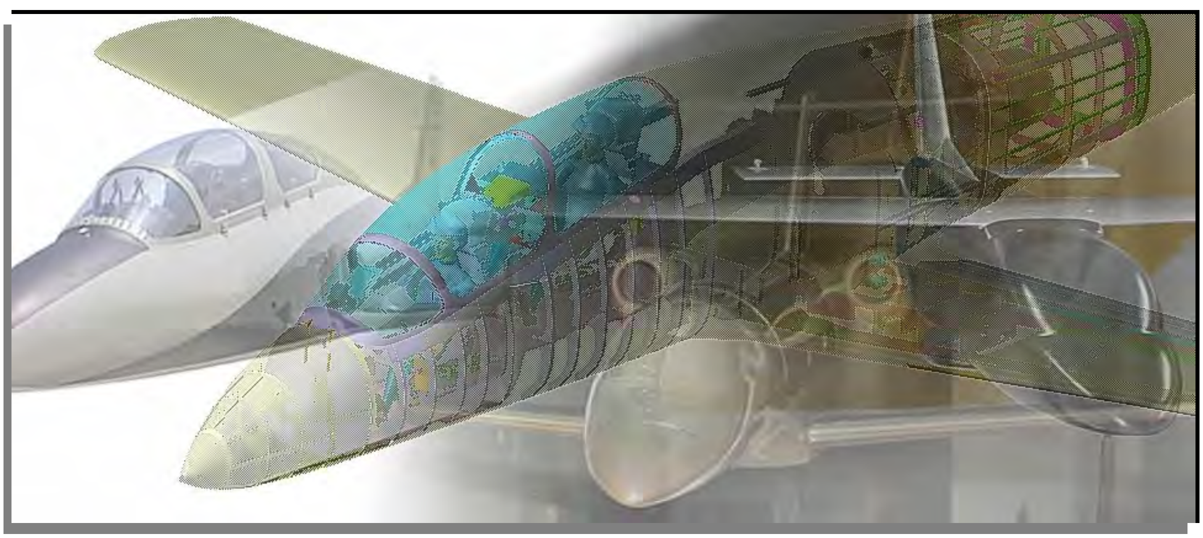
INCAS

National Institute for Aerospace Research

"Elie Carafoli"



Self - Assessment Report

2007 - 2011

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Foreword

INCAS - National Institute for Aerospace Research "Elie Carafoli" is the leading research establishment in aerospace sciences in Romania, with more than 60 years tradition in aerospace engineering, flow physics and applied aerodynamics, using state-of-the-art technologies and unique infrastructure of national strategic importance. INCAS has been involved in all major national aeronautical projects for civil and military areas, and currently is acting as a major player in EU policy for R&D development under FlightPath 2050 vision and future Horizon 2020 program.

Reorganized in December 2008 under HG 1463, INCAS has been repositioned as a research establishment, acting under public law as INCD, coordinated by ANCS - National Authority for Scientific Research. This transformation recovers the original position of INCAS as a successor of INCREST - National Institute for Scientific and Technological Creation before 1990 and follows almost 20 years of activity as a private company of the state.

Starting 2007 INCAS has initiated a solid long term strategy towards recognition of the status and capabilities of Romania in aerospace sciences, making usage of the unique research infrastructure (including wind tunnels with state-of-the-art technology) and outstanding competencies in major and niche areas for development at international scale. At the same time, INCAS has been recognized as a policy maker in Europe and at international level, playing a major role in all programmatic documents and visions developed in the last 5 years in aeronautics.

The crafting of the current Development Plan is based on analysis of the global R&D area and new challenges imposed by the changing economic and social environment. INCAS is one of the contributors for the FlightPath 2050, an active participant to the new ACARE - Advisory Council for Aeronautical Research, has jointly developed the EREA - European Research Establishment in Aeronautics programmatic "Vision for the Future - Towards the Future Generation of Air Transport System", has initiated and signed as an institutional member the European Charter for Researchers and the Code of Conduct for the Recruitment of Researchers" and is one of the founder members of the IFAR - International Forum for Aviation Research. This is a solid basis for the foundation and implementation of the proposed Strategy and Development Plan for INCAS in the next decade.

President and General Director

dr. Catalin NAE

Self-Assessment Report

2.1 INCAS Administrative Structure

INCAS is organized under HG 1463/2008 and based on OG 57/2004, with the following management structure :

1. Administrative Board
2. Board of Directors / General Director
3. Scientific Council

2.1.1 The Administrative Board

The Board of Administration is responsible for the management and control of INCAS, including the exclusive control of the administration and investments.

INCAS Administrative Board consists of 7 members who are appointed by the coordinator ANCS - National Authority for Scientific Research according to OG57/2004. The Board composition is mandated by law and cannot be changed unless approved by ANCS.

Administrative Board members are:

•Two INCAS members :

General Director of INCAS	- President of the Administrative Board
President of INCAS Scientific Council	- Board member

•Three members appointed by national authorities :

Ministry of Education/ANCS	- Board member
Ministry of Finance	- Board member
Ministry of Labor	- Board member

•Two members appointed by ANCS, as specialists :

ANCS specialist	- Board member
ANCS specialist	- Board member

Current structure of the Administrative Board of INCAS (December 2011) is :

- President of Administrative Board - dr. Catalin NAE, General Manager of INCAS
- Vice-President of Admin. Board - prof.dr.ing. Sorin DIMITRIU, President of Bucharest Chamber of Commerce
- Member of Admin. Board - prof.dr.ing. Anton ANTON, vice-Rector of UTCB
- Member of Admin. Board - Gabriela GUDA, Director in ANCS
- Member of Admin. Board - Daniela PESCARU, Director in Min. of Finance
- Member of Admin. Board - Ioana Gabriela SANTA, Director in Min. of Labor
- Member of Admin. Board - dr. Sorin RADNEF, President of INCAS Scientific Council

The Administrative Board meets regularly every month, usually in INCAS location, and traditionally on the last Thursday of the month.

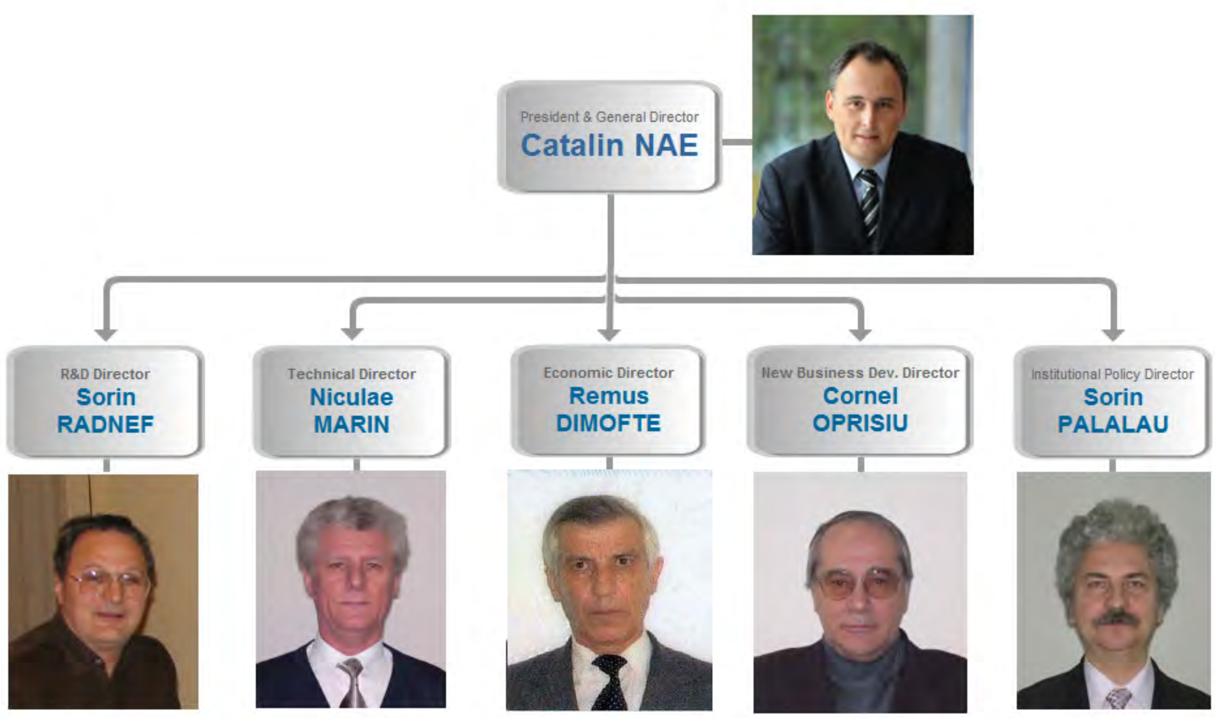
2.1.2 The Board of Directors and General Director

The Board of Directors is responsible for the operational management of INCAS. The General Director is in charge with all administrative and executive decision.

Current structure (December 2011) of the Board of Directors is :

- General Director - dr. Catalin NAE, President of INCAS
- Research & Development Director - dr. Sorin RADNEF
- Technical Director - dr. Niculae MARIN
- Economic Director - Remus DIMOFTE
- Director for New Business Development - dr. Cornel OPRISIU
- Director for Institutional Policy - Sorin PALALAU

INCAS Board of Directors



2.1.3 The Scientific Council

The Scientific Council is responsible for the development strategy of INCAS as a research establishment, enables direct control for the Institute policy for scientific excellence and quality and development of human resources, major strategic partnerships and policies.

Current structure (December 2011) of INCAS Scientific Council is:

President of Scientific Council	- dr. Sorin RADNEF, R&D Director
Vice-President of Scientific Council	- dr. Cornel OPRISIU, Director for New Business Dev.
Member of Scientific Council	- dr. Catalin NAE, General Director of INCAS
Member of Scientific Council	-dr. Ioan URSU, Head of Systems Dept.
Member of Scientific Council	-dr. Valentin BUTOESCU, Head of Flow Physics Dept.
Member of Scientific Council	-dr. Mihai NEAMTU
Member of Scientific Council	-dr. Richard SELESCU
Member of Scientific Council	-dr. Florin MUNTEANU
Member of Scientific Council	-dr. Victor MANOLIU

The Scientific Council meets regularly every month and uses several working bodies, as follows:

