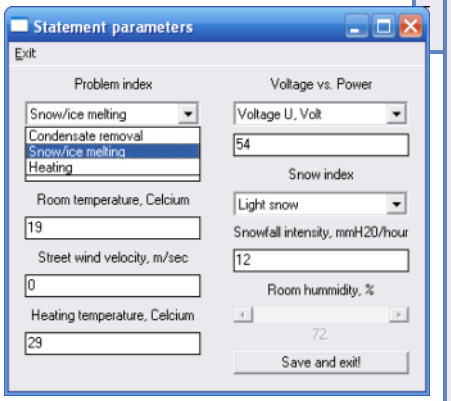
Computational FD/H&MT*

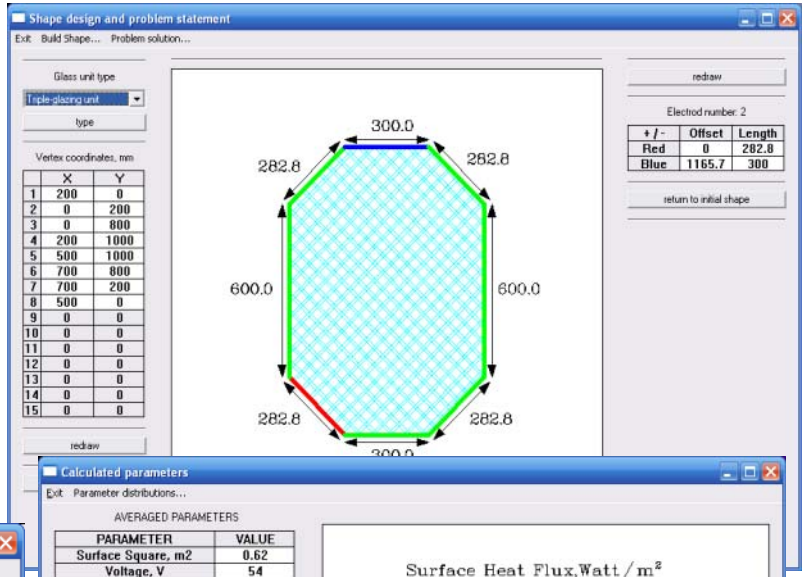
Heating glass covers and window glazing

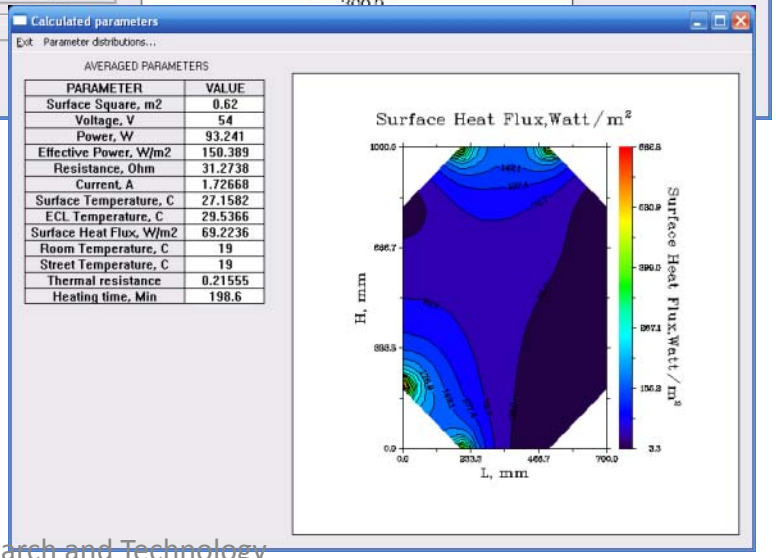
Developing in-house software ‘GlassHeat’ for calculation of heating of special glass covers with electrically conductive layers for:

- room heating,
- condensate removing,
- snow and ice removing









*fluid dynamics heat and mass transfer