

Military University of Technology (WAT)



Centre for Technology Transfer of the Military University of Technology is a university-wide organizational unit of the Military University of Technology, dealing with:

- transfer of research results to the industry,
 - intellectual property management,
- implementation and commercialization of the research and development results,
- increasing the efficiency and competitiveness of enterprises through innovation.



WAT is:

- public university
- military university supervised by the minister of national defense
- civil university supervised by the minister responsible for higher education in agreement with the minister of national defense
- educates military and civilian students
- military unit
- educates students in 21 fields of studies

WAT's mission:

- research and implementation to industry
- education of students and doctoral students, including candidates for professional soldiers, military training and professional development of officers
- professional support for central institutions of the Ministry of National Defense and other ministries

8 academic faculties



Faculty of Cybernetics



Faculty of Electronics



**Faculty of Civil Engineering
and Geodesy**



**Faculty of Advanced
Technologies and Chemistry**



**Faculty of Mechanical
Engineering**



**Faculty of Mechatronics,
Armament, and Aerospace**



**Faculty of Security, Logistics
and Management**



Institute of Optoelectronics

Key technologies



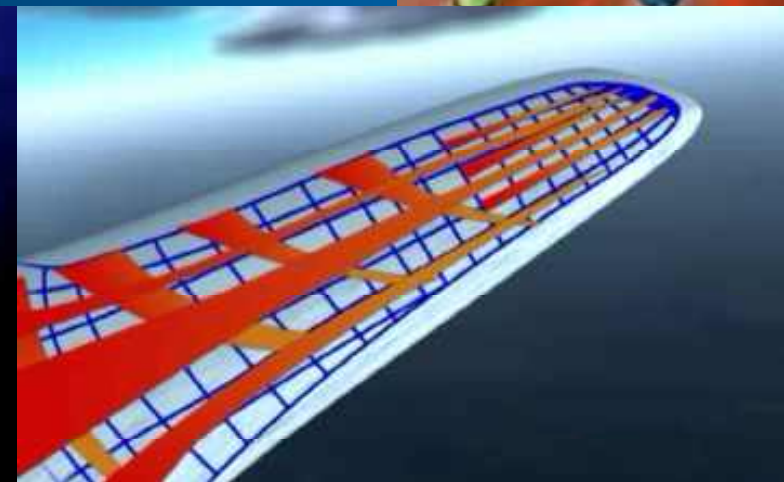
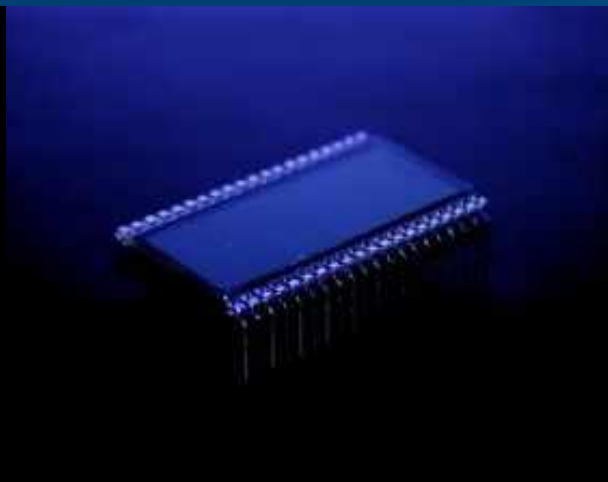
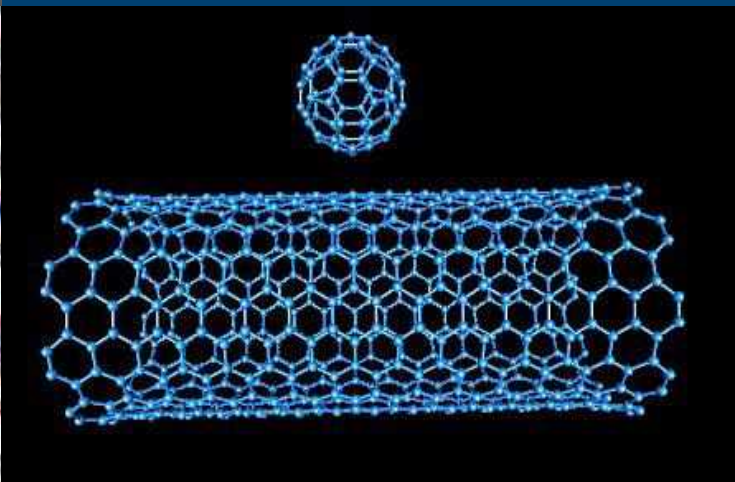
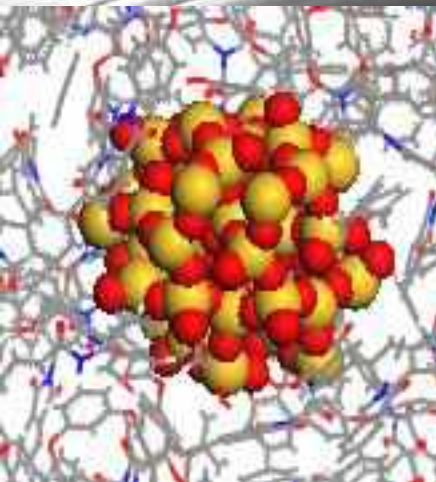
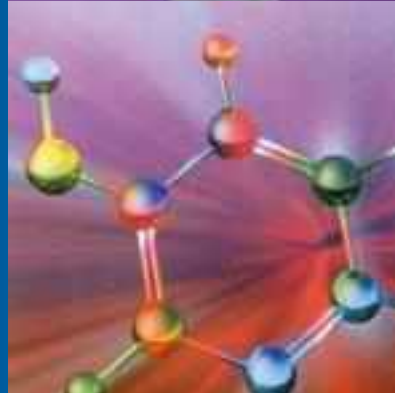
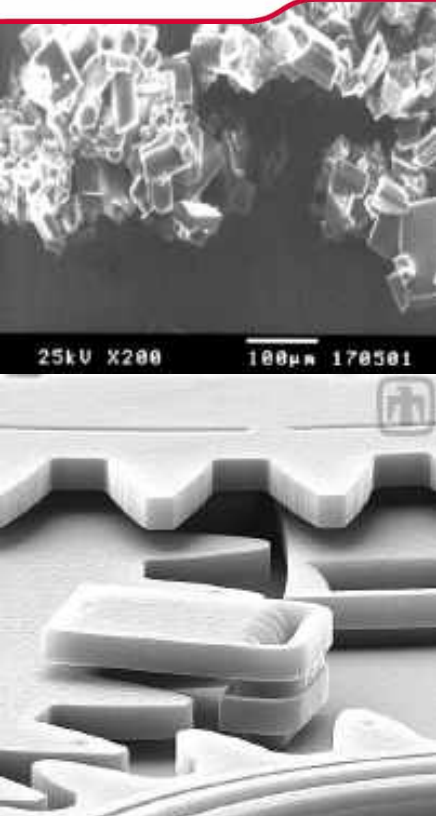
Space and satellite technologies