CASTI - Regulatory Internal Body for Quality of R&D activity

Head of CASTI Body - Victor EMANOIL

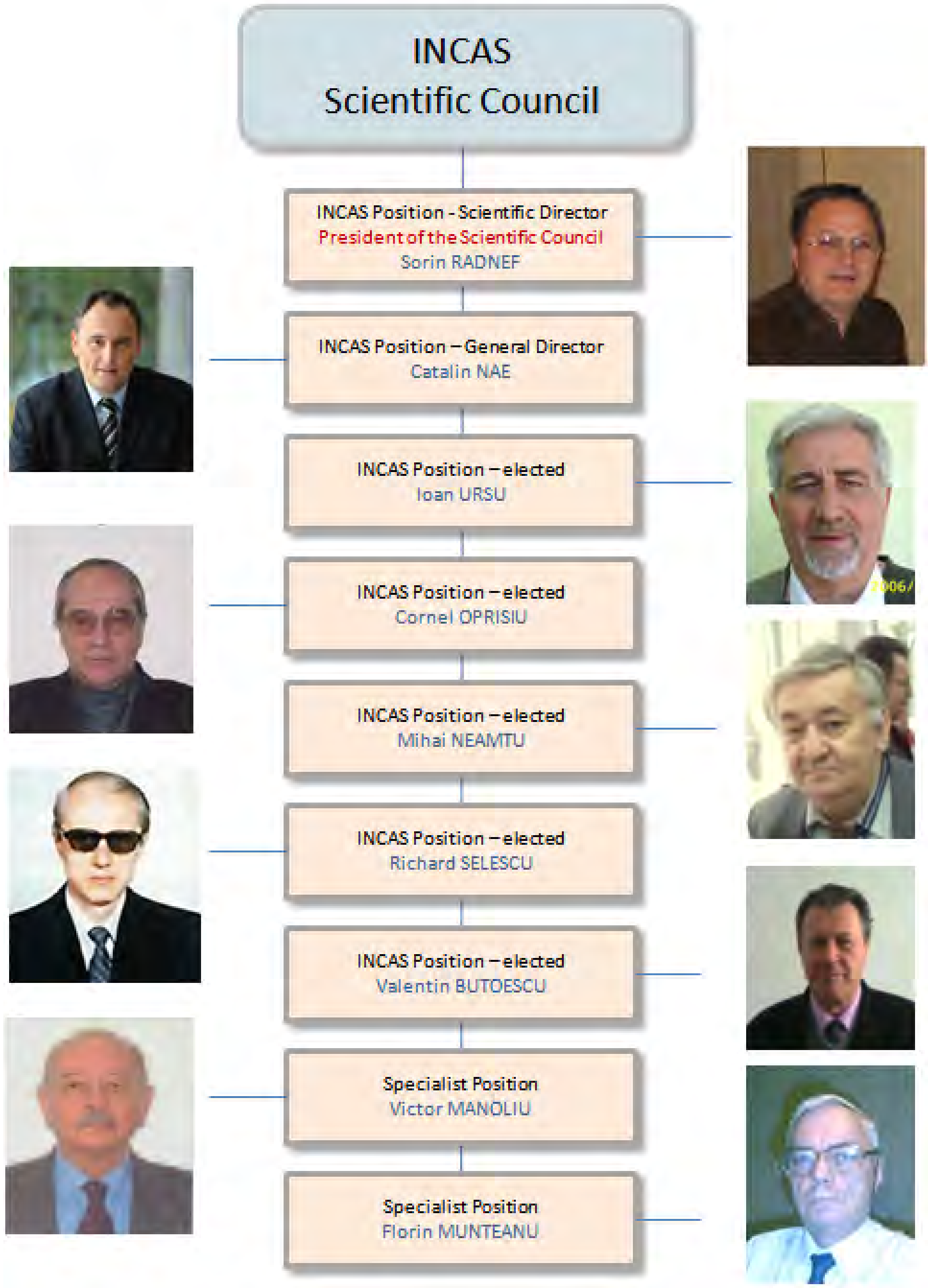
Ethics Body - Regulatory Internal Body for Ethics in R&D activity

Head of Ethics Body - dr. Mihai NEAMTU

Science Policy - Policy Making and Strategy Body

Head of Strategy Body - dr. Cornel OPRISIU

The Scientific Council uses INCAS web page for efficient communication with respect to all major activities related to development of human resources and recruiting of specialized personnel.


INCAS
Scientific Council
INCAS Position - Scientific Director
President of the Scientific Council
Sorin RADNEF
INCAS Position – General Director
Catalin NAE
INCAS Position – elected
Ioan URSU
INCAS Position – elected
Cornel OPRISIU
INCAS Position – elected
Mihai NEAMTU
INCAS Position – elected
Richard SELESCU
INCAS Position – elected
Valentin BUTOESCU
Specialist Position
Victor MANOLIU
Specialist Position
Florin MUNTEANU

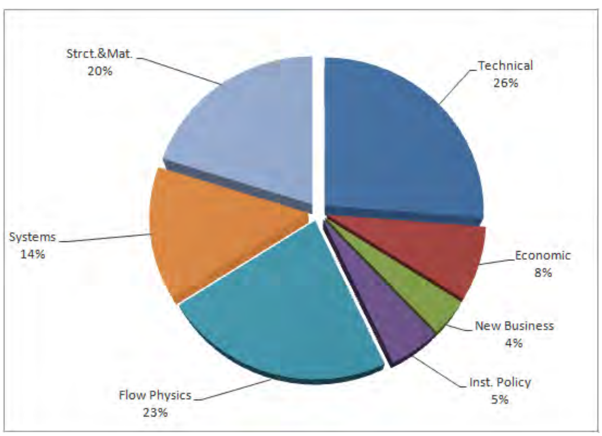
2.1.4 The Administrative Structure Diagram

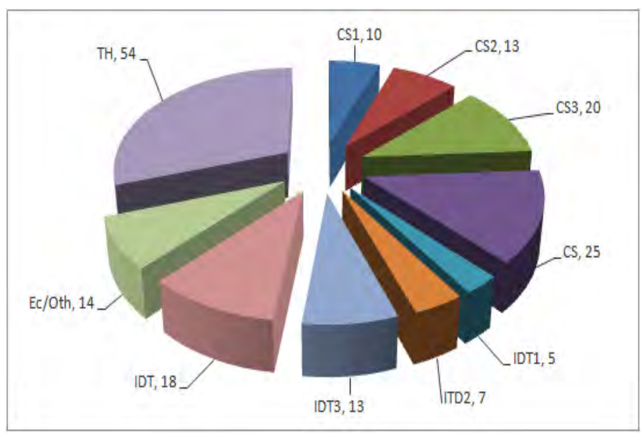
INCAS is a unique research establishment in Romania, with a specialized administrative structure able to meet the requirements for basic R&D and large experimental facilities of national strategic interest.

The organizational structure (December 2011) is based on five pylons:

- 1. R&D Department (57.0% personnel)
- 2. Technical Department (26.0% personnel)
- 3. Economic Department (8.0% personnel)
- 4. New Business Development Department (4.0% personnel)
- 5. Institutional Policy Department (5.0% personnel)

The current diagram of INCAS (2011) is for 179 positions in the global company structure, with 156 positions for long term contracts and 23 positions for short term contracts. This follows a long process of restructuring of the company in the last 20 years.



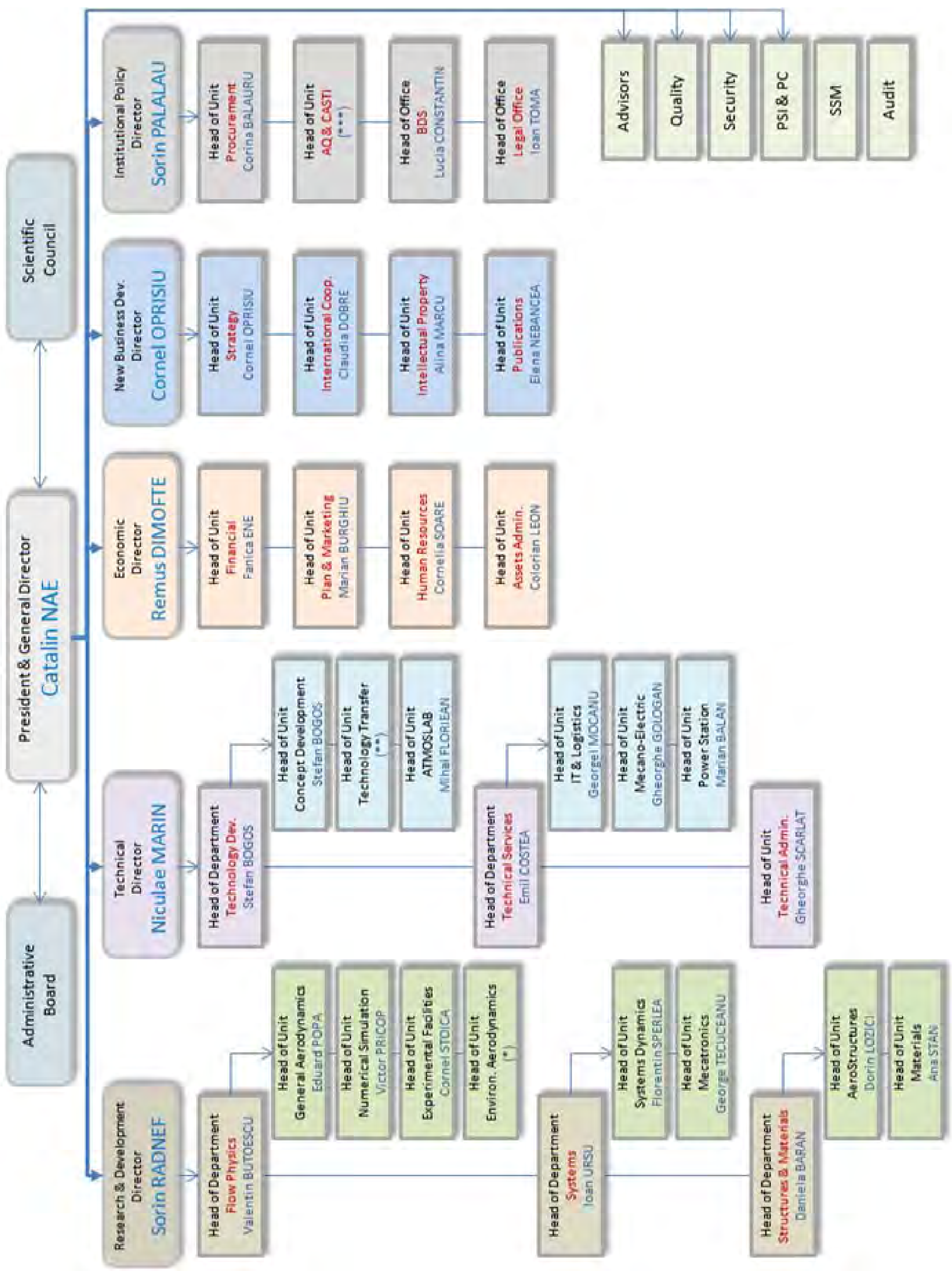


INCAS Diagram (for 179 positions, FTE)

At institutional level, INCAS has a strong policy with respect to major criteria for the evolution of human resources for R&D activities. The management was focused on three key components of the personnel policy at the company level:

- increase the level of competencies of the R&D in new high tech domains;
- increase the ratio of professionals with outstanding reputation and international recognition;
- preserve key competencies in the aerospace sciences.

INCAS Administrative Structure Diagram



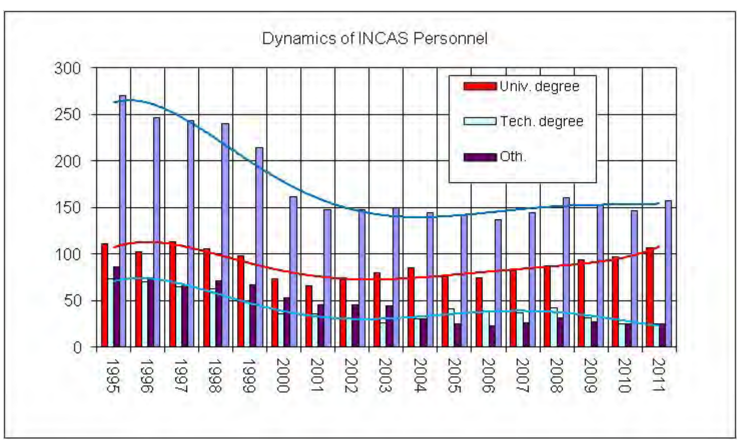
The total number of personnel with an university degree in 2011 is 107. INCAS encourages their continuous development of professionals skills towards a PhD degree :

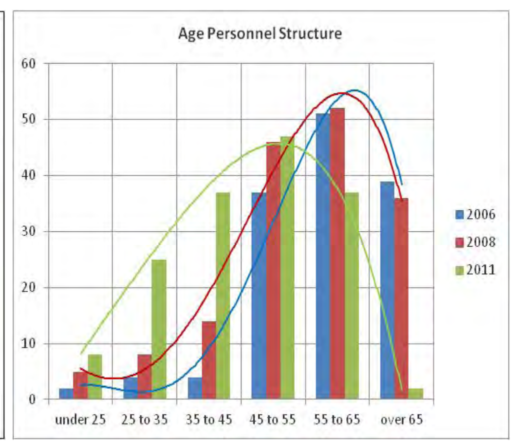
- Personnel with a PhD degree : 21
- Personnel in PhD studies :14

The specific R&D structure is (for 156 long term positions in 2011):

- CS 25 IDT 16
- CS III 20 IDT III 11
- CS II 10 IDT II 4
- CS I 7 IDT I 2
- Eng/Ec./Other 13
- Tehn. 48

The average age of INCAS personnel in 2011 is 49.6, decreasing from a historical high of 56.2 in 2007.





