NETCENG 2014 2015 2016

New Model of the Third Cycle in Engineering Education Due to Bologna Process in BY, RU, UA

Tempus Joint Project Curricula Reform

www.netceng.eu

Казанский национальный исследовательский технический университет им. А.Н. Туполева

KAZAN NATIONAL RESEARCH TECHNICAL UNIVERSITY KNRTU-KAI

1-5 December 2015

TEMPUS *(NETCENG) project*

«New model of the third cycle in engineering education due to Bologna Process in BY, RU, UA»

Presentation Author

Ellina GOGOL, ass.prof., KNRTU-KAI

The University's Key Dates

1932 - founded as Kazan Aviation Institute (KAI)

1992 – received a status of State Technical University

2009 – received a status of National Research University

2014 – opening of GRIAT

Administration Building in the downtown

Modern Building in a new campus

KNRTU-KAI new Campus project

University’s new campus

Sports Facilities

Multifunctional Complex “KAI-Olympus”

50-meter Swimming Pool

Indoor Playground

Outdoor Playground

The University Today

Number of Students – approx. 17 000

Licensed B/DE/M/PhD/DSc Programs – 160

Number of Academic Institutes & Faculty (in Kazan) – 7

Number of Departments – 46

Research-Educational Centres – 10

Research Laboratories – 57

Teaching and Research Staff – approx. 1000

Number of Branch Institutes (outside of Kazan) – 8

Alumni – approx. 100 000+

Subject Areas of the University

- Aircraft and Aircraft Engines Engineering
- Land Vehicles Engineering
- Machinery Engineering and Material Sciences
- Power Engineering, Electrical Engineering and Heat Power Engineering
- Instrument Making, Control Systems and Opto-Electronics
- Radio-Electronic and Info-Communication Technologies and Telecommunication Systems
- Electronics, Microelectronics and Nanoelectronics
- Computer Systems
- Applied Informatics, Software Engineering
- Economics, Management, Marketing, Sociology, Public Relations

ACADEMIC STRUCTURE of the UNIVERSITY

INSTITUTE of AVIATION, LAND VEHICLES and ENERGETICS

DEPARTMENTS:

- Automobile Engines & Service
- Air & Hydro- Dynamics
- Aircraft Design & Construction
- Material Engineering, Welding and Industrial Safety
- Machinery Engineering & Engineering Graphics
- Aircraft Production
- Strength of Constructures
- Jet Engines & Power System
- Heat Engineering & Power Engineering
- Machinery Technology & Production Organization

ACADEMIC STRUCTURE of the UNIVERSITY

INSTITUTE of AUTOMATION & ELECTRONIC INSTRUMENT-MAKING

DEPARTMENTS:

- Instruments and Information & Measuring Systems
- Opto-Electronic Systems
- Electrical Equipment
- Automation & Control
- Standardization, Certification & Technological Management
- Industrial Ecology & Safety
- General Chemistry & Ecology

ACADEMIC STRUCTURE of the UNIVERSITY

INSTITUTE of COMPUTER TECHNOLOGIES and INFORMATION SECURITY

DEPARTMENTS:

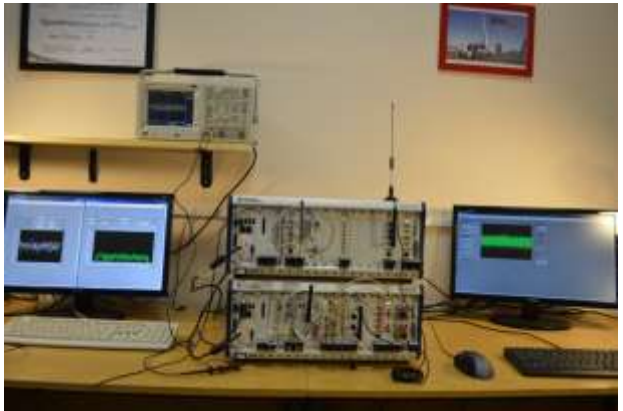
- Information Technology Design of Computing Machines
- Control and Process Dynamics
- Information Security System
- Applied Mathematics & Informatics
- Computer Systems
- Automated Information Processing Systems & Control

ACADEMIC STRUCTURE of the UNIVERSITY

INSTITUTE of RADIO-ENGINEERING and TELECOMMUNICATIONS

DEPARTMENTS:

- Radio-Electronic and Information & Measuring Technology
- Nanoengineering in Electronics
- Design & Manufacturing of Electronic Equipment
- Radio-Electronic & Telecommunication Systems
- Television & Multimedia Systems
- Radio-Electronic & Quantum Instruments
- Special Technologies in Education



ACADEMIC STRUCTURE of the UNIVERSITY

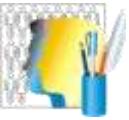
PHYSICS and MATHEMATICS FACULTY

DEPARTMENTS:

- General Physics
- Higher Mathematics
- Technical Physics
- Theoretical & Applied Mechanics
- Special Mathematics
- Laser Technologies

ACADEMIC STRUCTURE of the UNIVERSITY

Institute of Economics, Management and Social Technologies



DEPARTMENTS:

- Foreign Languages
- History & Public Relations
- Social and Political sciences & Management
- Philosophy
- Athletics & Sports
- Economics & Business management
- Economic Law
- Russian & Tatar Languages
- Economical Theory
- Engineering Psychology & Pedagogic

ACADEMIC STRUCTURE of the UNIVERSITY

German-Russian Institute of Advanced Technologies

Key Features:

- The GRIAT is a division of KNRTU-KAI that works on the basis of German standards of engineering education correlated with Russian requirements
- Offers Joint Master and Doctoral Programs
- Training language is English
- In respect of the Institute, the Russian Federation's legislation acts

Key Features:

- Training is conducted by Russian and German professors in English
- Master’s Degree Programs: 3 terms at KNRTU-KAI, 1 term at the German partner university
- Co-supervising of MSc thesis by German and Russian professors
- Graduates successfully completed the programs will receive a Double degree: from KNRTU-KAI and from the German partner university

GRIAT Academic Partners:

- **TU-Ilmenau;**
- **University of Magdeburg;**

DAAD Deutscher Akademischer Austausch Dienst
German Academic Exchange Service

Current Academic Programs:

- Communications and Signal Processing – a joint MSc-program with TU-Ilmenau;
- Electrical Engineering and Information Technology – a joint MSc-program with University of Magdeburg;
- Research in Computer and Systems Engineering – a joint MSc-program with TU-Ilmenau;
- Chemical and Energy Engineering – a joint MSc-program with University of Magdeburg;
- Automotive Engineering – a joint MSc-program with TU-Ilmenau (start in 2015);
- Systems Theory and Automatic Control – a joint MSc-program with University of Magdeburg (start in 2015)

Academic Fields planned to be covered:

- Radio-Electronics & Telecommunications;
- Electrical Engineering;
- Power Engineering;
- Instrument-Making;
- Information Technologies;
- Mechanical Engineering;
- Aviation and Transport;
- Computer Technologies.

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GRIAT is a PLATFORM
for German-Russian collaboration in the fields of research and higher education
New members are welcomed
to the Consortium!