Integration of all technologies and systems
mikro-, nano-, bio-, info-, opto-

Key technologies

Materials engineering and nanotechnologies:

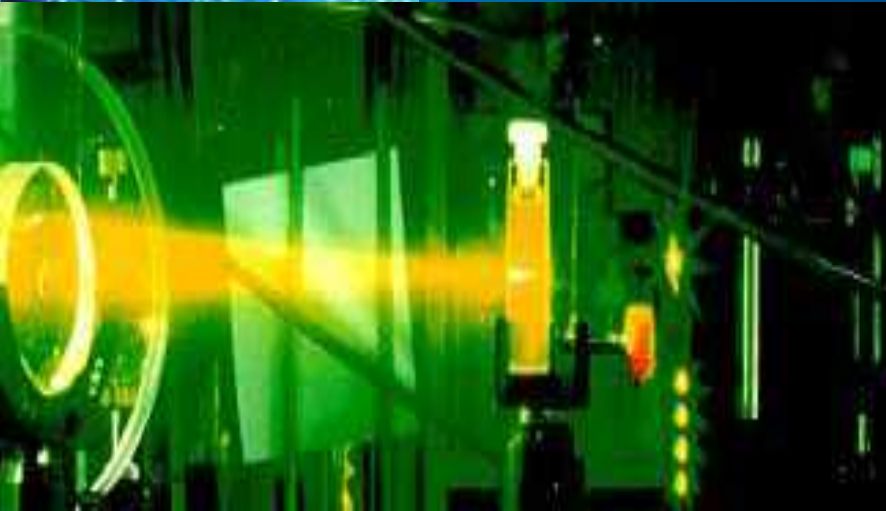
- new properties and functions of materials
- materials with programmable properties (optical, thermal, mechanical)
- polymers, ceramics and composite materials
- high-energy materials
- fuel cells, hybrid drives
- ultralight armour
- nanotubes
- MEMS and NEMS systems
- integrated nanosensors
- imaging systems
- adaptive camouflage, STEALTH technologies



