

# The TECHNOLOGY PARTNERS Foundation The Air Force Institute of Technology

**Michał Towpik**

Strategic and Targeted Support for Europe-Ukraine Collaboration in Aviation Research  
**AERO.UA Project**

*Kharkiv, May 31st, 2018*



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## The TECHNOLOGY PARTNERS Foundation

- Research and Technology Organisation, Advanced Technology Centre
- Specialising in RTD and Innovation Management
- Focus on performance of large, interdisciplinary projects
- Private, Non-for-Profit
- Coordinator of the *TECHNOLOGY PARTNERS Consortium*, composed of leading Polish RTOs:
  - **Air Force Institute of Technology**
  - Institute of Advanced Manufacturing Technology
  - Institute of Non-Ferrous Metals
  - Institute of Applied Optics
  - Road and Bridge Research Institute
  - Automotive Industry Institute
- Extensive cooperation with Warsaw University of Technology



## The TECHNOLOGY PARTNERS Network

- Consortium composed of 7 multidisciplinary RTOs
- Additionally, cooperation with Universities - Warsaw University of Technology
- +1500 researchers; EUR +100 million of revenues / year

RTOs  
Consortium

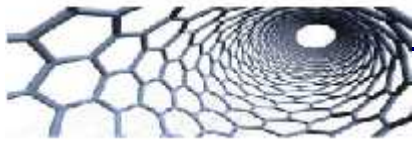
Cooperation with  
other entities





## Examples of projects

- **EU founded (Aeronautics - focus on materials engineering)**
  - Cooperation with AIRBUS since 2006 – a number of directly funded projects
  - PHOBIC2ICE (H2020) – Super-IcePhobic Surfaces to Prevent Ice Formation on Aircraft
  - PLATFORM (H2020) – „Open Access Pilot Plants for Sustainable Industrial Scale Nanocomposites Manufacturing based on Buckypapers, Doped Veils and Prepregs”
  - CANNAPE (PF7) – Canadian Networking Aeronautics Project for Europe
  - SARISTU (FP7) – Smart Intelligent Aircraft Structures
  - ELECTRICAL (FP7) – Novel Aeronautical Multifunctional Composite Structures with Bulk Electrical Conductivity and Self-Sensing Capabilities
  - MAAXIMUS (FP7) – More Affordable Aircraft through Extended, Integrated and Mature Numerical Sizing
- **Others**
  - Preparation and Demonstration of Multi-KETs Pilot Lines Actions (DG Enterprise)
  - Knowledge Management Platform for Polish RTOs
  - ELAN - Creation of a European and Latin American self-sustainable innovative cooperation Network
  - Study Towards a Single and Innovative European Transport System (DG Move)



**Call:** H2020-NMP-PILOTS-2014; **Consortium:** 12 Partners from 6 EU countries;  
**Aim:** to develop open access pilot lines for the industrial production of buckypapers, CNT treated prepreg and CNT doped non-woven veils for composite applications in aeronautic and automotive sectors.



[www.tmbk.pl](http://www.tmbk.pl)



Pilot plant in TMBK

**E- Platform is a joint venture which provides:**

- Nano-enabled advanced composites products with tailorable properties for parts manufacturers, SMEs
- Nano-enabled composites solutions and services

**Buckypapers**



nanocyl  
THE GREEN NANOTECHNOLOGY

tecnalia  
Inspiring  
Business

sisteplant  
Industrial Systems

**E-Platform**



technology  
PARTNERS  
**TMBK PARTNERS**



**Veils**

**ADAMANT  
COMPOSITES**

**Prepregs**

[www.platform-project.eu](http://www.platform-project.eu)