In fact GRIAT is a German-Russian Technical University

E-Learning

Unified Educational Space of the University

Web-based Teaching and Learning Technologies

Analitics and Reporting

Synchronous Learning: Classroom and Cooperation

Mobile Access and Communication

The Learning Process based on Blackboard

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Research Centers, Laboratories Innovation& Research Activities

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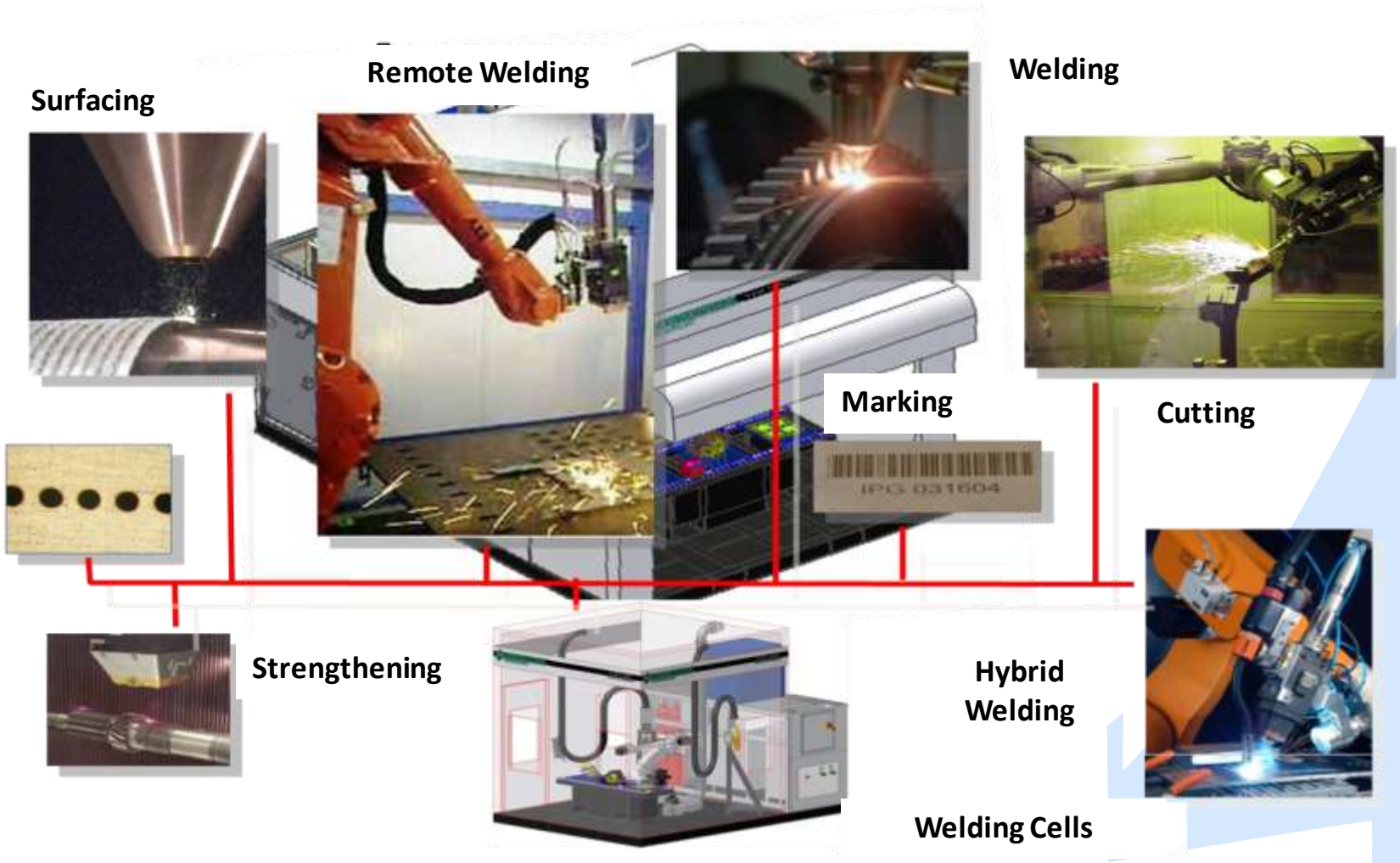
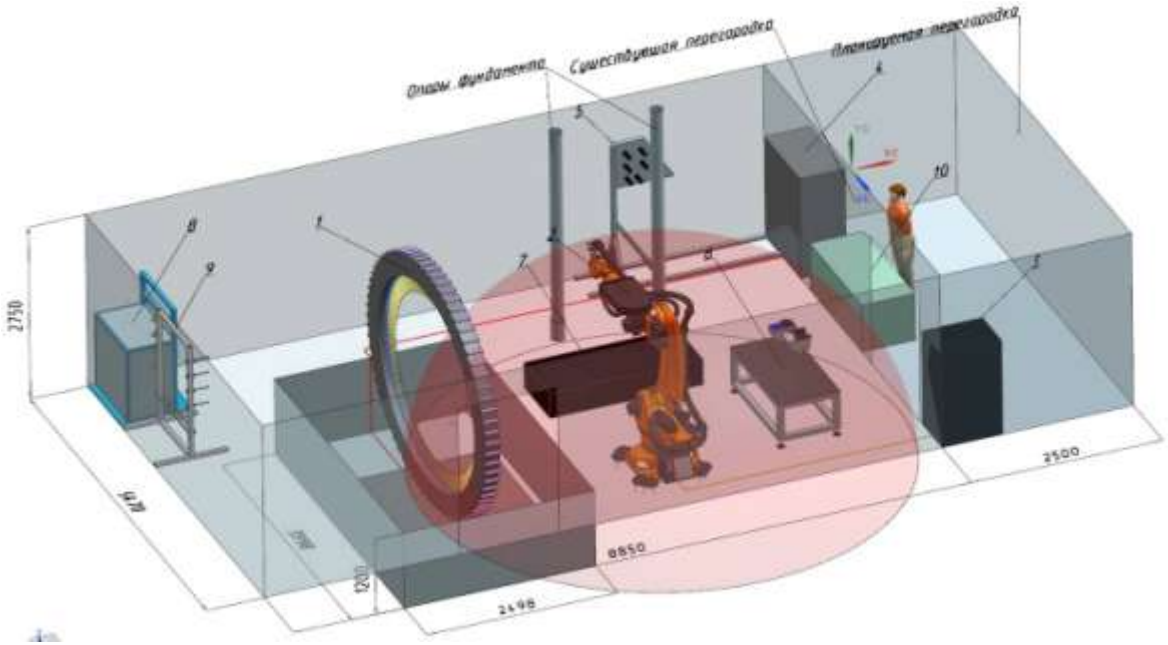
Regional Engineering Center of Laser Technologies «KAI-Laser»

Equipping of the Center:
All Competencies of Laser Technologies



Engineering Center of Composite Technologies «KAI-Composite»

Braider-Stitching Complex

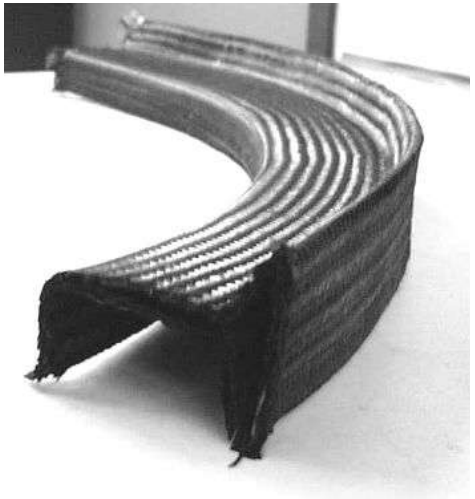


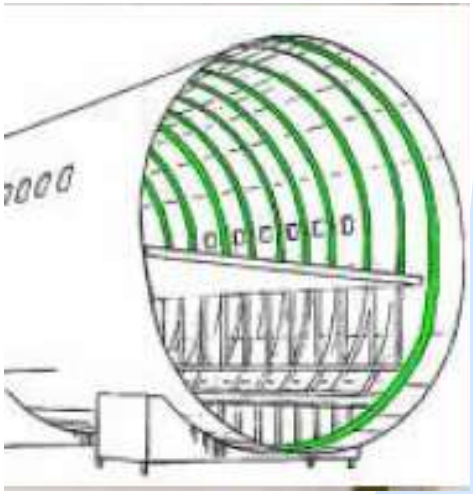
Cost: approx. 50 Mln.Rub.
Square: 100 Sq.m.