INCAS considers beneficial fact that the personnel structure has been stabilized to a number of 156 full time employees. Also, the increased number of staff with university degree, while decreasing the number of staff with basic technical degree is part of the successful HRS of INCAS.

INCAS R&D Department

The R&D department is the main component of INCAS structure, with almost 60% of the personnel and more than 80% of the personnel with university degree. The R&D department counts for 80% of the total business of INCAS in direct area of activities, from national and international contracts.

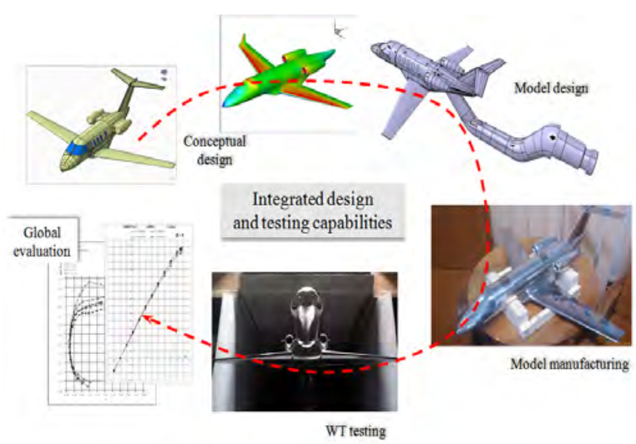
With respect to the INCAS policy, R&D department has the following structure :

- **Flow Physics Department** - 23% of INCAS personnel
- **Systems Department** - 14% of INCAS personnel
- **Structures & Materials Department** - 20% of INCAS personnel

Traditionally INCAS has been associated with all major R&D and industrial projects in aeronautics in Romania, for civil and military usage. The structure in place before 1990 included all components of an institution recognized as DOA - Design Organization by civil and military authorities, using more than 2,500 employees. This structure has disappeared due to a lack of capability from industry to support development of certificated products in aeronautics. It was a challenging process for INCAS to preserve certification capability for aeronautical products and to integrate as a research establishment with almost 90% of the business in R&D activities.

Starting 2007 INCAS has initiated a restructuring policy with respect to existing potential and available infrastructure, so that most of the researchers and teams could better benefit from the institutional support and policy of the company.

Industrial products integrated by INCAS



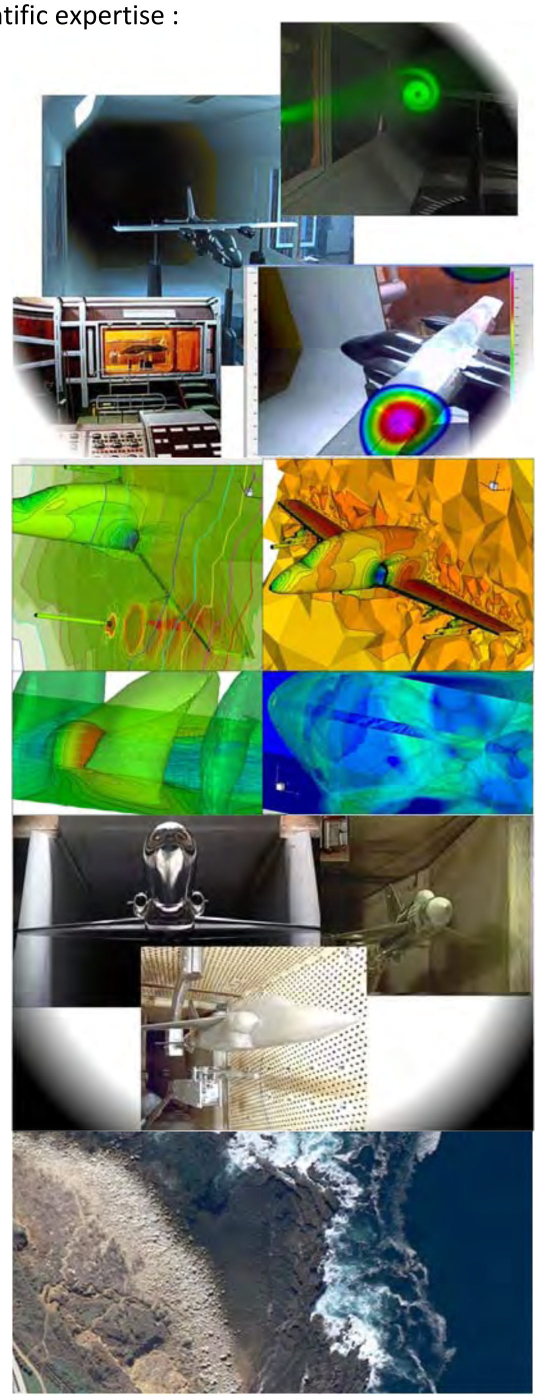
Basic R&D capability for aeronautical industry

INCAS R&D department is the main driver for INCAS as a research establishment recognized at international level as the interface with Romanian aeronautical industry and all strategies developed by INCAS are centered around constant development of world class competencies in this department.

Flow Physics Department

INCAS has a very strong tradition in fluid mechanics, starting from the first institutional days of the Institute in the fifties. This expertise has been continuously upgraded based in major areas where INCAS could identify development potential and niche competences and world wide recognition.

In the current administrative structure of INCAS, flow physics department is based on dynamic units featuring state-of-the-art technology and outstanding scientific expertise :



General Aerodynamics : - Unit dedicated to all areas related to traditional research in aerodynamics, from basic theoretical models to complex understanding of aerodynamic design of advanced flying vehicles for the Vision 2020 and FlightPath 2050.

Numerical Simulation : - Unit dedicated to most advanced numerical methods for complex industrial flows, including multifluid/multiphase non/reacting capabilities, implemented on TTT level high performance computing resources. Grid and Cloud computing is part of the latest technologies enabling complex simulations in aeronautics, including fluidic interactions, fluid-structure interactions and aeroacoustics.

Experimental aerodynamics : - Unit of special interest, where most advanced experimental facilities are operated, from the Subsonic Wind Tunnel (2.5mx2.0m test section, 110 m/s) up to Supersonic Wind Tunnel (1.2mx1.2m, Mach 0.1...3.5, MReynolds = 120), one of the most advanced facilities in the world. This unit has state-of-the-art technologies for advanced experiments, data acquisition systems and visualization, including latest developments in aeroacoustics and opto-electronics.

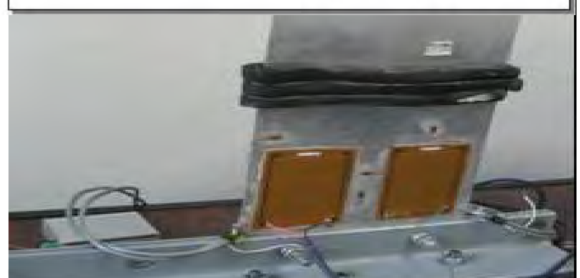
Environmental Aerodynamics : - Unit with a very dynamic development in the last years, taking advantage of the latest developments and investments in INCAS flying lab for atmospheric studies. Frontier reasearch in flow physics and chemistry is considered complementary to advanced validation for the large scale simulation models in meteorological studies.

Systems Department

INCAS mission was strongly linked to major aeronautical programs, where flight dynamics and systems were key areas for new developments. Key capabilities have been constantly developed using both advanced theoretical models and experimental facilities. Major success is linked to successful integration and certification of IAR-93 and IAR-99 aircrafts, where handling qualities and systems performance proved the level of expertise of systems departments.

Systems dynamics department is developed on a two pylons structure :

Systems Dynamics : - Unit dedicated in the past to major flight dynamics developments, from both theoretical and experimental perspective. Currently this unit is expanding towards more complex activities related to major challenges for the integration of unmanned systems in the future air traffic system, complex scenarios for steep ascent/descent for green operations, new generation of collision avoidance systems and formation flying simulation scenarios. Unit infrastructure includes advanced simulators for flight dynamics and virtual reality augmented simulation environments. Space dynamics, satellite formation flying as well as new launcher systems for low orbit are new areas for development of this unit.



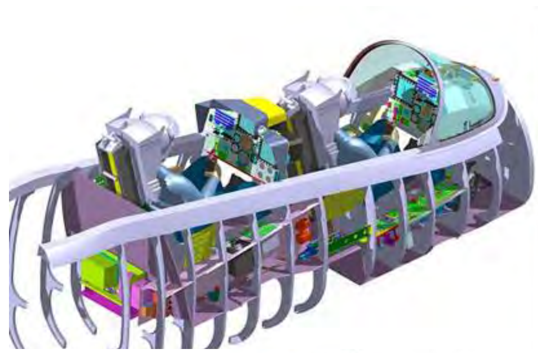
Mecatronics : - Unit dedicated to the area of smart systems and critical components in the new generation of flying vehicles. This units integrates expertise from basic aerospace systems up to new generation of smart structures, health monitoring using on-board and on-ground systems, morphing structures and control systems. Unit infrastructure includes state-of-the-art capabilities for advanced validation and certifications for basic systems, testing in harsh environments and advanced capabilities for large scale simulations for complex industrial products. Industrial developments for ground based demonstrators, testing for industrial certification of subsystems and virtual maintenance simulators have been initiated by this unit with major industrial partner in Europe.

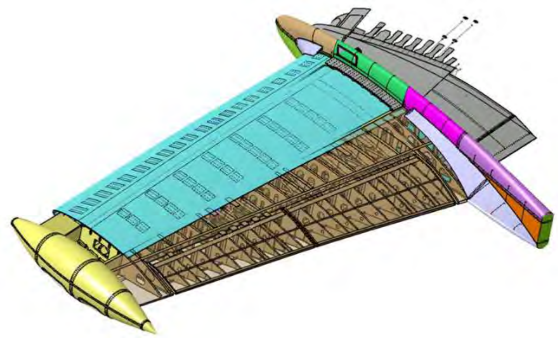
Structures & Materials Department

INCAS is design authority for all major aeronautical programs developed in Romania. Acting in an integrated environment with industry, INCAS has developed outstanding capabilities for design and analysis of modern aero-structures, integrating state-of-the-art capabilities for virtual enterprise. At the same time, a continuous effort enabled materials department to developed new materials with advanced properties for aeronautical usage, with important spin-off capabilities. This integrated approach enables enable INCAS to provide full expertise from conceptual structural design using new materials up to structural testing and validation for the benefit of the industrial partners.

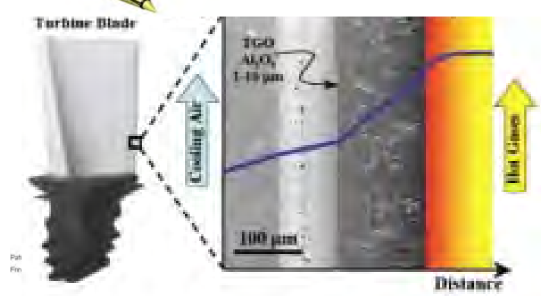
This department is based on two major units :

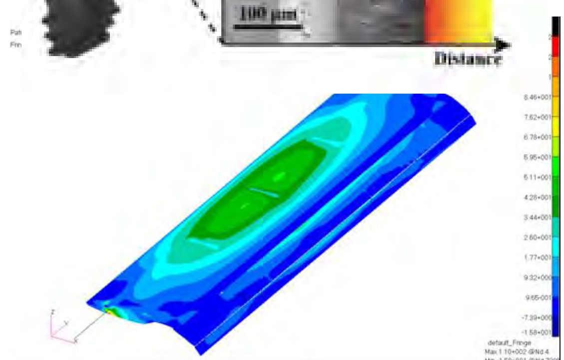
Aero-structures : - Unit based on advanced design capabilities, using CATIA environment and an integrated set of tools for structural analysis, complex mechanical and kinematic simulations. INCAS is also involved in in-house code development for structural analysis, mainly with respect to composite materials and structural integrity evaluation. Capability to work using state-of-the-art industrial tools enabled INCAS design team to be integrated into development teams of all major industrial partners. A special team is dedicated to wind tunnel model design and manufacturing, where almost all models for INCAS wind tunnel testing activities have been produced, for the benefit of aeronautical industry. Interconnectivity with new generation of unconventional manufacturing units, including 3D printers and virtual prototyping has been implemented in the last years.