Key technologies

Photonic technologies:

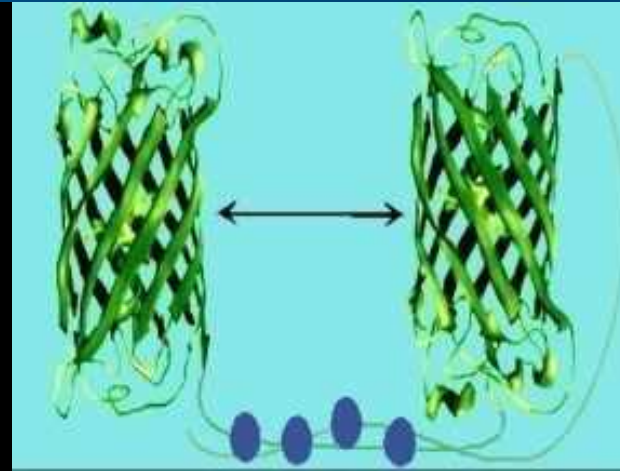
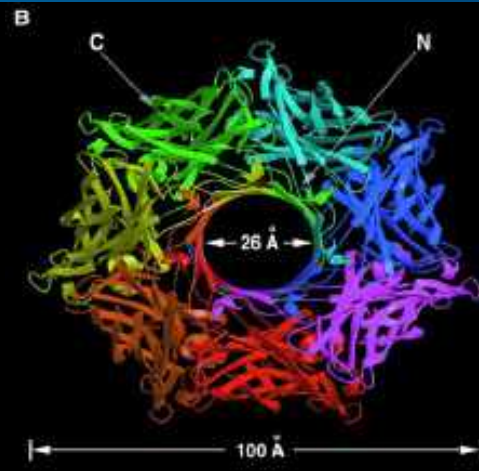
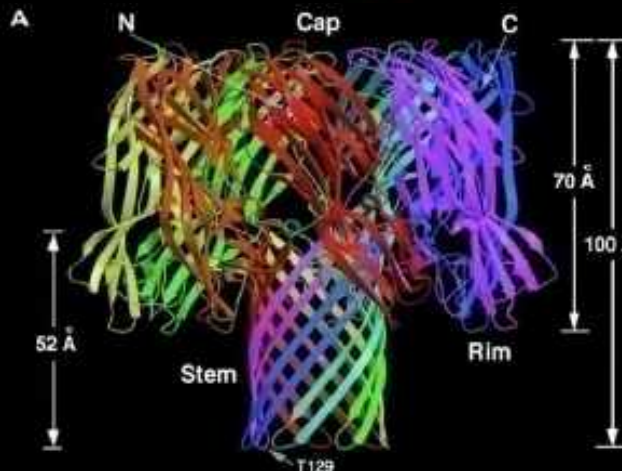
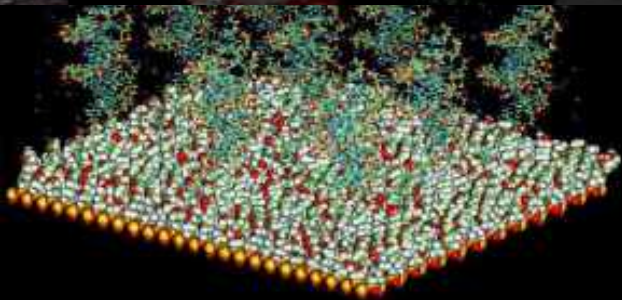
- photonic materials
- optical fibres and fiberscopes
- radiation detectors
- light sources
- solar panels and displays
- observation and reconnaissance systems
- laser technologies
- threat monitoring systems
- broadband laser communication
- biomedical optics