**Veil parameters**

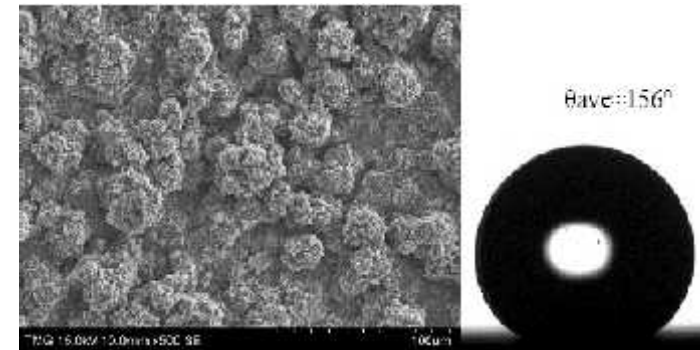
**Max dimensions:** 80x80 cm  
**Areal weight:** 7 - 200 GSM  
**Thickness:** ~50µm  
**Amount:** ~100 veils per one week  
**Mealting point:** 95–148°C

**Call:** H2020-MG 2015\_SingleStage-A;

**Consortium:** 9 Partners- 5 Canadian and 4 European; Coordinated by Technology Partners;

**Aim:** to DEVELOP MANUFACTURABLE AND ENVIRONMENTALLY FRIENDLY DURABLE ICEPHOBIC COATINGS / SURFACES

- **Surface and/or coatings modification with icephobic and superhydrophobic properties**
- **Development of new materials for coatings**
- **Tools to simulate ice accretion**
- **Eco-friendly, efficient manufacturing processes**



[www.phobic2ICE.com](http://www.phobic2ICE.com)



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## Selected areas of special interest in materials engineering for aerospace

- **CNT-doped thermoplastic veils for improving electrical and mechanical performance of composites (H2020 PLATFORM)**
  - Suitable for Antistatic or EMI Shielding applications.
  - Produced by the use of melt-blown technology.
  - Inserted into GFRP or CFRP during manufacturing of composites using infusion or pressing methods, as well as an autoclave.
  
- **Development of technologies and predictive simulation tools for avoiding or mitigating accretion of ice (H2020 PHOBIC2ICE)**
  - Collection of fundamental knowledge of phenomena associated with icephobicity issues.
  - Design and fabrication of icephobic surfaces with improved functionalities by applying innovative simulation and modelling.
  - Development of several types of polymeric, metallic and hybrid coatings using different deposition methods.
  - Preparation of laser treated and anodized surfaces.



# The TECHNOLOGY PARTNERS Foundation



Aircraft Engines Division



Airworthiness Division



IT Logistics Support  
Systems Division



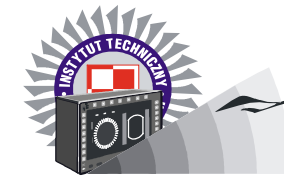
Aeroplanes & Helicopters  
Division

Support of operational use of Air Force technology in the scope  
of research and development

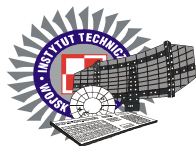


Air Armament  
Division

10 R&D Entities  
410 Engineers (594 employees)  
Laboratories accredited by PCA and MOD



Avionics Division



Command, Control and Training  
Systems Division



Propellants and  
Lubricants Division



C4ISR Systems  
Intergration Division



Airfield Systems Division





## AIRWORTHINESS DIVISION (ITWL)

### Operational loads monitoring

Airworthiness Division performs loads monitoring, both:

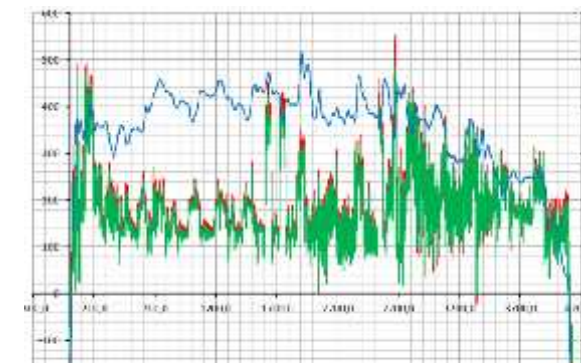
- direct - by means of sensors mounted on the aircrafts' structure;
- indirect - by means of a proper set of flight parameters;

for many types of aircrafts, e.g.: F-16, MiG-29, Su-22, PZL-130 Orlik.

In the future, we are going to develop usage monitoring system for Mi-14 helicopter.