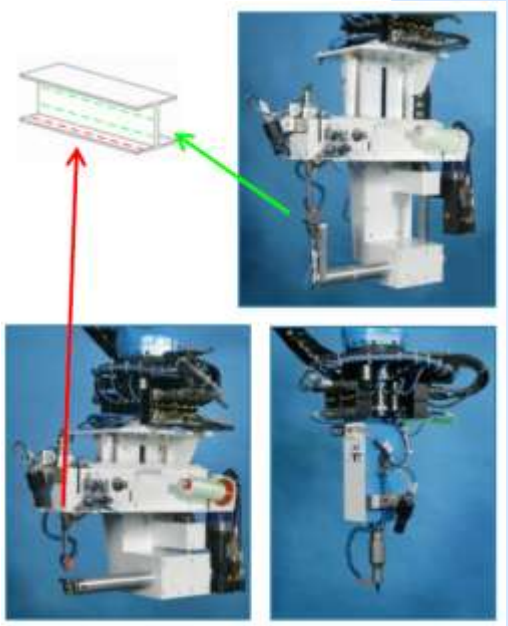
Applications

Pre-Forms for:

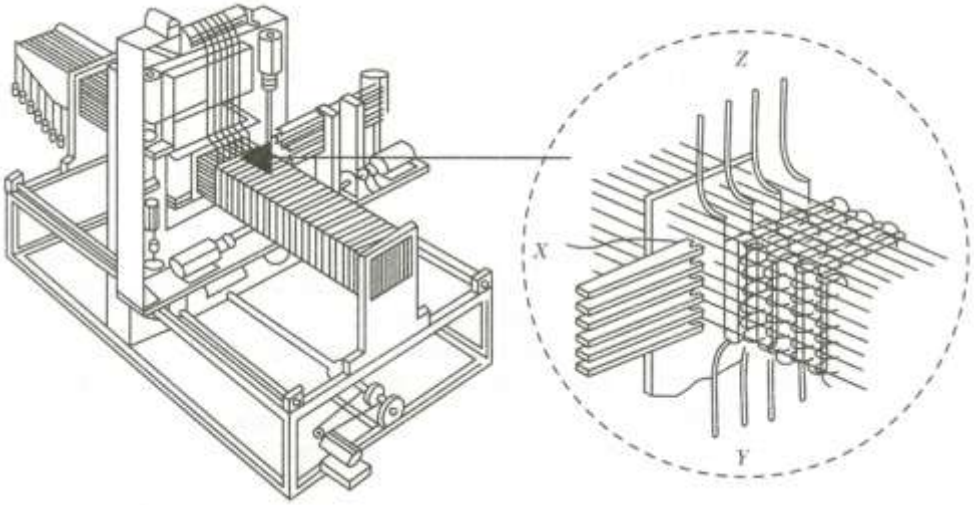
- **Aircraft's Frame Elements;**
- **Aircraft's Doors and Hatches;**
- **Elements of High-Lift System;**
- **Blades of Aviation Engine;**







3D Weaving Complex for Composite Pre-Forms



Costs: approx. 60 Mln.Rub.
Square: 200 Sq.m.

Laboratory of Armor-Clad Thermoplastics

Equipment:

- **High-Temperature Presses and Ovens;**
- **Foundry Machine;**
- **Complex for Automatic Laying Out of Thermoplastics**

Manufacturing of Matrices by Infusion Method

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HEAT EXCHANGE, HYDRODYNAMICS AND STRUCTURAL ANALYSIS COMPUTER MODELING CENTRE

Centre of computer modeling was established on the basis of research institute "Power efficient technologies KNRTU–KAI" and has:

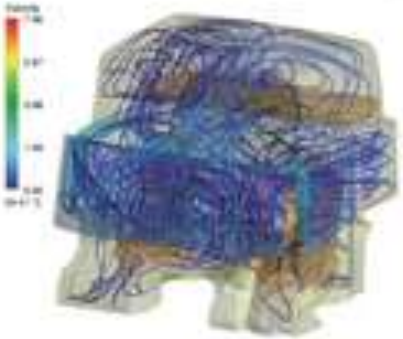
- High-performance computing cluster – Silicon Graphics SGI A450
- 3 graphics workstations – Arbyte CADStation WSW 620
- 35 computers based on processors Intel core 2 duo

UNIVERSITY HAS COMMERCIAL LICENSES FOR THE FOLLOWING SOFTWARE:
Ansys, Unigraphics NX, Team Centr, Pro E, Catia, ProCast and etc.

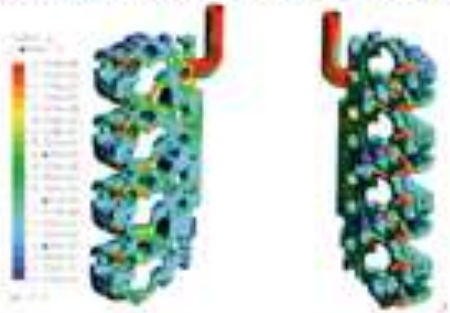
ANSYS NX UNIGRAPHICS TEAMCENTER PTC ProENGINEER CATIA ProCAST

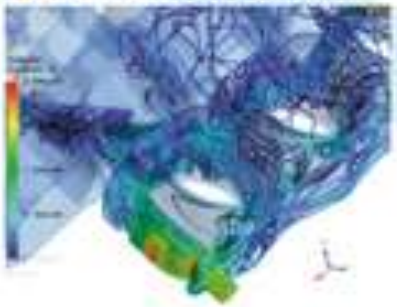
CENTRE IS DOING WORKS FOR OJSC KAMAZ, OJSC KMPO, KER-HOLDING CO LTD, FEDERAL STATE-OWENED ENTERPRISE "SSRICP", OJSC "SDTB RADIO EQUIPMENT", JOINT INSTITUTE FOR HIGH TEMPERATURES OF THE RUSSIAN ACADEMY OF SCIENCES, KAZAN SCIENTIFIC CENTER RAS, MINISTRY OF ENERGY OF THE REPUBLIC OF TATARSTAN