Key technologies

Biomedical technologies:

- bio- and nanomaterials
- protein nanotubes
- biopolymers
- biomolecular sensors
- gravity detectors
- bioradiometer
- miniature bioreactors
- DNA (Bio-IFF) tags
- diagnostic systems
- therapy devices



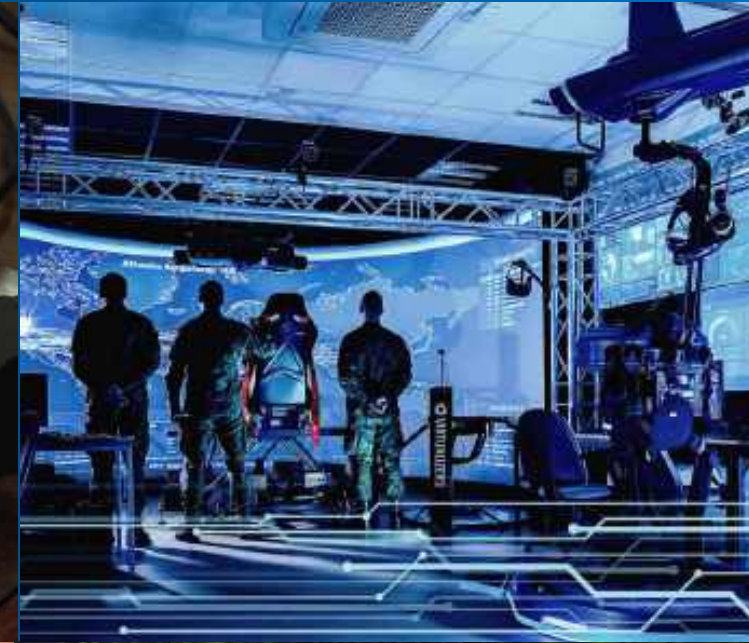
Key technologies

Information technologies and telecommunications:

- artificial intelligence
- supporting the decision-making process
- communication devices
- information protection
- security in cyberspace
- scenarios and simulations of decisions
- signal protection
- electronic authentication
- medical IT, telemedicine
- image processing
- analysis of physiological signals

Network-Internet:

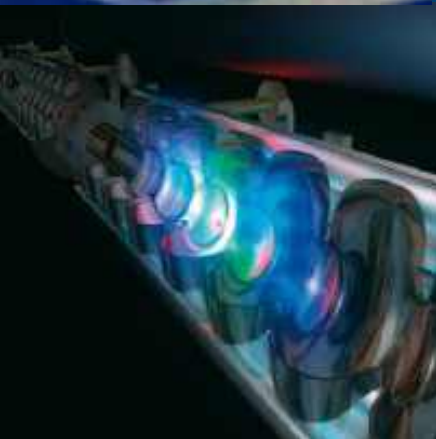
- introducing universal accessibility on the web
- reliable, consistent information in real time
- filling the web with new dynamic sources of information
- ensuring dynamic and flexible management



Key technologies

Energy technology:

- production and conversion of biomass
- hydrogen fuel systems
- geothermal systems
- heat pumps with high efficiency
- photovoltaic cells – multilayer structures
- fuel cells
- wind turbines
- nuclear Energy, nuclear fusion
- coal gasification
- clean coal technologies
- energy-saving light sources
- artificial photosynthesis



Key technologies

The MSC 23-150 "Cis" bridge



The innovative new design of the MSC 23-150 "Cis" folding bridge for heavy traffic developed in Military University of Technology (WAT) meets modern technical and operational requirements .

The proposed new bridge design enables the construction of crossings for one-way traffic for heavy vehicles (min. MLC 80 tracked and MLC 130 wheeled vehicles) and two-way traffic for MLC 40 vehicle columns. In the free-span arrangement, the maximum span of the MSC 23-150 bridge for the MLC 130 wheeled load is 66 m. It should be noted that for secure two-way traffic from the available bridge structures, it is possible in the case of the MS 54 structure with a roadway width limit of 3.0 m, which does not meet the minimum lane width requirements for roads of higher technical classes.