**DAU SSR-500 compartment**



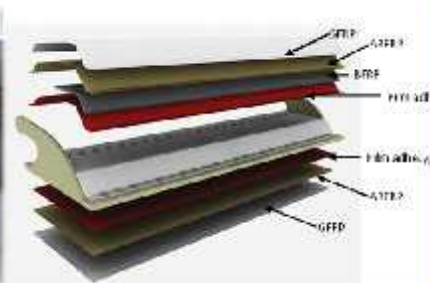
**sample of the flight record**



## AIRWORTHINESS DIVISION (ITWL)

### Advanced composites manufacturing

- different technologies of composite structures manufacturing (also autoclave)
- composite patch bonded repairs (e.g. C-130 Hercules, PZL-130 Orlik, Su-22, MiG-29)
- honeycomb structures repairs;
- modernization of existing aircraft structures (e.g. upper air inlet flaps of MiG-29's engines)
- smart structures manufacturing, e.g. smart patches for repairs monitoring





## AIRWORTHINESS DIVISION (ITWL)

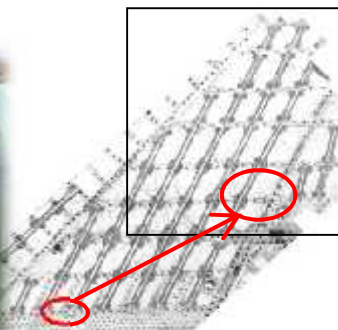
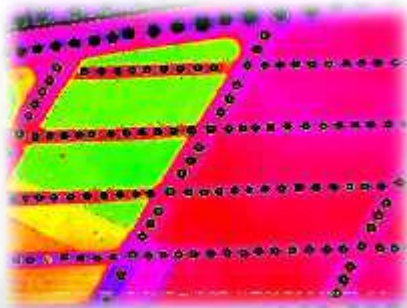
### Non-destructive inspections - certified IAW EN-4179:

Certification and equipment for most of NDT methods:

- ultrasonic testing (also phased array);
- eddy current testing;
- penetrant testing;
- magnetic particle testing;
- thermography testing;
- laser shearography testing.



Support in development of NDT and SHM technologies.



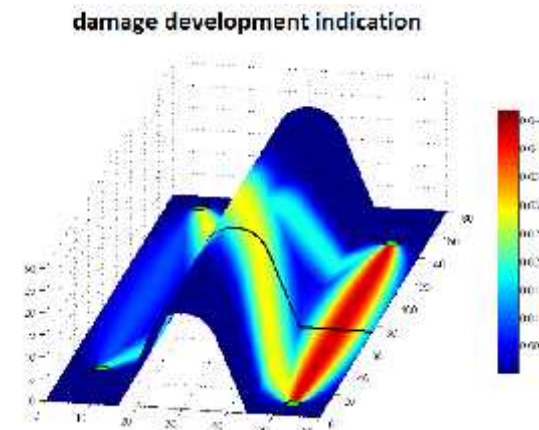
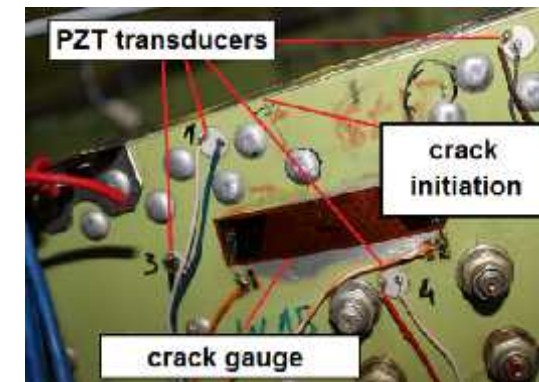


## AIRWORTHINESS DIVISION (ITWL)

### Research and development of Structural Health Monitoring (SHM) systems

The investigated areas are:

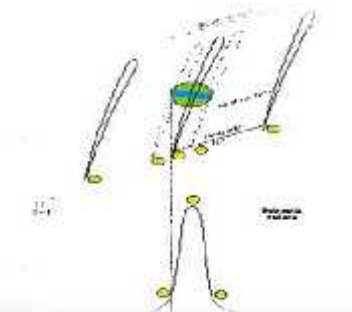
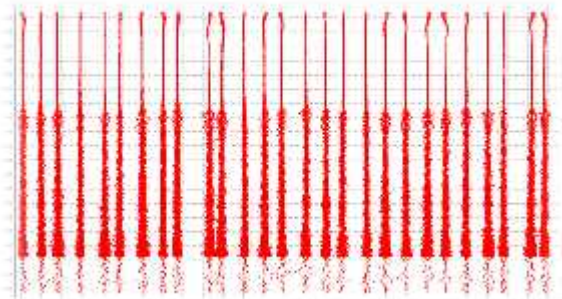
- different applications of PZT transducers (passive, active monitoring: guided waves and E-M impedance method);
- monitoring of different type of materials and damage thereof (metals, GFRP, CFRP laminates, Fiber Metal Laminates – FML);
- developing signal analysis and data classification methods in order to improve performance of the system;
- developing technology of sensors integration with the host structure;
- developing methods for network self-diagnostics;
- increasing technology readiness by improving system stability under varying environmental conditions;
- system validation studies (reliability, PoD);
- developing certification guidelines for system implementation;





## DIAGNOSTICS AND MONITORING OF AIRCRAFT PROPULSION SYSTEMS

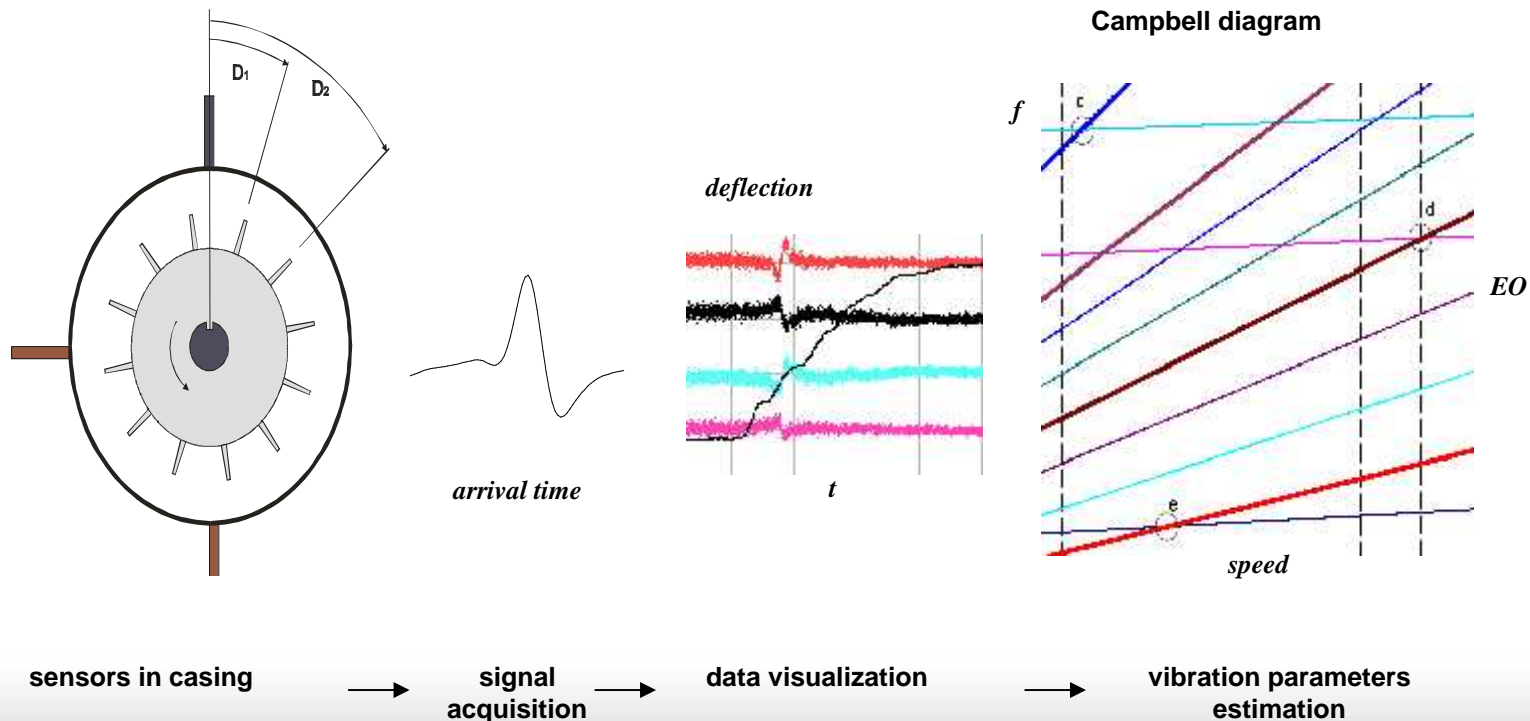
The development of new research techniques  
Monitoring and diagnostics of all kinds of aircraft engines types