DESIGN OF POWER EFFICIENT MULTIMODE VENTILATING AND HEATING SYSTEM OF THE CABIN

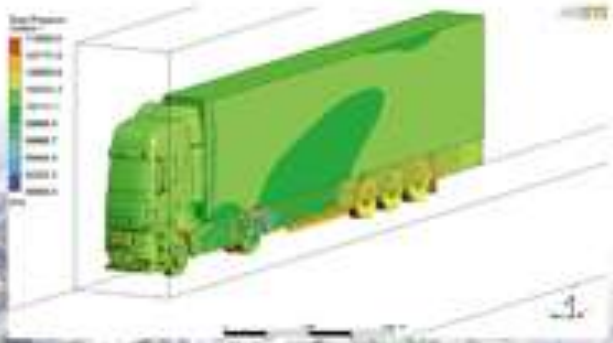


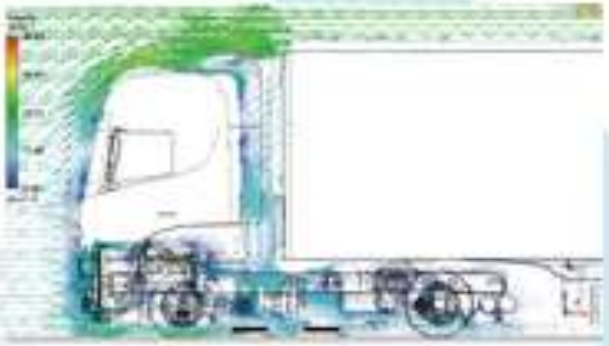
OPTIMIZATION OF COOLING SYSTEM BY-PASS FOR KAMAZ ENGINE





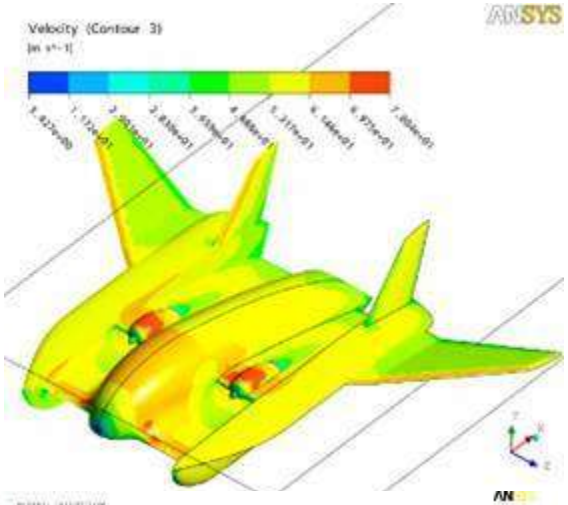
COMPUTATION OF EXTERNAL VEHICLE AERODYNAMICS OF KAMAZ 5490

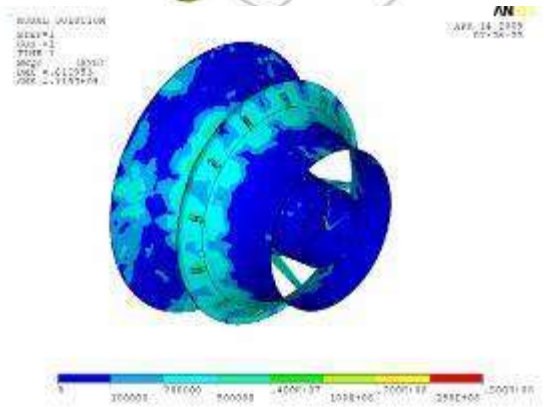


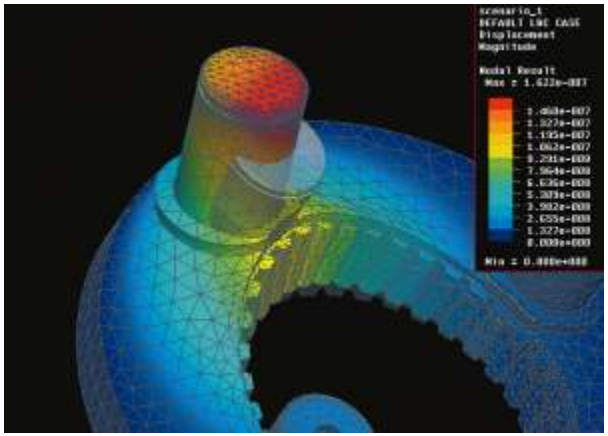


Numerical Analysis & Computer Modeling Center

Center is doing works for OJSC KAMAZ, OJSC KMPO,KER-HOLDING CO LTD, FEDERAL STATE-OWENED ENTERPRISE «SSRICP», OJSC «SDTB RADIO EQUIPMENT», JOINT INSTITUTE FOR HIGH TEMPERATURES OF THE RUSSIAN ACADEMY OF SCIENCES, KAZAN SCIENTIFIC CENTERS RAS, MINISTRY OF ENERGY OF THE REPUBLIC OF TATARSTAN







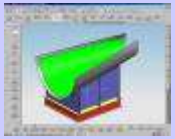
-Design of power efficient multimode ventilating & heating system of the cabin

-Optimization of cooling systems by-pass for KAMAZ engine

- Computation of external vehicle aerodynamics of KAMAZ 5490

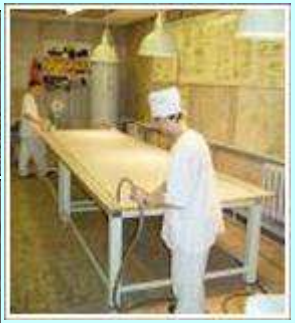
KNRTU-KAI has commercial licenses of: Ansys, Unigraphics NX, Team Center, Pro E, Catia, ProCast and etc.

Research Centre of Composite Technologies



Design of construction and rigging

Physics and chemistry of composites

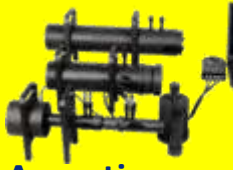


Technological processes

Impact tests

Multylayered construction

Static tests

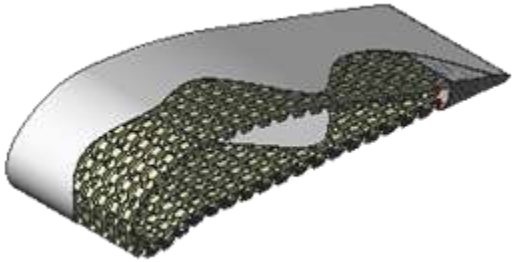


Acoustic research

Research Centre of Composite Technologies

- Optimization of technological processes of autoclave and transfer molding of composite products
- Development of special manufacturing equipment for production of parts from polymer composite by folding.
- Development of manufacturing technique of folded fillers of aircraft and integral constructions of composite panels.
- Research of static strength and impact resistance of composite constructions.
- Determination of physicochemical properties of composites and development of thermal-resistant binders
- Design of stockpile rigging and special-purpose equipment

Purpose: carrying out R&D in the field of development of composite technologies for enterprises of transport machine building



Казанский национальный исследовательский технический университет им. А.Н. Туполева

AERODYNAMICS LABORATORY

INCLUDES TWO WIND TUNNELS T-1K AND T-3K

Laboratory exists more than 60 years.
Both wind tunnels are in good workable condition and have required certificates.

Are equipped with:

- automated system for measuring integral (weight) and distributed aerodynamic characteristics;
- system for measuring local flow rate based on PIV-system;
- system for automatic measurement of surface pressure is being implemented.

Available complex of equipment and implemented automation system provide speeding-up of processes of carrying tests, picking-up, computing and processing of information more than 6 times.

WIND TUNNELS OF KNRTU–KAI NAMED AFTER A.N. TUPOLEV ARE RECOGNIZED AS ETALON IN THE SYSTEM OF STATE COMMITTEE OF THE RUSSIAN FEDERATION FOR STANDARDIZATION, METROLOGY AND CERTIFICATION

COMPLETED WORKS:

1. Complex aerodynamic researches for ASTC "TUPOLEV", "Academician V.P. Makeyev State Rocket Centre", experimental design office "SOKOL" and others are conducted.
2. Results of aerodynamic tests were used when designing Ty-204, Ty-334 and other aircrafts.
3. Aerodynamic researches for automobile experimental design offices "VAZ" and "KAMAZ" are conducted.
4. New constructions of wind turbines are examined and patented.
5. Series of skyscraper tests are conducted.