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Military crossings are dedicated as the equipment of the Polish Armed Forces and in case of the civilian crisis situations.

Key technologies

The Piezometer



The original device developed in Military University of Technology (WAT) enables for measurement of underground water pressure through the use of a sealed pressure measurement chamber.

The measurement of underground water pressure in the subsurface is carried out also by other piezometers which are vertical pipes installed underground. The developed, innovative device - unlike standard piezometers - is able to measure artesian water pressure and water pressure under the floors of underground parts of buildings and other paved surfaces. The developed measuring chamber can replace the vertical pipes used to check the level of established underground water. This solves the common problem described to the lack of space for installing piezometer pipes in underground parts of buildings. The WAT solution is inexpensive and simple to apply. It allows precise measurement of water pressure under the floor - with an accuracy of 1 cm H₂O. This value allows assessing the influence of underground water pressure for the underground part of the building's structure.

The device allows for testing the pressure continuously, determining its variability over the time and for continuous monitoring of water pressure under construction objects. This enables the solution to be effectively tailored to the existing threat and to determine of maximum, rather than instantaneous values. This is of particular importance with regard to the changing level of underground water levels over the seasons.

This is an excellent solution for construction companies and diagnostic laboratories, especially those dealing with deep foundations of buildings.

The Quantum Random Number Generator



The Quantum Random Number Generator is an innovative device that uses quantum phenomena to generate random numbers. Figure 1 shows the process of generating such numbers. The generated laser pulse carrying a packet of photons is attenuated to the level of a single photon using a variable optical attenuator (VOA). Then the single photon randomly selects an output of the fibre beam splitter (BS 50/50) where it can be observed by a detector. Based on this, 0 or 1 bits are generated depending on the detector's response. The device has been designed and manufactured in accordance with the current AIS 31 standard for the construction of physical random number generators. Statistical test results based on NIST standard SP:800-22 confirm the generated data are random.

The received random numbers are used to generate a key that is much more resistant to breaking and thus provides a higher level of security for transmitted data. Characteristic features of the device are the complete unpredictability of each successive bit generated, insensitivity to environmental changes, live verification of the operation status, and a high level of Shannon entropy. In addition, QRNG is a solution for setting up quantum protocols based on the measurement of Bell's state, and thus setting up and running multi-hundred-kilometre quantum communication channels.

The device is dedicated to entities concerned with the security of digital data such as the uniformed services sector, financial sector, banks, data centres. The product can also be used for numerical simulations, games of chance, lotteries, statistical research or secure printing.

The Laser System for Detecting and Tracking of Low-Flying Objects (ScanDRONE)



The key component of the system created as part of the project is a laser scanner developed from scratch at WAT IOE. It enables continuous monitoring of the observed sector at a 120° angle and determining the location of emerging drones in real time.

The system enables detection and tracking of small objects, measuring 18x32 cm, with a reflectance (reflection of the laser beam) of 17%.

The scanner developed at the Institute of Optoelectronics WAT (technology demonstrator at the 9th Technical Readiness Level) effectively detects drones with the parameters given above from a distance of not less than 850 m. Any larger object or one with higher reflectance is detected at much greater distances. For example: the plane will be detected from about several kilometres away. Commercially available multi-rotor drones move at speeds of up to approximately 70 km/h.

Precise data about the location of the detected object determined by the laser scanner are transferred to the optoelectronic head control module (dual: vision and thermal imaging cameras).

The functionality of this system can be used by services and law enforcement agencies performing tasks in the field of: protection of critical infrastructure, security of mass events, protection of facilities and property, counteracting the illegal use of UAVs. The system will help prevent the use of unmanned objects in border crime. It may be used to restrict unauthorised crossing of the state border.

Key technologies

The Portable System for Intercepting Miniature Unmanned Aerial Vehicles (PSP-MBSP)



The system consists of three basic elements: launcher, mesh projectile and converter ballistic. It is a response to what already exists and the ever-increasing threat caused illegal and unauthorized use of BSP, especially during mass events, gatherings, sporting events, etc.