## Blade Tip-Timing

Non contact measurement technique used to estimate blade vibration parameters: amplitude, frequency & stress.





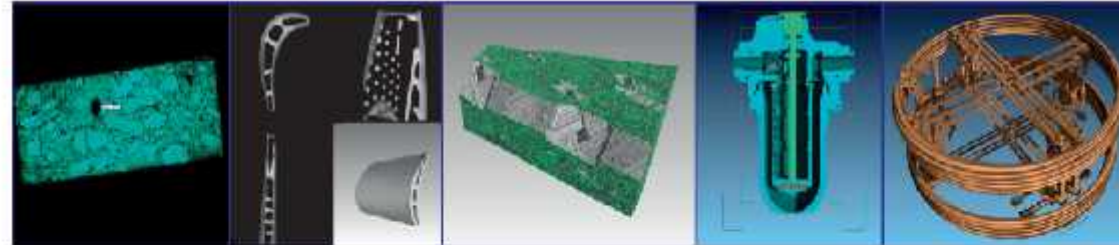
### Blade Health Monitoring

- passive magnetic sensors for adverse conditions
- flying on TS-11 trainer since 1992
  - SNDL-1b/SPL-2b system
- life: 5-10 years, 600-1200 flight hours
- > 300 sensors installed on > 100 aircraft





## X-ray Computed Tomography



Scientific research and analyses cover the following materials:

- Titanium alloys
- Steel
- Composites
- Concrete
- Rubber
- Others

The system offers:

- Detectability of failures of  $> 0.5$  mm with the 180 kV X-ray tube
- Testing/evaluation of high-density materials (e.g. aircraft engine turbine blades) with the 300 kV X-ray tube
- Analyses of electronic circuits (integrated circuits (IC) included)
- Diagnosing of explosives/pyrotechnic compositions
- Complex diagnosing of aeronautical (sub-)systems