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WIND TUNNEL T-1K

Velocity, m/s from	10 to 50
Flow inaccuracy, m/s	± 0.3%
Diameter of working area, m	2.25
Power, kW	300

WIND TUNNEL T-3K

Velocity, m/s from	10 to 50
Flow inaccuracy, m/s	± 0.3%
Diameter of working area, m	0.7
Power, kW	30

Robustness Testing Laboratory

(accredited by aviation register of interstate aviation committee)

Tested products:

- **Aircrafts**
- **Aircraft components**
- **structural elements and materials**

Test modes:

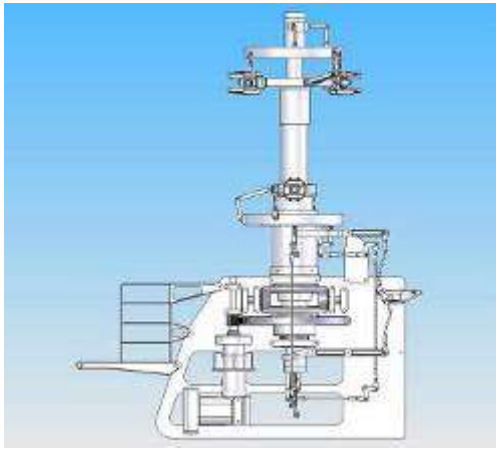
- **Static tests repeatedly static**
- **Life, fatigue and vitality tests**
- **Tribotechnical tests**
- **Environmental tests**

Laboratory provides certification and serial maintenance of JSC Kazan Helicopters helicopter equipment

More than 80% of all certification tests of ANSAT helicopter construction, units and devices are made here.

Design and Manufacturing of Small Aircrafts (Student’s R&D Center)

Full design of product, technological process and manufacturing of products from polymer composite in cyberspace using modern bundled software and research and processing equipment



CONSTRUCTION AND DESIGN OF SMALL AIRCRAFTS

KAI-81 IS SUPERLIGHT AIRCRAFT WITH PIVOTING WING

PATENT (RUSSIAN FEDERATION) №2277496 10 JUNE 2006.

Crew of flight tests

KAI-81 is ready for transportation

GYROPLANE – KAI-002A

SMALL UNMANNED AERIAL VEHICLES

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GYROPLANE – KAI-002A

SMALL UNMANNED AERIAL VEHICLES

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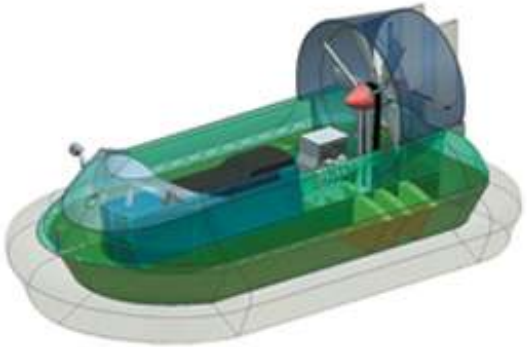
AMPHIBIOUS TRANSPORT SYSTEMS

HOVERCRAFT "OMEGA-2"

Hovercraft "Omega-2" is designed for year-round exploitation on river and lake waters. Hovercraft can be used on water, snow, ice, soil, grass and other types of relatively plane surfaces. Hovercraft can also be used on the first ice and during the ice drift.
Hovercraft "Omega" is excellent transport vehicle for movement on mountain rivers, since velocity of rivers does not affect on speed of hovercraft.



DESIGN DESCRIPTION OF HOVERCRAFT "OMEGA-2"

- Housing is made of fiberglass consists of three main parts: bilge, deck and air channel.
- Inner cavities of housing are filled with foam plastic. This provides 100% floodability of hovercraft.
- Cabin is designed to allocate 3 or 4 passengers. Depending on design passengers are allocated in 2 rows or longitudinally on one big seat (of motorcycle type).
- Awning and independent heating system can be mounted as an option for exploitation in cold weather and in winter. Segmental construction of flexible seal is reliable during exploitation and makes it possible for hovercraft to move even when several segments are damaged.
- Repair is not complicated because segment of flexible seal can be changed in 5 minutes. Fuel system consists of one tank with capacity of 60 l.
- Atmospheric gasoline engine VAZ 21114 with volume 1,6 litre and power 120 hp adapted for hovercrafts is mounted on the hovercraft.

TECHNICAL CHARACTERISTICS

Length	4 m
Width	2 m
Seating capacity	3 or 4 persons
Load carrying capacity	350 kg
Hovercraft weight	280 kg
Fuel tank capacity	60 l
Maximum run	300 km
Maximum speed:	
on water	80 km/h
on snow and ice	100 km/h
on sand	50 km/h
clearance	0.25 m

Scientific-Educational Center «Modern Technologies of Mechanical Processing»

Studies and Research in the field of application integrated CAD/ CAM/ CAE/ PLM/ ERP Systems for Mechanical Processing

FOUNDRY TECHNOLOGIES

The laboratory for determination of thermo physical and technological properties of various materials at high temperatures is used to:

- Design foundry equipment
- Development of foundry technologies and modeling of foundry processes.

Technology for manufacturing of high-porous cellular ceramic material free from low-melting phase:

- Filtration refining of metallic melts is carried out by passing the liquid metal through filter element.
- Elimination of inclusions, degassing and uniform distribution of elements in the form of additives over the volume of melt

Center of Quick Prototyping and Technology of Direct Straight Manufacturing

3D Printer OBJET EDEN250

Thickness of construction layer – 16 micron
Accuracy – up to 0,1 mm
Min thickness of prototype's wall – up to 0,6 mm
Resolution of printing – up to 1600 dpi
High speed for prototype constructing
Compact, Safe, Easy to Maintain

Laser sintering system for the production of inserts mold for casting plastics and metals, as well as for the production of prototypes and manufactured products directly from the metals

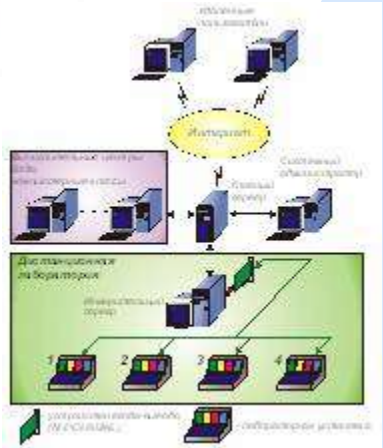
Performances:
Max Volume of Construction - 250 mm x 250 mm x 215 mm
Rotation Velocity – up to 220 mm/sec.
Thickness of layer (depends on metal) - 20 100 µm
Type of Laser - Yb-fiber laser, 200 Wt
Scanning Velocity - 7.0 m/sec
Variable Focus Diameter - 100-500 µм
Power (Maximum) - 5.5 kWt

The Remote Centre of Automatic Training Laboratory (National Instruments)

The center's main goals are:

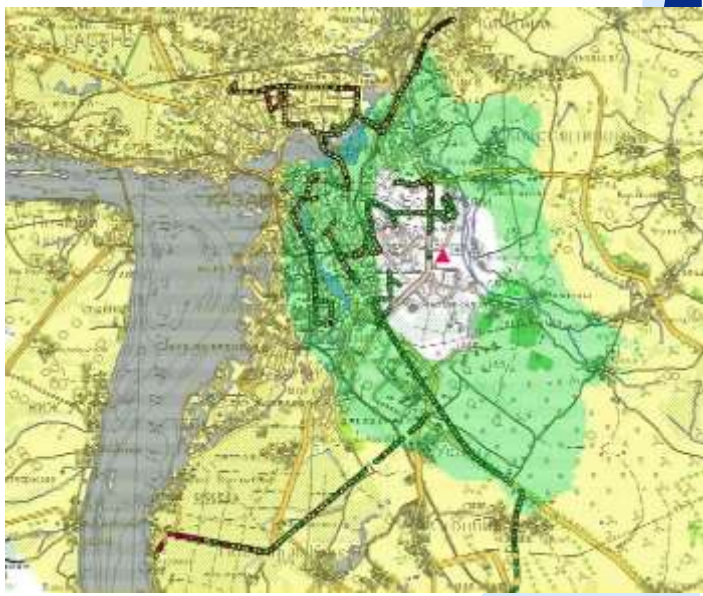
- Building and implementation of new technologies to the training process National Instruments (NI);
- Organization of extended professional programs of using new technologies NI;
- Organization of work-shops, seminars, conferences on implementing of new technologies, NI.

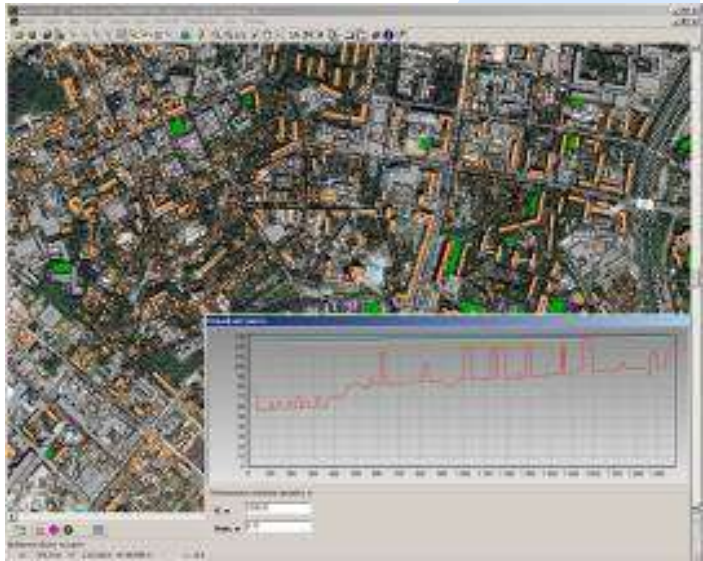
The structure of remote management of training and scientific experiments



Scientific-Educational Center «Radio-Electronics and Infocommunications»

- Research and development of electronic, information and communication technologies, systems and complexes.
- Specialized electronic systems of communication, navigation, identification.
- Theory directional and microwave radiating systems.
- Satellite navigation and GIS technology.
- Biomedical electronics.
- Energy-efficient, energy-saving electronic systems.
- Information and communication technologies in education





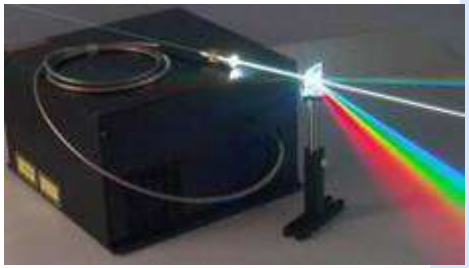
Scientific-Educational Center «Fiber-Optic Technology»

- Design, development and implementation of fiber-optic telecommunications systems and components.

- Design, development and implementation of fiber optic sensor systems , fiber-optic pressure sensors , temperature sensors , vibration sensors to monitor temperature, pressure , movement , vibration , deformation of objects for different purposes, removal and analysis of measurement data from distributed and the quasi sensory systems.

- Design and manufacture of fiber lasers and boosters based on optical fibers doped with rare earth elements.

- Development and production of electronic devices used in the creation of systems and devices in the field of fiber optics



Regional educational and research centre «Diagnostic and certification of nanomaterials»

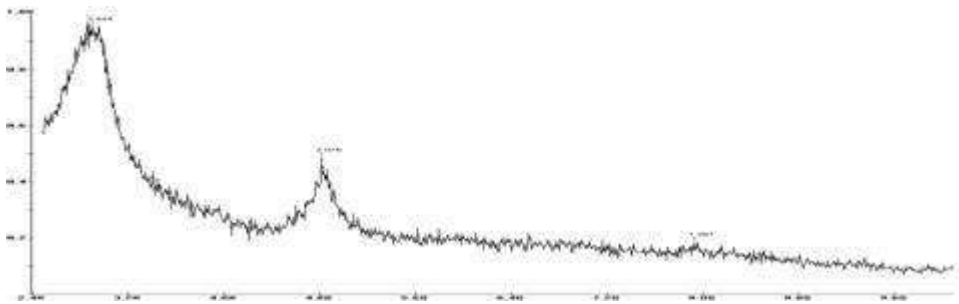
The centre has a wide range of new scientific equipment:

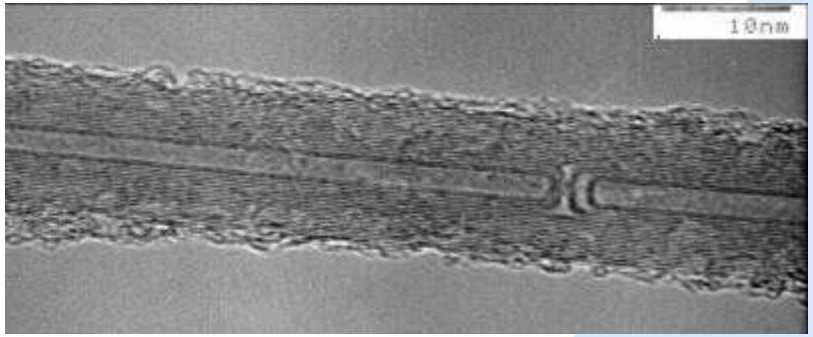
Illuminate electrical scope LIBRA-120

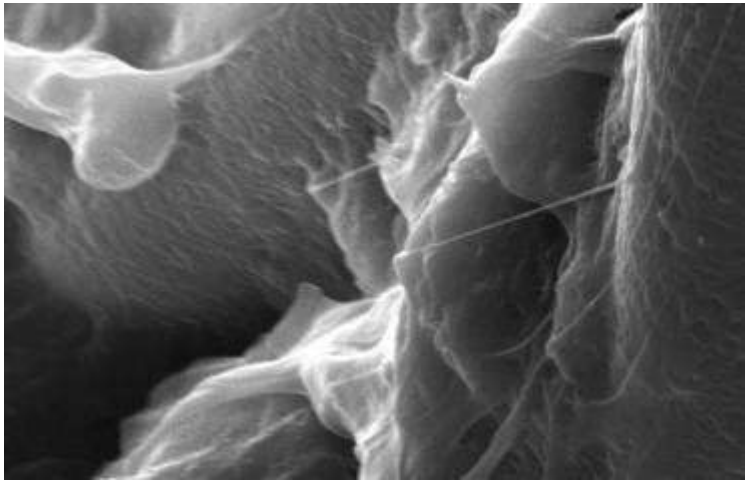
Working station Auriga™ CrossBeam®

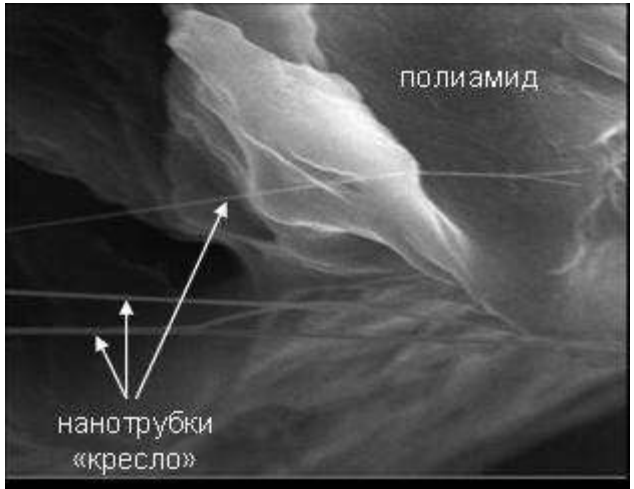
Regional educational and research centre «Diagnostic and certification of nanomaterials»