The idea behind the solution is to physically intercept a miniature UAV located at an altitude of several dozen meters via firing a mesh projectile at it, which will break apart at an appropriate distance from the target, will unfold the mesh and capture the UAV. After this fact, all important elements of the missile, along with the captured UAV, will fall to the ground by parachute.

The innovation of the presented system is: among others on the use of electronic, innovative programmable igniter controlling disconnection projectile while flying towards the target (throwing net and parachute) and application two-chamber propellant system.

The Wagon With a Rotating Loading Platform for Intermodal Transport



A wagon designed for fast, safe and autonomous loading and unloading truck trailers may be also used for transport: various types vehicles, e.g. tractors, trucks, vehicles special trailers and cargo containers. Cooperation with the industry and taking action aimed at implementing the developed one solutions resulted in cooperation with Polish companies interested in purchasing a license for use of a patented solution. Further cooperation with a potential manufacturer will involve design development and adaptation her, among others for transporting heavy vehicles military personnel equipped with the Forces Armed vehicles of the Republic of Poland and their unloading outside the terminal, w unsuitable terrain. Innovation of the solution is of a supra-national nature on the scale of the Polish market and foreign markets.

The wagon with a rotating cargo platform for intermodal transport is an innovative and easy special system for transporting various vehicles by rail, especially car semi-trailers trucks, which does not require large expenditures on adapting the infrastructure of loading ramps /discharge, meeting the restrictions resulting from the so-called railway gauge. Proposed solution it is free from the disadvantages of accelerated wear of the wheels of the trolleys of the moving road system and not requires complex terminal transshipment solutions used in available ones intermodal transport systems.

Potential recipients: manufacturers of rolling stock ensuring product certification in accordance with the Parliament Directive European Union and of the Council 2008/57/EC of 17 June 2008 on system interoperability railways in the Community; buyers of wagons used for intermodal transport (domestic and foreign); railway logistics and forwarding companies.

The Dual-Use Shelters



Reinforced concrete shelters prefabricated buildings, consisting of repetitive structural elements segments supporting defense tasks are divided into: stationary and mobile. Modules are performed in a stationary setting factories of reinforced concrete elements and composites structural. They consist of concrete reinforced with steel reinforcing bars or one steel element, steel insert, and then they are delivered to their destination using typical trucks. Single Shelter modules can be equipped with installations necessary planned infrastructure, as appropriate to their intended use before delivery or on-site assembly of the functional unit. Proposed the concept meets the need for maximum shortening the object execution time in comparison to traditional monolithic technology implemented at the location, especially in the conditions limited time, which will most likely be standard. The balance of work should include earthworks, and the structure has modular nature, significantly shortens the preparation time modern fortification, and also enables shaping shelters of various sizes and purposes. The essence of dual-purpose technology consists in the possibility of meeting operational requirements technical specifications appropriate to driving conditions defense operations.

It is also possible to place an order family shelters by individual investors, which is likely to increase dangers resulting from atmospheric hazards will be a growing trend.

The System for Centralized Management of a Swarm of Unmanned Land Platforms (SCAR)



The solution developed at the Military University of Technology enables the organization of units capable of exchanging information with each other in the so-called swarm. The swarm is under a manager who can create common tasks for all elements. SCAR is the system that supervises this process, ensuring that each member of the group receives a new order. This significantly increases efficiency because the system supports the soldier and allows him to efficiently manage the entire team. The soldier-manager creating the swarm also obtains a real-time view of the status of each swarm element. It includes location preview and streaming video from swarm elements and monitoring the status of an element in the SCAR network - whether it is working properly, whether there are interruptions or whether communication has stopped for some reason.

One of the innovative aspects of the SCAR system is the ability to co-create the so-called "living reports". After receiving a reconnaissance task, the swarm can constantly update the content of the report, which remains available even if the swarm is completely lost. Each element of the swarm has insight into the current status of the report, so it can update it on an ongoing basis. In the SCAR system, the report is sent not only to the manager, but also to the command. This is possible thanks to the SCAR server, where such reports are sent with all current updates. Even in the event of huge losses in the field of operations, there will be a reconnaissance report that will allow you to assess the situation and take appropriate actions. Another useful aspect of the system is the fact that all units know what elements appear in the report and thus do not duplicate events. It is worth emphasizing that "live reports", in which everyone has access to information, help avoid errors. Each group member can verify whether the information they want to generate is already in the report.