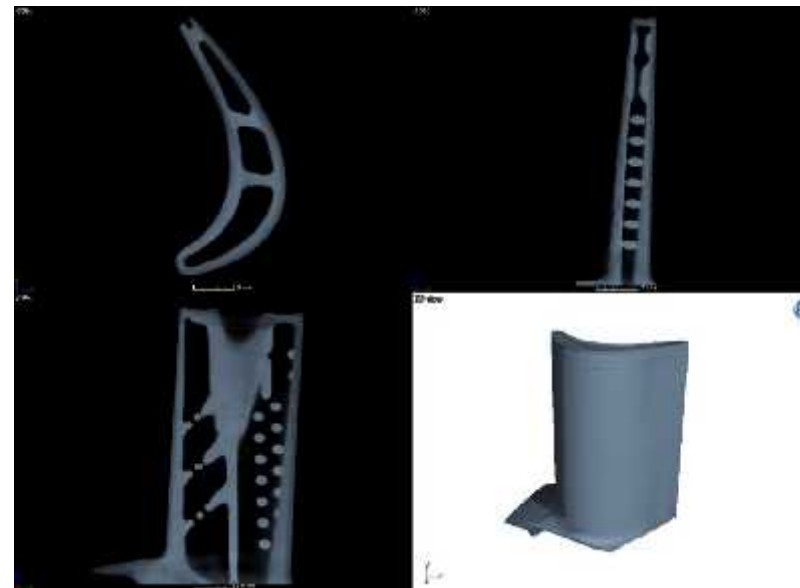
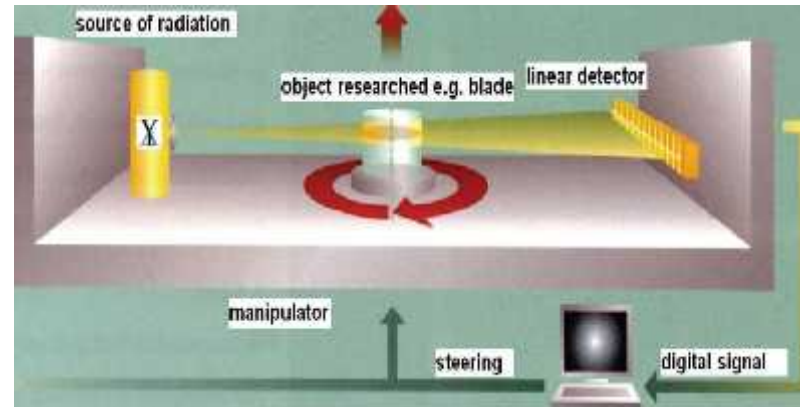
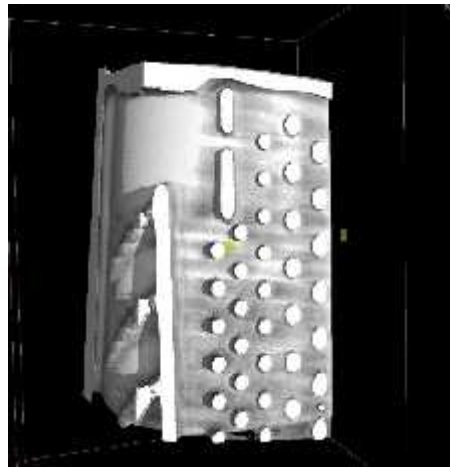
Weight of objects under examination: 50 kg  
Approximate dimensions: 50×50×60 cm





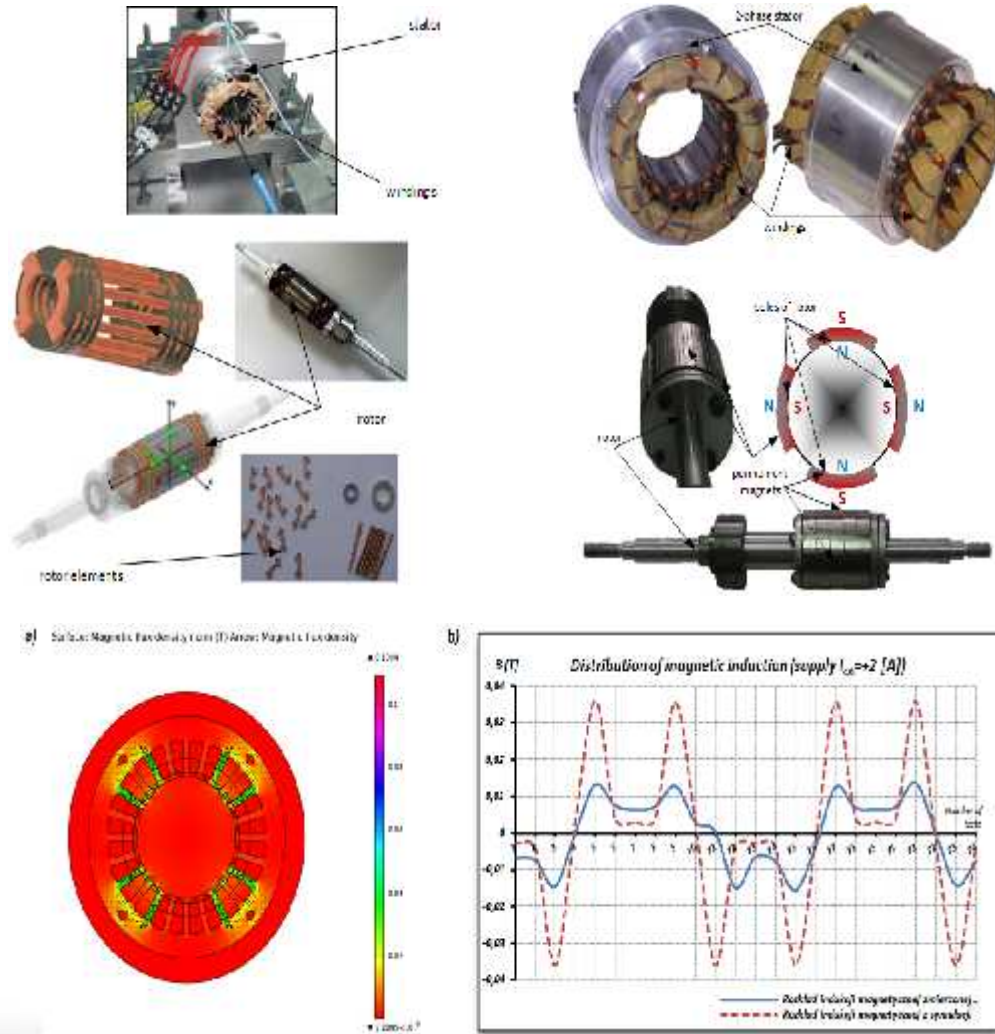
## X-ray CT Inspection of Turbine Blades