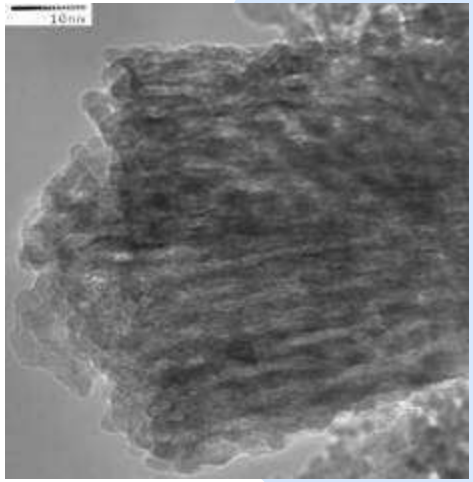
The goal of concept is to train the specialists of the world level and the creation of native breakthrough industrial technologies in the field of high technological machanic engineering on the base of infocommunicational technologies, nano- techologies and new composite materials.









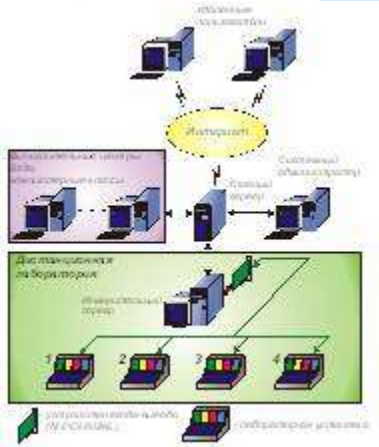


The remote centre of automatic training laboratory (National Instruments)

The center's main goals are:

- **Building and implementation of new technologies to the training process National Instruments (NI);**
- **Organization of extended professional programs of using new technologies NI;**
- **Organization of work-shops, seminars, conferences on implementing of new technologies, NI.**

The structure of remote management of training and scientific experiments



Research and Development Laboratory of Material Science, Welding and Structure-forming Techologies

Heat-resistant water-based binders for foundry

Binders Armosil are colloidal silica in aquatic environment – outwardly liquid of slightly yellow or grey color without visible mechanical impurity

Planetary-type mill «ACTIVATOR 2SL»

Is one of the ways of mechanical synthesis of nanopowders from solid substances.

Diffraction particle-size analyzer «ANALYSETTE 22 MICRO TEC Plus»

Laser diffraction particle-size analyzer is instrument of multipurpose application for determination of particle distribution over size in suspensions, emulsions and powders by laser diffraction

Казанский национальный исследовательский технический университет им. А.Н. Туполева

JOINT PROJECT OF KNRTU–KAI NAMED AFTER A.N. TUPOLEV AND JSC KAZAN HELICOPTERS

(Russian Federation government regulation №218)

PROJECT NAME: "Deign of modernized ANSAT helicopter with hydromechanical control system. Modernization of JSC KAZAN HELICOPTERS production to produce modernized ANSAT helicopter"

AMOUNT OF FINANCING: 162.0 MILLION RUBLES

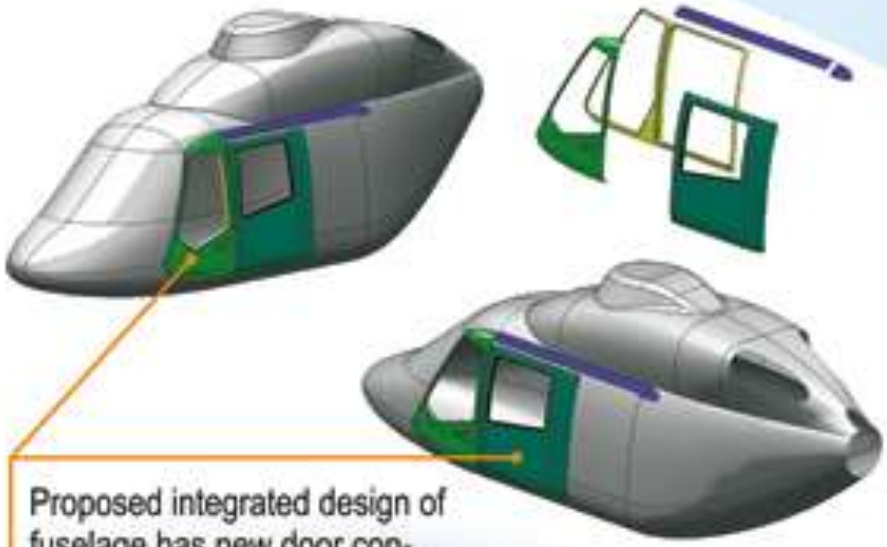
Areas of work:

1. Modernization of helicopter components including their production from new composite materials
2. Robustness and life tests of ANSAT helicopter com ponents.
3. Design of ANSAT helicopter anti-icing system.
4. Design of better control stability system of ANSAT helicopter.
5. Modernization of ANSAT helicopter electrical equipment on the basis of CALS technologies.
6. Design and implementation of automated planning and production control system.

Казанский национальный исследовательский технический университет им. А.Н. Туполева

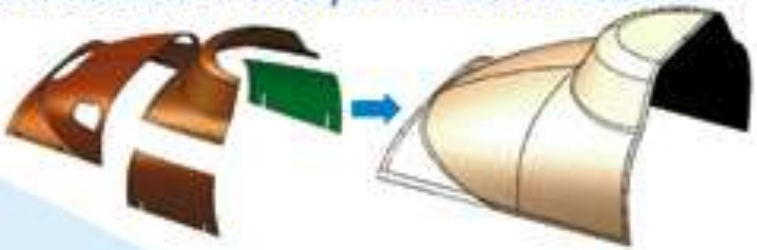
INTEGRATED DESIGN "FUSELAGE–DOORWAY–DOOR"

Based on the analysis three design variants of pilot and cargo compartment doorways were designed and proposed for consideration.

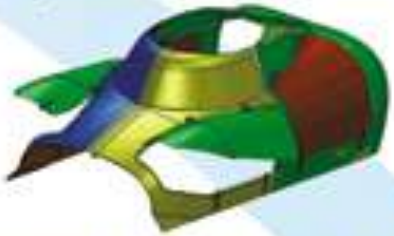


Proposed integrated design of fuselage has new door construction, new doorway and fairings.