New Materials : - Unit dedicated to development and testing of new materials for aeronautical applications. Due to a natural spin-off activity, the customer area for the proposed new materials is much broader, from heavy industry to space application, thus making this department a very competitive one. State-of-the-art technology is used for the experimental characterization of the new materials developed (mainly for carbon fibers). Latest experimental facilities include a unique thermal shock facility used in order to qualify materials for aeronautics and space industry.





INCAS Technical Department

INCAS is a unique research establishment in Romania mainly due to the combination of the following qualities associated with a very successful historical background:

- system integrator and design authority for all major aeronautical civil and military programs
- operator of a large experimental infrastructure, including facilities of national strategic importance

The Technical Department has the major responsibility to perform associated functions with respect to INCAS mission and to enable the quality of service requested by the highest standards. Also, due to the innovation culture associated with the R&D activity of the institute, this department has a very dynamic structure mainly with respect to the interface with the partners and customers.

The current structure of the Technical department is based on 3 pylons:

- **Technology Development Department** - 6% of INCAS personnel
- **Technical Services Department** - 16% of INCAS personnel
- **Technical Administration Unit** - 5% of INCAS personnel

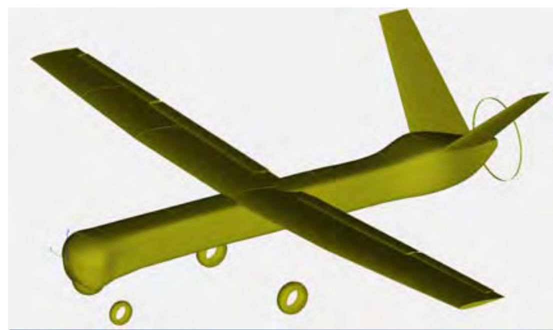
This department has an increasing role in the future development plans. The major challenges this department is facing are related to the industrial policy of INCAS and exploitation of the intellectual property rights developed by the R&D department, the increasing investment in the development of the research infrastructure on the Militari platform (14 ha) and the capability of INCAS to use internally and deliver to customers specialized services according to the highest quality standards and certifications.

Technology Development Department

INCAS capability to develop mature technologies and to integrate them in new products for industrial customers is based on the activity of this department, the main driver with respect to the achievements of the mission and strategic objectives of the Institute. At the same time, this department is considered for further development, integrating all major technical assets of INCAS able to deliver added value services for potential customers.

This department is the main interface with the business world, where mature technologies, specialized services and IPR are delivered towards customers. There are three units active in this department:

Concept Development: - Unit dedicated to both mature designs and products (e.g. IAR-99) and new concepts developed for the benefit of the aerospace community. This unit takes technologies at low-to-medium TRL level, pre-concepts and/or mature ones from R&D programs and enables customer support and industry services for the benefit of INCAS. This unit has the mission to enable proper visibility of the value of the R&D activity performed by the Institute



Technology Transfer: - Unit dedicated to already implemented projects at the industrial customers. It is based on the assumed role of INCAS as system integrator and design authority for civil and military products in service at various customers. Also, major INCAS initiatives (e.g. spin-off and start-up initiatives) with respect to industrial policy and marketing are directly linked to the technical activity of this unit.

ATMOSLAB: - Unit under development, starting with a EU project funded under O2.2.1, where INCAS invested in the first flying lab under civil registration in Romania. This is a KingAir C90 GTx aircraft, fully equipped with advanced systems for atmospheric studies and Earth observation, supported by a ground based mobile unit. This is a major area for strategic development at INCAS, where new areas for applied research partnerships is foreseen, as well as a major interest for added value services.

Technical Services Department

INCAS has a large experimental platform, on two locations: Militari-Bucharest and Maneciu, Prahova district and important area dedicated to offices on Militari platform. Basic functionalities and utilities, as well as energy supply for the wind tunnels is a very demanding task for a specialized department in charge with this support activity.

Based on the specialization of the required services, three units are involved in this challenging activity:

IT & Logistics Unit : This unit has the responsibility to deliver IT services to INCAS, using state-of-the-art technologies in computer science, telecommunications, on-line and on-demand logistical services. This unit is also responsible for the global communication network, including security systems and access control to the infrastructure

Mecano-electro Unit :Unit dedicated to global maintenance services for the technical systems of the research infrastructure, as well as for the basic functionalities for the utilities. Due to the technical nature and origin of the electro-mechanical systems serving the experimental facilities, mainly the wind tunnels, this unit has unique expertise with respect to maintenance and monitoring of the systems involved.

The Power Station: - Unit of particular importance due to the high power consumption of the wind tunnels. This unit is also serving a broader industrial community for historical reasons, while still acting as an independent energy distributor according to the Romanian laws. It is organized as a business center and has some financial independence due to the added value of the services provided to the industrial clients in Militari platform.

INCAS location on Militari Platform - (14 ha, 12.000m^2 offices)

Technical Administration Unit

This is a small unit is based on a dynamic group of people providing technical and administrative services for day-to-day activities. This group is in charge with various activities, including:

- supply activity;
- house keeping and gardening;
- direct surveillance at Maneciu location;
- various support services.

It is a constant action for INCAS to enable this unit to make usage of specific equipment and tools for increased productivity and efficiency.

INCAS location on Maneciu Platform - (11 ha, 2.800m^2 offices)

INCAS Economic Department

The Economic Department is a specialized entity with extensive experience in the economic problems related to R&D activities, able to face new challenges imposed by a very complex business environment. At the same time this department has adapted to the major changes of the legislation, either imposed by changes of the legal status of INCAS or by the EU legislation for FP6/FP7

As part of the constant policy of INCAS towards efficiency in R&D, the structure of this department has been designed for maximum productivity with an optimum number of specialists. The result is a department with 7.5% of the total personnel of INCAS, but preserving all key positions in the economic and administrative structure requested by the legislation and INCAS internal procedures.

The activity is based on a four internal unit, as follow:

Financial Unit: - Unit dedicated to all financial administration of the company according to the legislation, also interfacing with requirements from EU with respect to FP6/FP7 financial administration.

Planning & Marketing Unit: - Unit in charge with all major centralized policies involving contracts and business planning, either in the preliminary phase for prospective activity and in the finalization phase with respect to R&D business evaluation. The marketing activity is tailored with respect to the R&D, focusing on innovation and spin-off.

Human Resources Unit: - Small and efficient unit, involved in critical areas of human resources for R&D, facing major challenges imposed by the constant policy of INCAS towards young researchers integration and international cooperation through exchange programs.

Assets Administration Unit: -This is a new unit in INCAS administrative organization, imposed by the unique infrastructure for research and new investments in R&D. Major challenges for this unit are linked to a major investment in Maneciu platform and ATMOSLAB infrastructure.

INCAS New Business Development Department

The New Business Development Department is a rather restricted department in terms of personnel (4% of total INCAS personnel as FTE) but a major component of INCAS with respect to business strategy, international cooperation and a facilitator for new business development in R&D at national and international level.

The group of people involved in this department have a unique experience, either with respect to a long involvement in complex industrial projects for civil and military applications, or in international cooperation, mainly in EU projects. Their role is to provide guidelines for the global strategy of INCAS as a research establishment, to increase national and international visibility of the company and to provide new development strategic directions.

There are four units working in this department:

Strategy Unit: - Unit based on a group of personalities, working either as full time employees or part-time, but all with a huge experience in aerospace activities. At the same time, part of this unit is working as advisors to the General Director on specific projects and contracts. This unit is providing major strategy guidelines for INCAS development as a research establishment and advise with respect to strategic partnerships, mainly with industry.

International Collaboration Unit: - Unit in charge with major contracts and support actions coming from INCAS participation mainly in EU FP6/FP7 projects. This unit also acts as an interface to all mobility programs where INCAS participates and enables developments for human resources in the international context and legislation.

Intellectual Property Unit: - Major component of the INCAS business strategy, this unit is in charge with all problems raised by an institute that delivers technology to the industry and has a strong background with respect to industrial products in service for civil and military customers. This unit is supported by external advise with respect to sensitive legal matters and international legislation.

Publications Unit: - INCAS has a long tradition for publications. A major achievement of the last years is INCAS Bulletin, a journal with international distribution and ranking in R&D for aerospace sciences. Also, this unit is in charge with the two major conferences organized every other year by INCAS, namely AEROSPATIAL and "Caius Iacob", under the aegis of Romanian Academy of Sciences.

INCAS Institutional Policy Department

INCAS is the leading establishment for aerospace sciences in Romania, with a strong position as a major company in R&D area. The Institutional Policy Department is facing grand challenges coming from the legal status and business environment, meeting all requirements from public legislation and specific sectorial standards.

As a public body, INCAS meets the legislative requirements and internal business procedures and practices using the following units:

Procurement Unit: - Unit organized according to the public law, in charge with the acquisition and procurement procedures. This unit faces increasing challenges from the growing investments in R&D infrastructure, mainly for Maneciu experimental platform.

AQ & CASTI Unit: -Unit with a long tradition for INCAS, major agent with respect to the policy for quality and excellence of the company. All activities with respect to the internal quality validation are monitored by this unit. Also, this unit provides the quality certificate, according to ISO and other standards in place, to all INCAS beneficiaries.

BDS Unit: - Unit in charge with restricted access documents and strategic archives, organized under the current legislation. This unit is mainly linked with major military projects and special activities performed by INCAS.

Legal Office: - Office organized with a major focus on the R&D legislation, either for internal and international activities. This unit provides basic support in all contractual matters and has been constantly updated with respect to the new legislation in contracts, mainly et EU level. Also, this unit provides basic support for all IPR related matters in R&D activities, using external specialized support in critical areas.

Units coordinated by the General Director

According to the Romanian legislation, also imposed by international standards, current best practices in use in R&D activities and aligned with INCAS internal policy, the General Director has direct responsibilities in several specific areas.

Advisors Unit : - INCAS uses a special unit of advisors, mainly for complex industrial projects, based on a group of personalities with proven record of achievements in aerospace sciences and industry. The General Director is assisted by this group, also participating to the strategy development of INCAS.

There are several direct responsibilities of the General Director, mainly linked to the following policies:

Quality : The General Director is the company responsible person for the overall quality policy . INCAS is a ISO certified company (series 9, 14 and 18), also meeting the certification requirements for quality from military areas.

Security : The security structure in place at INCAS is under direct supervision of the General Director, according to Romanian legislation.

PSI & PC : Local civil protection and fire protection units are under the direct responsibility of the General Director, according to specific Romanian legislation.

SSM : This is a direct responsibility for the General Director, imposed by the labor legislation in Romania, also aligned with international legislation and best practices.

Audit : The General Director of INCAS is in charge with the internal auditing of the company. This specialized activity is enabled using contractual work from external service supplier.

The Organization Diagram include these units under direct coordination of the General Director. Activities with respect to specific policies are performed by specialized personnel, most of them already part of the basic organizational structure. For maximum efficiency, specialized support in several units is enabled via external contracts.