The core of the SCAR project is an extensive IT system used in world-class BMS (Battlefield Management System) solutions. However, SCAR is equipped with additional modules: manager equipment, commander server and swarm element module. This makes the scope of its functionality unique.

Key technologies

The WABIK Unmanned Aerial Vehicle



The WABIK Unmanned Aerial Vehicle (WABIK UAV) is an autonomous helicopter with maximum take-off weight of 35 kg, which is equipped with an on-board flight control system enabling performing a vertical, autonomous take off flight and vertical landing. Considerable value payload allows it to be mounted on board a series of customized measuring devices and observation, including an optoelectronic head. Features indicating modernity and originality and innovation of technical and technological thought:

- long range, flight duration and much greater lifting capacity compared to powered platforms electric with similar take-off weight
- arrangement of tracking antennas ensuring communication with an air unit even at a distance several dozen kilometers
- Autonomous flight ability to perform precise flights along a previously defined route maintaining the appropriate speed and altitude flight
- adapted measurement and observation equipment, including an optoelectronic head with a camera daylight and a thermal imaging camera.

Developed monitoring system using vertical unmanned aerial vehicles take off and landing can be used down:

- monitoring gas transmission networks;
- patrolling and conducting forest complexes reconnaissance during fires; conducting aerial reconnaissance during floods and flooding;
- supporting damage assessment activities natural and anthropogenic disasters;
- patrolling border areas;
- supervising communication routes (traction railway, land roads) - especially key ones communication hubs;
- supervision of land infrastructure elements of particular strategic importance (complexes industrial, power plants, airports and marine);
- searching for missing people in open areas, forest or in the mountains on tourist trails and beyond;
- supporting rescue operations;
- monitoring mass stadium events or outdoor;
- monitoring public space in order to protection against undesirable accounts and acts of vandalism;
- supporting actions to counteract terrorist attacks;
- supervising military facilities and areas;
- supporting the training tasks of the Armed Forces.

Key technologies

The Automatic Syringe

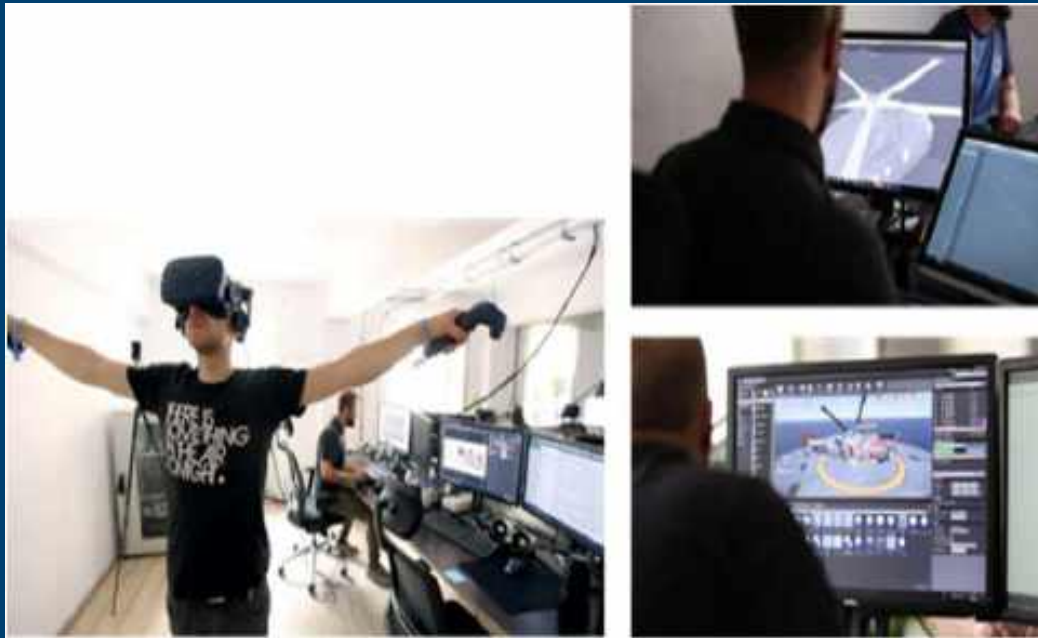
The automatic syringe is used to perform injections using one hand, allowing for independent, quick and efficient administration (also through outerwear) of intramuscular drugs in situations of direct threat to human health and life, with particular emphasis on situations occurring on the modern battlefield. The developed syringe can deliver the drug using the commonly known so-called "insulin ampoules", which makes it a universal device. It is composed of four basic elements: three in a modular arrangement and a sleeve acting as a casing.