- cooling channels
- manufacturing flaws
- 3d printed components



## Bearingless electric machines for aviation

- More Electric Aircraft
- Magnetic suspension systems
- Control of bearingless motors





## UNMANNED AERIAL VEHICLES

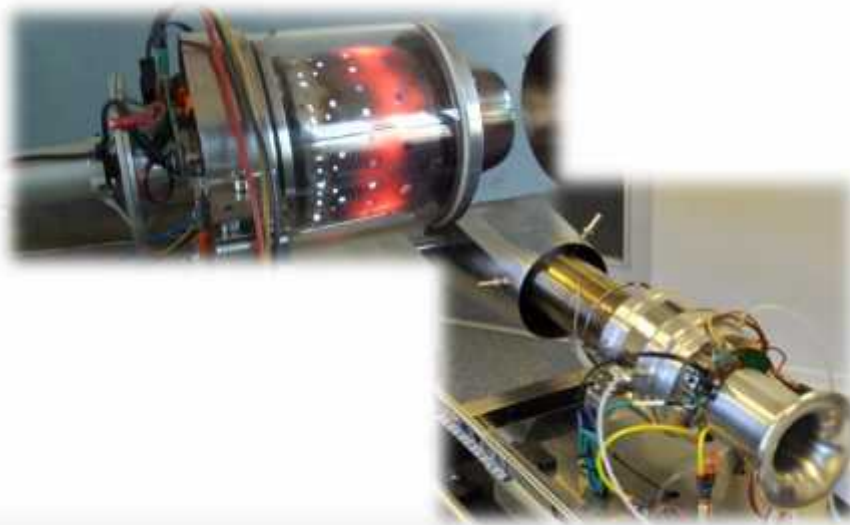




## TEST BEDS FOR COMBUSTION PROCESS IN JET ENGINES

Testing of:

- ✓ new fuel, including ones from renewable sources of energy
  - ✓ innovation material technologies
  - ✓ novel structure solutions
- ✓ designed & developed test beds dedicated for individual client's needs.





## AIRCRAFT MODERNIZATION

- ✓ **Digitalization of Avionic Systems (open architecture)**
  - ✓ **Adaptation to a modern network-centric battlefield**
  - ✓ **Integrated Communication Systems**
  - ✓ **Helmet Mounted Display systems**





## ADAPTATION FOR BATTLEFIELD REQUIREMENTS

**Extension of technical life time  
up to 45 years**

- 1

**0 Military Aviation Works No 1**

**&**

**Air Force Institute of Technology (ITWL)**

**are specializing in an extension life time of Mil helicopters**

**Mi-8 up to 45 years**

**Mi-17 up to 42 years**

**Mi-14 up to 36 years**

**Mi-24 up to 45 years**





**Thank you for your attention**