2.2 INCAS General Activity Report 2007 - 2011

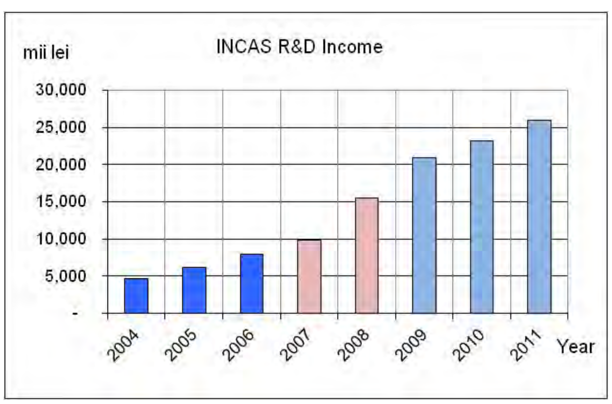
INCAS activity for 2008 - 2011 was in line with the legal status and general strategy developed starting 2007 in order to reposition the Institute as INCD under the coordination of ANCS - National Authority for Scientific Research. There were two distinct periods, when :

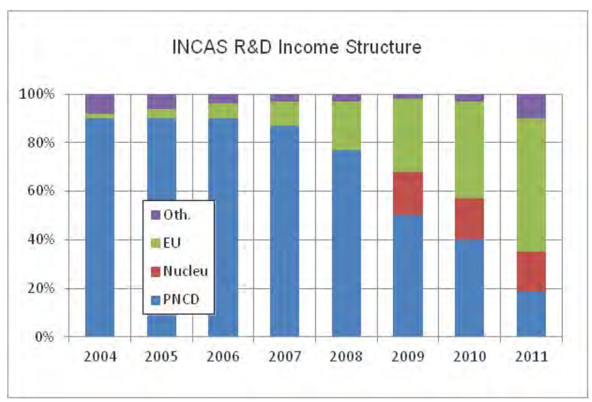
- 2007 - 2008 : INCAS acted as a private research company in private property of the Romanian state, 99.8% owned by AVAS
- 2008 - 2011 : INCAS is a research establishment, acting under public law as INCD, coordinated by ANCS - National Authority for Scientific Research

Based on the development strategy formulated in 2007 with respect to the major transformation of the Institute, INCAS has been very active in national and mainly international R&D activities. It was a very successful period, with a fundamental reorganization of the Institute and many important achievements with respect to the international recognition of the outstanding scientific capabilities of the personnel and the world class quality of the infrastructure.

Basic R&D activity

INCAS is a research establishment in aerospace sciences, with major topics for research in aerospace engineering, applied aerodynamics, flow physics and associated areas, where technology involved is in low-to-medium TRL level (up to TRL 4). At the same, INCAS has a unique position as system integrator for IAR-99 aircraft, in service with the Romanian Air Forces, where R&D activities and mainly technology development are performed at TRL 7.

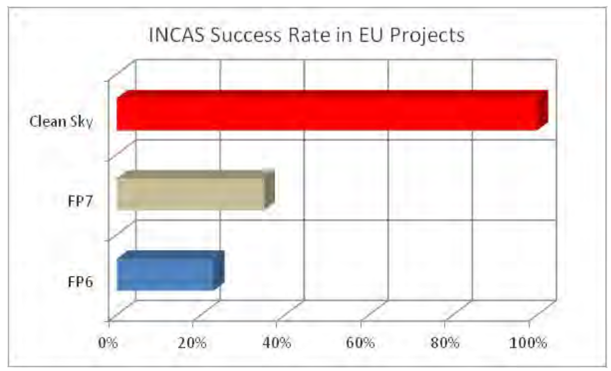




In global terms, income from R&D activities increased at a very high and sustainable rate, by more than 265 % compared to 2007. This was obtained in the context of the global overall decreasing rate of financing in national R&D programs (from 84% in 2007 to a historical low value of 19% in 2011) and is a measure of the successful development of INCAS in the last years as INCD with a very high international visibility.

The four major sources for financing INCAS R&D activities at national and international level are: National R&D program (PNCD2), basic funding (NUCLEU, starting from 2009), EU funding by FP7 program and external contracts (industry).

INCAS has been involved in PNCD2 activities linked to the last 2 calls (2007 and 2008). The overall rate of successful proposals in call 2007 was 68% for projects where INCAS had a leading role, and 53% in projects as partner. The success rate in 2008 call was 73% in leading projects and 41% as a partner. Due to a major lack of resources, ANCS was not able to provide funding opportunities in PNCD2 starting 2009. INCAS adapted to this situation by shifting the major source for financing from national programs to EU projects.



Starting from 2009 INCAS was eligible for funding as INCD using NUCLEU. This was financed by a dedicated program for a 3 years period, rated at 20% of the overall R&D income of the previous fiscal year. Due to a constant growth of the total income of INCAS in R&D, this flat rate of 20% decreased in 2011 to 16% of the total R&D income.

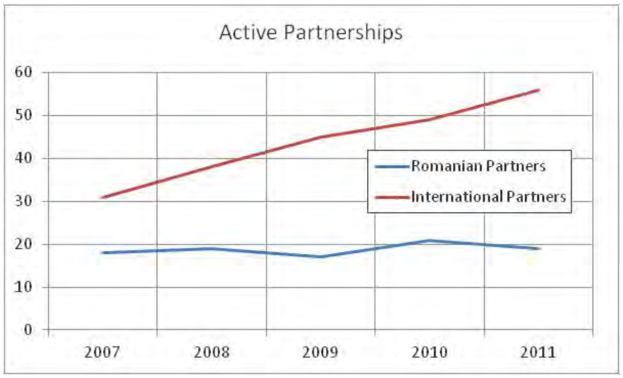
As a conclusion, INCAS success in R&D activities in 2007 - 2011 is illustrated by the total income from R&D activities and the major shifting from national financing (86% in 2007) towards a significant share in EU FP7 projects (55% in 2011). At the same time, being associated member in Clean Sky gives a long term perspective for financing up to 2016 at a similar rate compared to 2011.

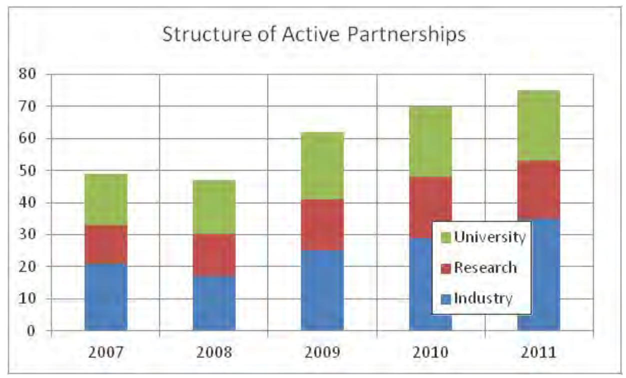
INCAS participation in EU projects started in FP5. From FP6 INCAS has been successful as a partner in several major STREP and IP projects, as well as in 2 SA and CSA actions of smaller value. Some of these projects have ended in 2007 to 2008 (e.g. STREP - UFAST and IP - CESAR). A very important project (STREP - AVERT) has been extended and ended in 2009.

From 2009 INCAS has been successful in FP7 projects, mainly linked to JU Clean Sky initiative. Acting as an associated member of Clean Sky in SFWA and GRA ITDs, INCAS made a major step forward with respect to an alternative source of financing to the national PNCD2. At the same time, INCAS has been included in other FP7 projects, thus having a success rate of almost 35% with respect to overall participation in EU projects between 2007 - 2011. This is a very high score compared with the average success rate in FP7 projects (below 20%) !

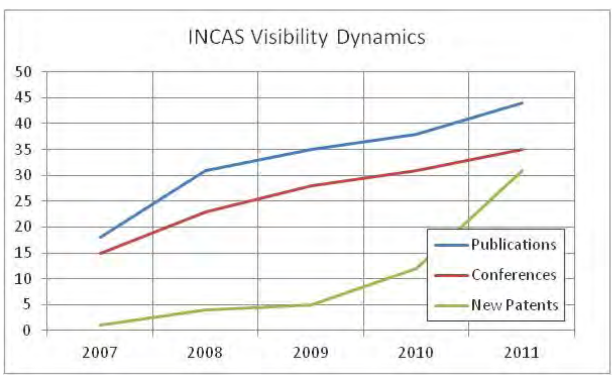
Industrial contracts are highly dependent on the traditional customers (Romanian Air Forces) and this activity had very limited financial support from national authorities. However, INCAS managed to get 3 important contracts with external industrial partners in the aeronautical sector, with a long term perspective in the context of new developments for a multirole fighter.

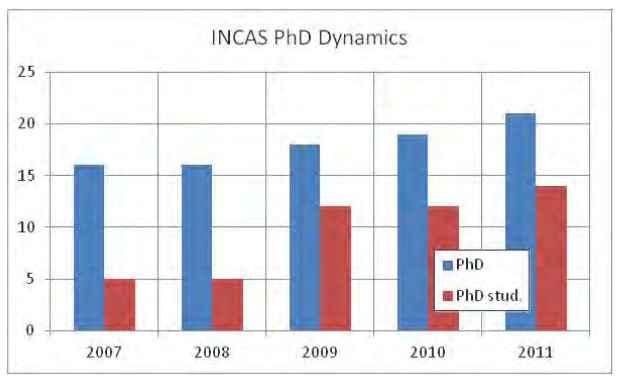
The number of active partnerships of INCAS in aerospace sector grew constantly, together with the increased involvement in EU projects, while internal partnerships remained almost constant, mainly due to the stop of PNCD2. The structure of active partnerships is almost balanced, with a small focus on industrial partnerships due to the main assets INCAS has as a wind tunnel operator and integrated design capabilities for industry.





Most of the activities in R&D projects were presented in scientific papers and conferences. Also, for specific activities in industrial environment, INCAS has developed innovative solutions with associated IPR materialized by an increasing number of patents. Dynamics of this activity is giving a perspective of the role INCAS is now playing as INCD for aerospace industry.





The successful period 2007 - 2011 has also been materialized in the constant growth in the number of PhD and PhD students from INCAS. Starting from 2008 INCAS has hosted PhD students as part of an international partnership with Toulouse University. This has continued and enlarged with similar actions in national and international cooperation, also involving INCAS PhD students being included in similar stages in international universities (Delft, Torino, Braunschweig).

Starting 2010 INCAS has initiated a continuous action for promoting innovation among young and experienced researchers. They have been encouraged to use patents they have already developed and initiate spin-off companies in order to exploited the marketing potential. Currently there are a 3 spin-off initiatives that have been included in a program with EU funding. Another 4 similar developments are waiting final approval with respect to a financial support of EU.

Major achievements

The greatest achievements of INCAS in R&D activity in 2007-2011 may be linked to two major moments:

- INCAS was reorganized as a INCD - a very successful institutional achievement in 2008, based on a very delicate administrative process and a tough scientific evaluation;

- INCAS has been selected and validated in 2009 as associate member of JU Clean Sky for SFWA and GRA ITDs in the most selective R&D club, an official international recognition of the scientific capability and outstanding resources INCAS has to offer to the international aerospace community.

These achievements are top level recognitions in the scientific community, following a long list of specific technical results, with a major impact in the scientific community:

- Participation to AVERT Project : - the most important project in FP6/FP7 dedicated to active flow technologies for the future ATS in the ACARE Vision 2020, the technological basis for development in Clean Sky - SFWA ITD.

- Integration in a very important partnership generated by CESAR Project - Cost Effective Small Aircraft, the only IP in FP6/FP7 dedicated to CS-23 aircraft category, followed by a successful engines and systems related project in FP7 - 2011, ESPOSA;

- First partnership ever in INCAS history dedicated to off-set activities in Romania, with Alenia as a major partner;

- Integration in EREA and strategic partnerships with DLR, ONERA, NLR and CIRA for integration of unmanned air vehicles in the civil air space, part of EDA;

- HELENA Project - Major initiative for a new generation of regional aircraft in a strategic partnership with DLR, VZLU and ILOT

This selection of institutional major achievements is supported by a long list of personal achievements of INCAS scientist with respect to the international recognition of their expertise.

Major Investments and Institutional Development

For more than 20 years INCAS has invested in technologies for aerospace sector, aiming to become a regional leader for specific niches. At the same time INCAS has upgraded the research infrastructure, mainly the wind tunnels and simulators with state-of-the-art technologies and equipments making INCAS one of the most cost-efficient services supplier for aerospace industry. More than 20% of the yearly total revenues from basic R&D activities included such technological acquisitions.