The impact mechanism used and safeguards that prevent spontaneous activation of the trigger mechanism (uncontrolled flow of the drug), simplicity of construction and easy operation make the resulting solution, an automatic syringe, innovative. Moreover, it is a reusable device that can still be used after replacing the drug ampoule and needle or just the ampoule, which is particularly important in the process of rotation of drugs with a short shelf life.

The target market for the developed solution is the medical market. The direct users of the solution are soldiers of the Polish Armed Forces, officers of the Border Guard, Police, Fire Brigade and rescue services.



The Training Simulator of Hand Signals on a Helicopter Landing Pad Using Virtual Reality



The training simulator consists of modules. Essential part of the system is dedicated to training operators who manually, using standard, clearly established and mutually understandable signals, direct the flight of the virtual helicopter. The remaining components play a complementary role, among others familiarize themselves with the construction of a helicopter, provide training in carrying out the review procedure pre-takeoff aircraft, check and prepare the landing site, which is necessary to ensure safety and is within standard limits procedures. Open simulator architecture allows you to include pre-programmed modules in the system scenarios of critical situations in all phases of flight, as well as emergency procedures deck and fire.

The solution is characterized by high-quality graphics and faithful animation reproduction of conditions activities on board the ship. Accurately reproduced simulation objects, visual physical features ship, helicopter, taking into account the sea state and any changes in weather conditions (e.g. wind strength), which are important factors influence the degree of difficulty in positioning the helicopter on board or taking off.

The original purpose of the project was fulfillment needs of the crews of Oliver Hazard-class missile frigates Perry, ships of the Polish Navy. However, noting the universality of application system, it is currently addressed to State Fire Department, Mountain Volunteer Fire Department Emergency Medical Service, Air Ambulance Service Rescue Service, other entities using ground crew-helicopter cooperation.

The Low-budget, Mobile Research and Teaching Station for Conducting Classes and Research in the Field of Construction and Operation of Hydrostatic Drive Systems



Discussions conducted with representatives of educational institutions and centers indicate that one of the main barriers to implementing and maintaining high quality of the practical education process and, above all, ensuring professional competence standards is the lack of modern laboratory equipment in these institutions and centers. "A low-budget, mobile research and teaching station for conducting classes and research in the field of construction and operation of hydrostatic drive systems (hydraulic systems)" is a proposal to meet these needs. Modern hydraulic elements (hydraulic amplifiers) used to build the station allow for both the teaching process and scientific research. In this way, by using a hydraulic power supply and components with low working pressures, it is possible to obtain several times higher pressures at the system output, corresponding in value to the working pressures prevailing in the hydraulic drive systems of modern machines and devices. This solution significantly reduces the cost of the station (compared to solutions proposed on the market) and allows it to be powered from a typical, single-phase electrical installation, and low heat emission during operation combined with the mobility of the station allows it to be placed in rooms that do not require special adaptations.

The station is manufactured by RDL Hydraulics, based on an exclusive license agreement signed with WAT.

Key technologies

The Ni₃Al Based Intermetallic Alloys



The proposed production technology of thin Ni₃Al foils (with a thickness even below 50 µm) includes strictly controlled (in claimed conditions) intense plastic working and heat treatment. This procedure allows obtaining material with a wide range of parameters (depending on expected application) i.a. with appropriate: strength, stiffness, deformability, catalytic activity and stability of the structure at elevated temperature and in corrosion conditions. The potential applications of these foils were confirmed in laboratory and pre-commercialization tests.

Foils were exploited as: active elements in the air purification system removing toxic chemical (e.g. chemical weapons) and biological agents, panels with high relative strength and stiffness, elements absorbing mechanical energy and light armors or for geothermal solution like pipes.



Thank you for your attention

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