CHANGE OF CONSTRUCTIVE SEPARATION AND USAGE OF COMPOSITE PANELS (MULTI-CORE/SANDWICH) IN THE COWL DESIGNS



THE VARIANT OF COWL FLAPS WITH INTEGRATED POWER PARTS (LOAD-BEARING) USING POLYMER COMPOSITE



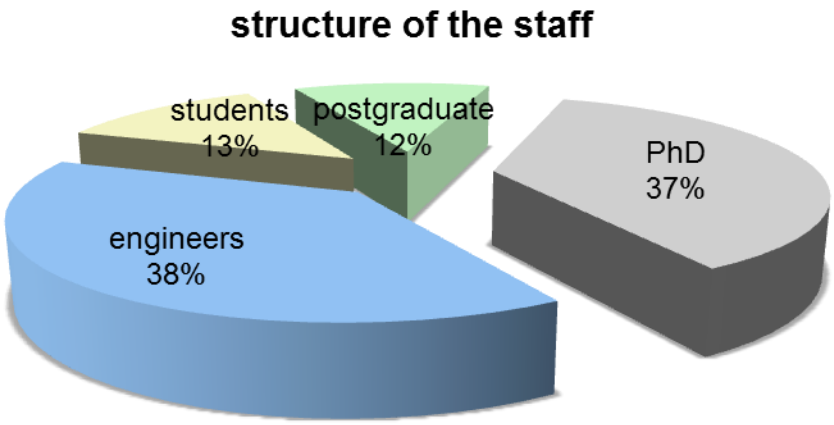
PROMISING VARIANT OF COWLS WITH IMPROVED AERODYNAMIC CHARACTERISTIC

Advanced Ecofriendly Vehicles with High Consumer Properties and Low Operating Costs

Resolution of the Government of the Russian Federation dated April 9, 2010 N 218 "Government support for the development of cooperation of Russian higher education institutions and organizations implementing complex projects on high-tech production

Financing of $ 9.2 million
Co-financing of $ 11.62 million
Involved staff of 9 Departments
Total Involved Staff - 254 persons
Number of research areas - 12

2009-2012 year

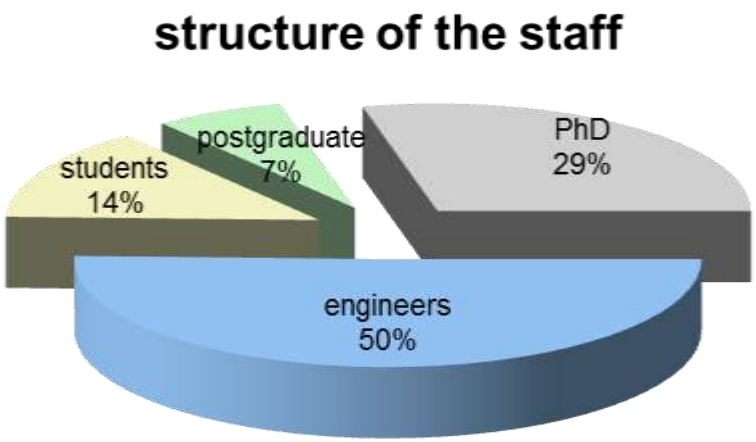


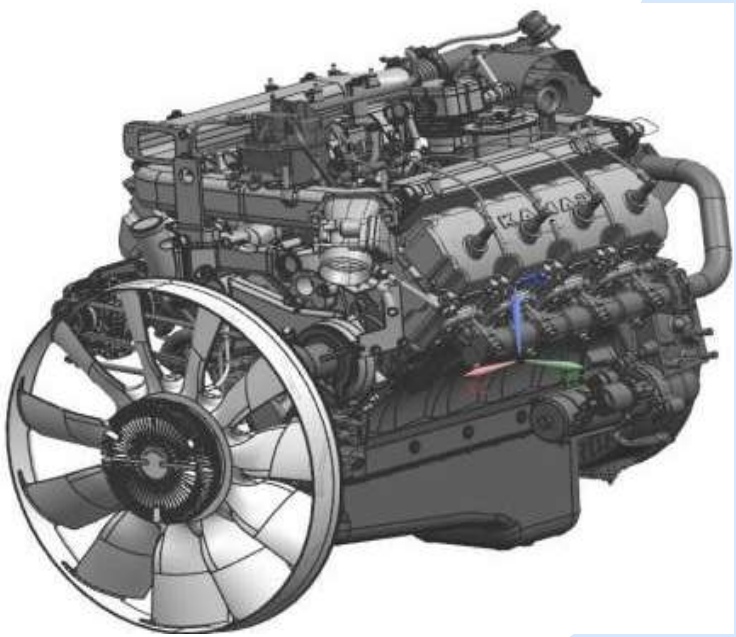
Creating a family of engines KAMAZ on alternative fuels with a power range of 300 ... 400 hp and compliance with future environmental requirements

Resolution of the Government of the Russian Federation dated April 9, 2010 N 218 "Government support for the development of cooperation of Russian higher education institutions and organizations implementing complex projects on high-tech production

Financing of $ 9.2 million.
Co-financing of $ 9.2 million
Involved Staff of 12 Departments
Total involved staff - 300 persons
Number of research areas - 17

2013-2015 year





CORPORATE STUDY CENTER

GRADUATE SCHOOL OF ENGINEERING ENTERPRISES
«KAI-INNOVATION»

The system of student's involving in entrepreneurship and innovation

Involvement → Design → Accompaniment → Partnerships

Corporate Study Center

Accelerators:
«Self-made», «50 Best Ideas»
Enterprise partners

Venture Fair
Venture capital funds
IPOCA

CORPORATE STUDY CENTER

GRADUATE SCHOOL OF ENGINEERING ENTERPRISES «KAI-INNOVATION»

Design of technical thinking

Innovation's promotion

CDIO – engineering staff for Tatarstan

Industrial design

HR infrastructure of high-tech engineering

Intellectual Property management

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CORPORATE STUDY CENTER

GRADUATE SCHOOL OF ENGINEERING ENTERPRISES «KAI-INNOVATION»

инновация

Technical Systems

Invention Problem Solving (TRIZ)

Psychological and sociological aspects of the engineering business

The practice of project implementation in the existing legal framework

Perspective Plan Engineering Entrepreneurship

Joining the International Proof-of-Concept Centers Association (IPOCA) – an organization that will promote the transformation of knowledge into the final products and services, including through the establishment of a global innovation ecosystem

Key meetings in 2015

XV Российская и X Казанская
ВЕНЧУРНАЯ ЯРМАРКА
Казань – 23 апреля 2015 года

ОТКРЫТЫЕ ИННОВАЦИИ

STARTUP VILLAGE
ИННОВАЦИОННЫЙ ЦЕНТР СКОЛКОВО, МОСКВА
2-3 ИЮНЯ `15

Partners who signed a Memorandum of Understanding for the creation of IPOCA:

Skoltech
Skolkovo Institute of Science and Technology

INNOPOLIS UNIVERSITY

ITMO UNIVERSITY

Russian Venture Capital Association (RVCA)

MIT DESHPANDE CENTER FOR TECHNOLOGICAL INNOVATION

Masdar INSTITUTE

TOMSK POLYTECHNIC UNIVERSITY

LOBACHEVSKY STATE UNIVERSITY of NIZHNI NOVGOROD
National Research University

PERM NATIONAL RESEARCH POLYTECHNIC UNIVERSITY

Samara State Aerospace University

KAZAN FEDERAL UNIVERSITY

TEL AVIV UNIVERSITY אוניברסיטת תל אביב

Ural Federal University

North-Eastern Federal University in Yakutsk

Казанский национальный исследовательский технический университет им. А.Н. Туполева

Thank you for attention!