Starting 2010 INCAS has planned two major lines for investments : experimental platform at Maneciu and ATMOSLAB, the only Romanian flying lab under civil registration.

The modernized Maneciu platform will enable new business development with respect to green technologies, also serving as a base for aerodynamic testing and training. The total value for investment between 2010 - 2011 in this experimental base in 1.5 mil. Euro, to be continued using additional investments of 0.5 mil. euro in the next 5 years.

ATMOSLAB is a dedicated facility for airborne atmospheric studies and Earth Observation, making INCAS one of the most important provider for such specialized services. The starting of this investment has been made using POS-CCE-O2.2.1 EU funding scheme, at an initial value of 5 mil. Euro. INCAS will continue to invest in new equipments for both guidance and navigation and atmospheric studies in the range of 0.5 mil. Euro in the next 5 years.

As part of the institutional policy, INCAS has planned 15% investments in new technologies and equipment from R&D contracts, and additional 1 mil. euro investments for external funding for investment in both Militari and Maneciu platforms and ATMOSLAB.

Starting 2009 INCAS has initiated an institutional support for spin-off and start-up innovative companies, mainly with respect to advanced technology transfer and higher exploitation of patents and IPR. In 2010 INCAS has founded Aerospace Consulting, as a professional association for consultancy, and in 2011 Aerospace Services has been founded as a 100% owned start-up SME in aeronautical area.

At the same time, based on 3 patents from INCAS, in 2011 three spin-off companies have been initiated with major development plans in air vehicles as small helicopters, unconventional small aircrafts and new generation of active balloons. The total value for spin-off initiated companies is 600.000 Euro, based on the 90% financing from POS-CCE-A2-O224 EU funding scheme.

Development of Human Resources

The most challenging management activity for INCAS is related to development of human resources in a very competitive R&D sector. INCAS has initiated a new policy in this area, under the leadership of the Scientific Council. Current situation has improved major problems related to the age distribution of personnel, in 2011 having average age below 50 years old. Lowering the average age has been combined with increased number of PhD and PhD students. Also, as part of continuous effort for scientific excellence, more than 50% of the R&D personnel has been promoted in a higher scientific position, based on nation legislation and competitive examination, as presented on INCAS web site.

INCAS has also been active in 2007 - 2011 in promoting outstanding personalities in the highest scientific boards in aerospace community. INCAS has 2 board members in ICAS - International Council of Aerospace Sciences board, in ECCOMAS Program Committee and 3 INCAS members are AIAA Senior Fellows.

A major interest was also in raising the global visibility of the R&D personnel, with a solid dynamics of the ISI ranking and patent international recognition.

Technology Transfer Activities

INCAS is associated with all major aeronautical developments in Romanian aeronautical industry. IAR-99 is an aircraft in-service for the Romanian Air Forces where INCAS has IPR and acts as design authority, under continuous development with AVIOANE Craiova as manufacturer. It is INCAS major area for industrial technological transfer.

New international partnerships enabled INCAS to enter on the international technological market. The major vectors for technological transfer are linked with Clean Sky technologies, where INCAS is in a position to deliver a Krueger-flap system for a biz-jet of new generation and a active flow technology for high lift systems using oscillatory blowing. These technologies have been developed at TRL4 by INCAS and are under maturisation towards TRL6 in the next 3 years.

A separate area for technology transfer is linked to unmanned vehicles for special missions. INCAS is in a position to transfer towards potential users in the civil and military sectors a large system for situation awareness and special missions, able to integrate in the unsegregated civil airspace.

International Visibility

Starting 2007 INCAS has been recognized as regional policy leader in aerospace community, having a strong position as a valuable and active player in this field. Major area for INCAS international visibility at institutional level are linked to the EU activity, where participation in EREA - European Research Establishments association in Aeronautics and ARG - Aeronautical Research Group is a basic recognition. INCAS is having also an active role in ES - Executive Secretariat and in SRG - Security Research Group.

At the same time INCAS is ACARE member from 2007, also General Assembly member in the new ACARE starting 2011 and has a seat in PC7 Transport for aeronautics.

World wide recognition has been achieved by partnership in IFAR - International Forum for Aviation Research, and membership in two professional associations in wind tunnel testing area : STAI - Supersonic Tunnel Association International and EWA - European Wind Tunnel Association.

INCAS has a participation as observer in major actions of EU in the strategic projects like OPTI, Mefisto, VFF-SIG. At the same time INCAS is participating to all new activities initiated by ESA - European Space Agency with respect to the new enlargement with Romania membership in 2011.

A list with major international projects active in 2007 - 2011 where INCAS participated is provided.

FP6

- EGEE – Enabling Grids for e-Science
- SEE-GRID – South-Eastern European Grid-enabled e-Infrastructure Development
- UFAST – Unsteady Effects in Shock Wave Induced Separation
- CESAR – Cost Effective Small Aircraft
- AVERT – Aerodynamic Validation of Emission Reducing Technologies

FP7

- CEARES – Central European Aeronautical RESearch initiative
- AeroPortal – Support for European Aeronautical SMEs
- Testing Activity on Distributed Maintenance Training Infrastructure
- RESTARTS – Raising European Students Awareness towards Aeronautical Research Through School-Labs
- SAT Rdmp – Small Air Transport – Roadmap
- EGI-InSPIRE - European Grid Initiative
- MIDMURES – Mitigation Drought in Vulnerable Area of the Mures Basin
- ESPOSA—Efficient Systems and Propulsion for Small Aircraft
- HYDRA – Hybrid ablative development for re-entry in planetary atmospheric thermal protection

... and JTI Clean Sky in

- SFWA ITD - Smart Fixed Wing Aircraft
- GRA - ITD - Green Regional Aircraft

2.3 Activity Report by Teams

T1 - New Concepts for Advanced ATS

Team leader:

dr. Sorin RADNEF

1. Team Status

This team was established considering the trends and the development directions identified and stated by the official European documents of European Commission, ACARE and EREA. The first attempt to structure such a team started 2000, when INCAS was involved in many projects covering the objectives of ATS. Now the team is well stated as an advisory group for new trends in aeronautics and as a working group for defining general objectives of the INCAS projects.

The documents that guide the activities of the team are:

1. ACARE - Aeronautics and Air Transport: Beyond Vision 2020 (Towards 2050), june 2010
2. CREATE – Creating Inovative Air Transport Technologies for Europe, oct 2010
3. EREA Vision for Future – Towards the Future generation of Air Transport System, oct 2010
4. Flight Path 2050 – European Commision, High Level group on Aviation research, 2011

2. **Human Resources**

Regarding the objective of this team human resources are critical. There are necessary engineers (and some physicists) having a strong professional background, a large experience in their field of expertise and in other connected domains:

Systems dynamics: Neamtu Andrei, Tudose Mihai, *Aerostructures*: Dobrescu Bogdan, *General aerodynamics*: Pricop Victor, Popa Eduard, Neamtu Mihai, *Materials*: Mihailescu Alexandru, Manoliu Victor, *Board of directors*: Nae Catalin, Radnef Sorin, Marin Nicolae, Oprisiu Cornel

3. Research Domains - Projects

The main research activities are focused on the following topics, used by EREA for its “vision for the future”:

Revolutionary configurations:

- Design and studies for a nonconventional aircraft
- Torus platform using inertia effects to control the flight path
- Studies for morphing shapes of the lift surface
- Blended wing body shape development for a medium fighter

Revolutionary propulsion:

- Electric power/ propulsion for UAVs
- Layer deposition , nanotechnologies for advanced engine components

Revolutionary on-board systems:

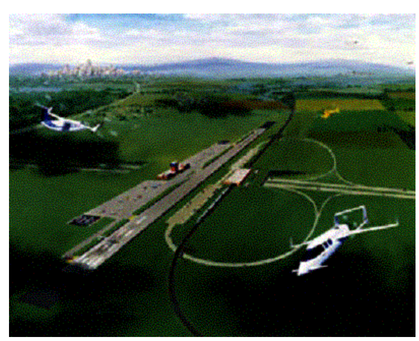
- Integrated systems for on-board sensors
- Power systems for controls actuation
- Assisted piloting system for flight evolution
- Electric and hydraulic power systems
- Digital flight data recorder system (DFDRS)
- Automatic pilot & control systems with delays

Full automation of ATM:

- Increasing air traffic safety: prediction of flight collisions
- Optimisation for air traffic: trajectory configuration for a given air space sector
- Flight mechanics adapted to the intrinsic characteristics of flight path-independent on coordinate system

a. *Projects*

Some of the projects the team is/ was involved:



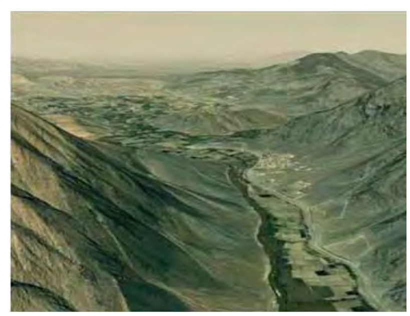
EREA study ATS 2050 To enable a safe, environmentally friendly expansion of the air transportation system, ATS vision for the future is backing the idea of introduce technologies to improve these points. Revolutionary aircraft that will enable a new future of aviation and mobility are essential to the aviation industry. Considering these results the team is going to lead its activities according to future demands of the air transport.

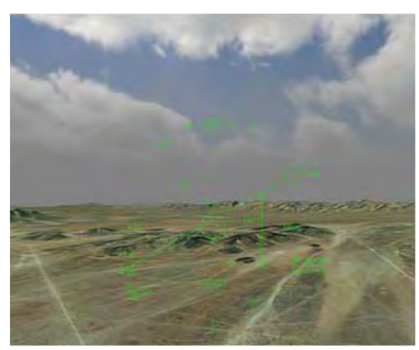
EREA for UAS -E4U- "Study support to the scoping and prioritisation of topics for the launching of a European Framework Cooperation on Unmanned Aerial Systems". There are five technical topics which are analysed through a methodology leading to identifying gaps, the actions to fill these gaps and prioritization of these actions. This work was based on an assessment of the current state of the art that will be identified and analysed through three workshops with experts from relevant stakeholders. Our institute participated to the monthly meetings with EDA that ensured the proper identification of technology areas according to pMS needs. T

CNTAR –"National Company for Regional Air Transport"

Considering the continuous development of the regional transport system in Europe, we believe that it is appropriate to try a large scale cooperation between the state and private entities in order to organize, develop and capitalization an air transport infrastructure intended for light aircraft. The project takes into account all the needs for such an attempt, giving the whole perspective for a regional air transport network.

CADCAS –"Methods and Software for defining and calculus of subsonic aircraft configuration". Considering the needs for advanced design and analysing tools the project approach the problem of conceptual design and analysis at the first stage of the aircraft programme. For ATS vision 2050, there is a need for airplanes more adapted to the needs of the passenger (comfort and safety) and so, the demand to be able to search the adequate configuration for a given mission of the aircraft. In this project there are stated and developed methods and analytical tools to study in a convenient way the aircraft alternative configurations. The first application of these procedures for the conceptual design was the preliminary design of a multirole aircraft having advanced features compatible with modern regulations.





VISUALLAND –"Advanced system based on artificial relief for guidance and assistance of aircraft". The targets of the project are placed in the field of special developments of aircrafts that are conceived to be part of the new ATS vision 2020. The overall objective is the development of theoretical background and the experimental implementation of a navigation system which integrates data from many data sources giving a 3D image for the terrain, flight path and aircraft position necessary to better assist the pilot.

AUTONOM - “Integrated system of equipments for autonomous flights in predefined conditions” This project intend to define a new concept for the integration of on bord subsystems designed for UAS vehicles.

Considering the requirements for the UAS insertion into the ATS, revealed by the results of the project *EREA for UAS -E4U*, the team decided to approach such a problem step by step, staring from the design and functional features of the main subsytems of the aircraft in an integrated vision.

4. Interdisciplinary

The team consider that an aircraft must be seen as a Flight Vehicle System and so all of its sub-systems must operate in a coordinated manner to accomplish the flight missions. This vision implies a strong interdisciplinary which is emphasized even by a list of sub-systems:

1. Avionics, 2. Cockpit Systems, Visualisation & Display Systems, 3. Navigation / Flight Management / Autoland, 4. Warning System, 5. Electronics & Microelectronics for on-board systems, 6. Sensors integration, 7. Flight Data/Flight Recording, 8. Communications Systems, 9. Identification, 10. Avionics Integration, 11. Optics - Optronics - Lasers - Image processing and data fusion, 12. Electronic Library System, 13. Aircraft health and usage monitoring system, 14.Smart maintenance systems, 15. Lighting systems, 16. Aircraft Security, 17. Electrical Power Generation & Distribution, 18. Pneumatic systems, 19. Hydraulic power generation & distribution, 20. Passenger and freight systems, 21. Environmental control System, 22. Water and waste systems

23. Fuel systems, 24. Landing gear and braking systems, 25. Fire protection systems, 26. Basic structure, 27. Aerodynamic controls, 28. Auxiliary mechanical systems (including the landing fear, in flight refueling system, …), 29. Recovery systems, 30. Propulsion systems (including fuel tanks, …).

The integration of all of these systems or some of them, at least, requires knowledge from many professional domains which must be put together to work synergically.

T2 - Health Monitoring Research Team (SHMRT)

Team leader:

dr. Ioan URSU

1. Team Status

This team, emerged from INCAS System Analysis Laboratory in 2007, when launching the competition PNCDI2 Programme 4, "Partnerships in priority areas". On this occasion, in INCAS was initiated, in partnership with Romanian Space Agency-ROSA, Romanian Academy Institute for Solid Mechanics-IMSAR, University Politehnica Bucharest-UPB and Advanced Studies and Research Center-ASRC, the project proposal **"Intelligent system for simultaneous control and monitoring of structures" - SIMOCA**.

2. Team Human Resources

Responsible from INCAS is dr. **Ioan Ursu, the leader of a team. SMHRT** is working since then in INCAS, and today is composed of the **PhD Student Eng. George Tecuceanu, PhD Student Eng. Adrian Toader, Eng. Vladimir Berar**. The mission of a team such as SHMR is to advance the state-of-the-art in structural health monitoring to improve public safety, reduce maintenance costs, improve readiness, and foster a paradigm shift in design by leveraging and fostering collaborative R&D efforts between academia, industry, and Ministry of Education and Research Agencies (ANCS, CNCS).

3. Objectives and Research Domains

This team, as scientific pole in INCAS, inherits an old and long **cooperation in the field** of aeroservoelasticity in INCAS, former INCREST, extended until the early 1990s, **between Dr. Ioan Ursu and Prof. Dr. Victor Giurgiutiu**, currently working in Mechanical Engineering Department at South Carolina University. Dr. Giurgiutiu is now a well-known researcher, with extensive publications read world wide: author of several recent books (Structural Health Monitoring with Piezoelectric Wafer Active Sensors, Elsevier Academic Press, 2008; Micromechatronics 2nd Edition, Taylor and Francis CRC Press, 2009) in the field of structural health monitoring.

On the other hand, in PNCD2 project 81 031 approach, Dr. Ursu came with about 40 years experience in the fields of aviation servomechanisms, applied control, mechatronic systems, experience fructified in numerous articles published in ISI archival journals, including the book “Active and semiactive control”, published by the Romanian Academy and awarded by the Romanian Academy Prize Aurel Vlaicu in 2002.

SHM definition. The process of implementing a damage detection and characterization strategy for engineering structures is referred to as **“Structural Health Monitoring” (SHM).** The SHM process involves the observation of a structure or system (such as aircraft, spacecraft, ships, helicopters, automobiles, bridges, buildings, large scale industrial applications, biological systems) over time using periodically sampled dynamic response measurements from built-in or autonomous sensory systems, the extraction of damage-sensitive features from these measurements, and the statistical analysis of these features to determine the current state of system health. For long term SHM, the output of the process is periodically updated with information regarding the ability of the structure to perform its intended function in spite of the inevitable aging and degradation resulting from operational environments. The new topic has a tremendous importance, because it is related to the reliability and economical benefits.

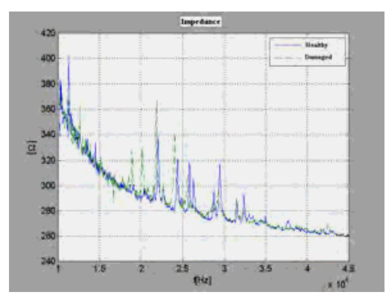
Broadly speaking, **structural active vibration control (SAVC)** is accomplished by so called active actuators, which consume external energy and deliver in system several/a number of external forces, rigorously determined by virtue of a control law, based on the measurement of the system response, materialized as unwanted, harmful vibrations, to external disturbances. For measurement purposes, sensors are employed and with the help of computers, the digital signal, converted to analog signal, activates the active actuator.

The two invoked directions – SHM and SAVC– are usually distinct and independent tasks in technical applications. In the project SIMOCA, another approach was considered, starting from the development of a synergic viewpoint: a simultaneous implementation and operation of these two methodologies, relating two research fields as applied to aerospace structures. The derived problems were complex:

a) vibration definition as major factor for health depreciation;

b) mathematical modeling for complex vibration systems, like aerospace structures;

c) definition of a procedure for the performing depreciations at a great rate;



d) the analysis of the usual health monitoring methodologies and the development of a suitable monitoring methodology;

e) the development of a **robust active control methodology**;

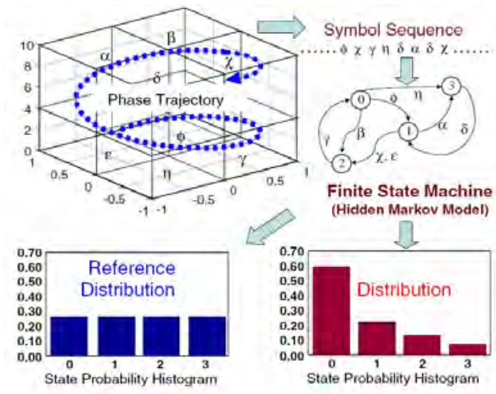
f) **validation of the integrated strategy**– health monitoring with active vibration control – by numerical and laboratory tests.

So, for the team, this area for research has meant a great success, ending with the realization of a **demonstrator** and a convincing **dissemination of results**. An Intelligent Strategy of Monitoring and Active Control (SIMCA) was implemented and tested on a ground based active demonstrator. The used **monitoring technique was impedance based** one, associated to a monitoring Macro Fiber Composite (MFC) sensor glued onto the plate. Control synthesis was chosen as LQG synthesis, using a MFC as actuator.

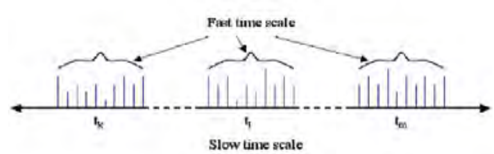
4. Active Projects

Based on the close ties the SHMRT has developed with other Departments in INCAS and with traditional partners, this team is involved in two complex project proposals in the field of SHM:

1) A Funding Application for Complex Exploratory Research Projects – PN-II-ID-PCCE-2011-2: **"Health Monitoring For Active Smart Structures – HMASS**". The overall goal of the proposed project is to develop an unprecedented health monitoring approach and methodology for active smart structures, enabling Technology Readiness Level (TRL) 4 validation of a global "active wing" concept. The inherent interconnected concepts are: active load control, active vibration control, and structure health monitoring (SHM).



2) A Funding Application for Joint Applied Research Projects PN-II-PT-PCCA-2011-3: **Advanced technologies for Predictive Maintenance based on Health Monitoring systems-PdMHM.** The goal of this proposed project is to develop a Predictive Maintenance based on Health Monitoring systems (PdMHM) methodology, implemented and validated by in-flight experiments with duration of about 2 years carried out on the Romanian Jet Trainer IAR 99 - Soim.



The inherent interconnected concepts are: SHM, predictive maintenance (PdM) and reliability theory. Within this framework, the project will consider, among other things, the symbolic time series analysis (STSA) of ultrasonic sensor signals for early detection of evolving anomalies.

5. Team Perspectives

INCAS committed important resources to this topic and enabled horizontal competences of teams members, thus participating in several projects simultaneously. It is expected that current SHMRT be enlarged with 4 young graduates. In the present composition, we mention that the 2 PhD Students (G. Tecuceanu and A. Toader) have the theses in an advanced state, and will therefore be, with the completion of their works, available to address new research teams in INCAS.

T3 - Advanced Materials for Aeronautical Industry

Team leader:

dr. Victor MANOLIU

1 Team Status

The team was established considering the trends and the development direction stated by INCAS strategy, regarding new advanced materials for aeronautical industry. This team addresses major challenges for new advanced materials and related technologies for a new generation of air vehicles.

2 Human resources

Incas team initiated and continues to conduct the research concerning new materials represented by young researches having solid professional training: dr. Adriana Stefan, Cristina Ban, dr. Alexandru Mihailescu. Also senior researches with experience in this area participate to the work: Gheorghe Ionescu, dr.Victor Manoliu, dr. Ion Dinca. Also. the team uses partners with competencies in optoelectronics to develop research in fiber optic sensors.

3 Research directions

The major objective of INCAS team is to integrate in the current international directions concerning the synthesis of new, high performance materials as smart composites, FC Epoxy elastic composites, C-C composites-ceramic matrix, metal–hybrid composites, carbon nanotubes /polymer and nanoclays/ polymers nanocomposites. INCAS team developed the research directions presented below.

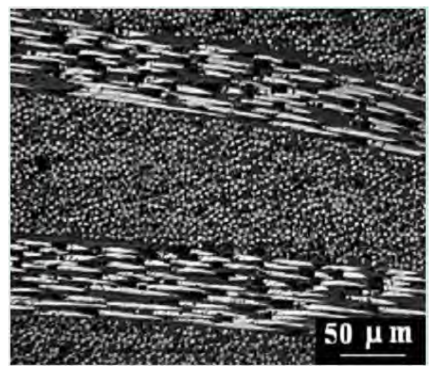
- Carbon fiber technology with advanced mechanical properties for aeronautics using the laboratory installation conceived and made by INCAS: filament diameter: 7μM 6000 filaments (6K), tensile strength= 3100 MPa, tensile modulus= 240 GPa, ultimate strain= 1.3%
- Carbon fiber/ epoxy matrix composites: flexural strength= 650 MPa, flexural modulus= 25 GPa, drive friction coefficient= 0.3
- Carbon- carbon composite: flexural strength= 200 MPa, flexural modulus= 100 GPa ;
- Hybrid Metal/Fiber composites GRAAL type:
    - Aluminium/Glass fibre: flexural strength= 170 MPa, flexural modulus= 8600 MPa
    - Aluminium/Carbon fibre: flexural strength= 250 MPa, flexural modulus= 8600 MPa
- MWCNTs/epoxy matrix Nanocomposites: flexural strength= 140 MPa, flexural modulus= 2800 MPa

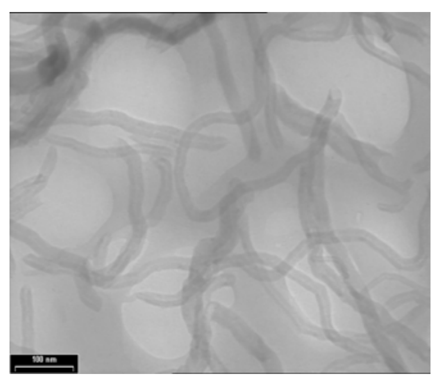
- Montmorillonite/ epoxy matrix Nanocomposites: flexural strength= 100 MPa, flexural modulus= 1800 MPa

The main aim is safety increase, cost reduction, “greening” of air transport and in particular the production of new materials for future transport such as: smart-FC Epoxy Composites C-C composites- ceramic matrix, as a potential solution for hypersonic aircraft radome, natural fibers and ecological matrix composites for aircraft interiors, Titan-FC hybrid composites.

The research conducted so far, provide the guarantee of successful development of goals proposed by the INCAS team:

- INCAS team initiated the research in our country concerning the synthesis of carbon fibre from PAN precursor, phenolic and mezophase matrix C-C composites, GLARE metal- fibre hybrid composites (mainly these represent an alternation of aluminium foils with glass fibre foils with an epoxy adhesive). Research has resulted in award-winning project X1C05 CEEX ANCS in 2008.
- INCAS team also initiated the research in our country concerning carbon nanotubes and nanoclays additivated epoxy and phenolic matrix composites and nanocomposites with remarkable results.
- The carbon nanotubes (single and multi-wall type) and montmorillonite clays nanoadditivation effects on the mechanical characteristics of structural composites for aircrafts were studied, the results showing a 10 to 15% increase of mechanical strength and 20-25% increase of the modulus of elasticity for the obtained composites.
- The effects of nanodditivation of epoxy polymers on the electrical characteristics of structural composites were also studied. Research has been conducted concerning the rheological effects of the nanodditivation process of epoxy resins.





The team activity has been successfully recognized for two patents:

1. Implementation of PAN carbon fiber technology and the adequate laboratory facility
2. Installation for performance evaluation of extreme pressure lubricants

4. Major Projects

As part of national and international projects, research has been conducted concerning C-C composites and carbon fibre- partially ceramic matrix (silicon carbide) composites. The studies made by the INCAS team are in consonance with international research in this area.

- ***Advanced materials for aerospace industry: C-C composites with matrix mezofazica additively with carbon nanotube composite laminates and fibre-metal***, ctr. CEEX-X1C05/2007; Project Manager: Eng. Ion DINCA,
- ***Nanocomposite stratified polymer-inorganic as hybrid reinforced at nanometric scale***-NANOCHRASN, ctr. CEEX -737/ 2007; Project Responsible: ing. Ion DINCA
- ***Advanced composite structures for aerospace and transport industries***-SUPERSOLID, ctr PN2 – 71-001/2007; Project Responsible: Eng. Ion DINCA
- ***Advanced materials for the aerospace and transportation industries: Nanocomposite polymer-carbon fibre/glass reinforced with structures carbonic or silicon carbide***, ctr PN2 – 71-125/2007; Project Responsible: Eng. Ion DINCA
- ***Research on achievement nanocomposites polymeric with organic/inorganic component for aerospace industry,*** PN - 09-17-04-01/2008; Project Responsible: chim. Ana STAN

- **“Hybrid ablative development for re- entry in planetary atmospheric thermal protection”**- acronym **HYDRA**- FP 7- SPACE- 2011-1/283797- 2012- 2014
- **“Efficient Systems and Propulsion for Small Aircraft”**- acronym **ESPOSA**, 284859-PF7-2011- 2014

5. Development areas

The future research activities will be in accordance with the 3 project proposals for the 2012- 2015 period:

- **Advanced Materials for Future Transport and Aerospace Industry: Composites C-C polymer-based, hybrid metal-fibre and ablative** - AMFTAI
- **Synthesis of fullerene- like organic nanomaterial with high tribological performances as solid lubricants, and additives of extreme pressure lubricants**”- Nano-friction
- **Hybrid composite materials with thermoplastic matrices doped with fibres and disperse nano fillings for materials with special purposes**- HYBRIDMAT

Research concerning polymer/ carbon nanotubes nanocomposites will also be taken forward, together with strategic area for development at INCAS for smart materials for aeronautical industry.

T4 - Advanced Simulators for Aerospace Applications

Team leader:

Alexandru ANDREEV

1. Team Status

The team was established to allow INCAS' involvement in modern projects which place a large emphasis on the use of virtual environments for simulating real phenomena or procedures in aerospace. This approach is capable of producing results of purely scientific value specific to academic research as well as results with immediate application to commercial products, which is specific to industrial research. This large area of relevance has made the creation of the team a natural progression of INCAS' resource organization. The objectives of the team are to first reach a high level of competence in the field through the participation in relevant European projects along side more experienced partners after which to commence the design and development of simulators for human-machine interaction in aircraft, flight characteristics determination for various aircraft designs – offline and online (requiring an engineering flight simulator), maintenance procedural analysis and improvement, etc.

2. Human resources

The subject of human resource selection was a difficult especially due to the far reach of the topic and the skills required to handle it well. The team was assembled trying to satisfy the need of IT specialists, aircraft system engineers as well as scientist representing the aerospace core disciplines (e.g. flow physics, mathematics, etc.). The composition of the team is as follows: Alexandru Andreev, Nicolae Apostolescu, Florentin Șperlea, Andreea Bobonea.

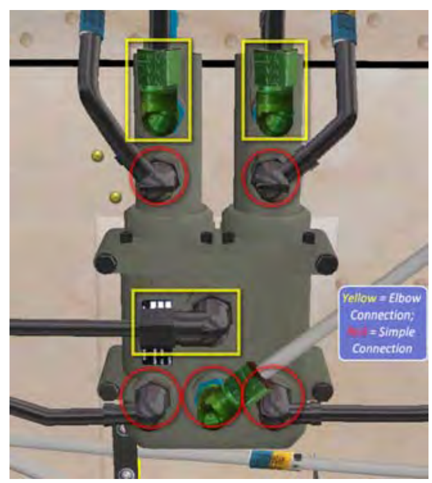
3. Research directions

The main research interests are focused on real-time simulation for aircraft in flight, aircraft systems simulation for quick prototyping and human-machine interaction.

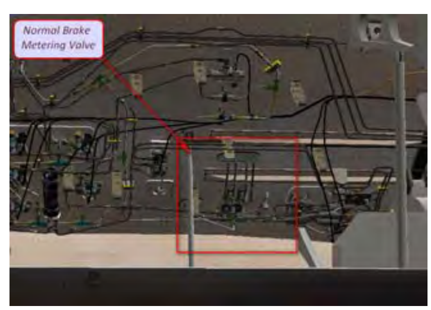
Real-time flight simulation - This is an enveloping solution for two distinct situations: offline simulation and online simulation. The offline simulation aims at assessing the performance of an aircraft under strictly controlled inputs. The real-time nature of the simulation is not a requirement since the all the inputs are defined mathematically beforehand, but the capability for real-time means gives a guarantee that the experiment can be performed in a reasonable time frame. The online simulation aims at determining the same performance parameters, but this time under the control of a real human, who is subject to response latency, errors in judgment and sensory corruption. This is a final step in assessing the quality of an airplane. The real-time online simulation allows also studying the case of remote piloting by introducing communications delays and interference. This is a popular topic in the present and will continue to be so for the foreseeable future, as the integration of UAVs goes to full throttle.

Aircraft systems simulation - The ability to dynamically study the interaction of various aircraft systems (e.g. electrical power consumption by hydraulic or lighting system) facilitates the optimization of the design process in what is known as "rapid prototyping". This type of simulation is not intended be reach a high level of accuracy, but rather to involve as many of the dynamic variables (subsystem characteristics) as possible. The purpose is to be able to look at the system as a whole, which is the main focus of system engineering, a discipline that is receiving a lot of attention in the present.

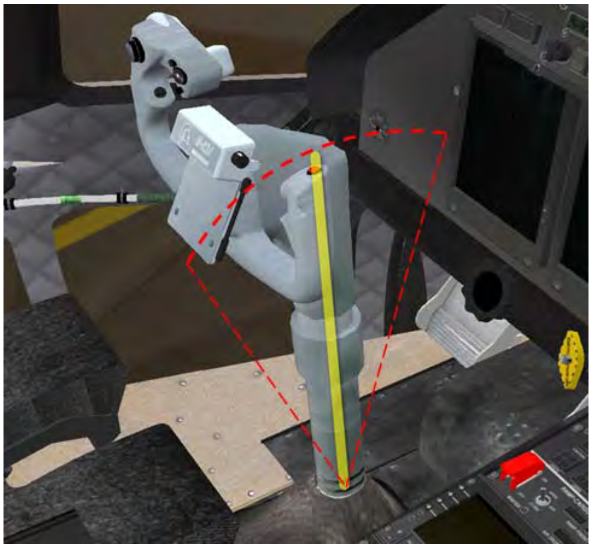
Human-machine interaction - The term human-machine interaction has a somewhat established meaning in the engineering and refers to the ease of use by a person or people of a given tool or piece of equipment. A simple example is how comfortable, and therefore less of a distraction, is the control joystick in a cockpit configuration. Here however we are trying to expand the meaning to include also entire procedures or complex processes where a human comes in contact with various pieces of equipment. An example for this is the procedure of changing a component of an aircraft system during maintenance. Such a study performed in a synthetic environment would allow the early detection of problems in the definition of the procedure (e.g. excess steps) or difficulties in performing the procedure due to space constraints or areas impossible to reach. Since maintenance procedure planning is a area which comes into play fairly early in the development of an aircraft, it is of great value to have a way in troubleshooting it sooner rather than later.



Currently the main project that saw INCAS' involvement in the subject of simulators was the collaboration with ALENIA AERONAUTICA or Turin, Italy for the creation of interactive and integrated simulation models for the Landing Gear (LDG) and Flight Controls (FCS) systems of the C27J Spartan military transport. The models were used in the Basic Maintenance Trainer (BMT) simulator as part of the larger framework of Distributed Maintenance Training Infrastructure (DMTI).



Below – for demonstrative purposes – are some images showing the BMT virtual environment (LDG and FCS).



Also at INCAS in development at the moment is a flight simulator for engineering research (flight qualities investigation with human-in-the-loop).

4. Interdisciplinarity

For this type of project interdisciplinary is paramount. While it is reasonable to assume that the various facets of the development of such simulators are tackled by specialized groups, the complex nature of the project dictates that all the groups involved speak a common language. For example: the software engineer must have good knowledge of physical principles and basic aerospace engineering in order to create proper tools to be used by the aerospace engineer in creating models, while at the same time the aerospace engineer must be able to understand and predict problems that the physical characteristics of the aircraft might introduce in the software.

T5 - Aerospace technology transfers to energetics

Team leader:

Ion NILA

1. Team Status

This team was established considering the trends and the development directions identified and stated by the official European documents of European Commission and GRANT, CITON projects. The first attempts to structure such a team comes from 2006, when INCAS was involved in CEEX projects covering the objectives of wind energy and nuclear technology study. Now the team is well stated as a working group for the design and technology of aerorotors used in the generation of wind energy and for the design of dampers for oscillations occurring in nuclear plants.

The documents that guide the activities of the team are:

5. European Commission, European Aeronautics-A Vision for 2020/ Meeting Society's Needs and Winning Global Leadership – report of the group of personalities, jan 2001
6. Blueprint to Safeguard European Waters, 2012
7. European Water Stewardship Program – Establishing a voluntary scheme to promote sustainable water use in industry and agriculture, 2011
8. European Water House – A concrete location making the Water Vision a reality, 2011
9. Council Directive of 2009 establishing a Community framework for the safety of nuclear installations, 2009
10. The Convention on Nuclear Safety, 1994
11. Aeronautics for Europe-A Partnership for Research and Technology and Europe Growth – European Commission, External Advisory Group for Aeronautics, april 2010

2. Human resources

Regarding the objective of this team human resources are critical. There are necessary engineers having a strong professional background, a large experience in their specialty and in other connected domains. So, the team is composed of the following researchers from the involved departments:

Aerostructures: Nila Ion, Ilinoiu Viorica, Dobrescu Bogdan, Bogateanu Radu, *Experimental aerodynamics*: Cornel Stoica, Horia Dumitrescu, *Mechano-Hydro-Pneumatic Group*: Arghir Minodor, Beraru Vladimir, *Board of directors*: Oprisiu Cornel

which fulfill the necessary requirements for the group activities.

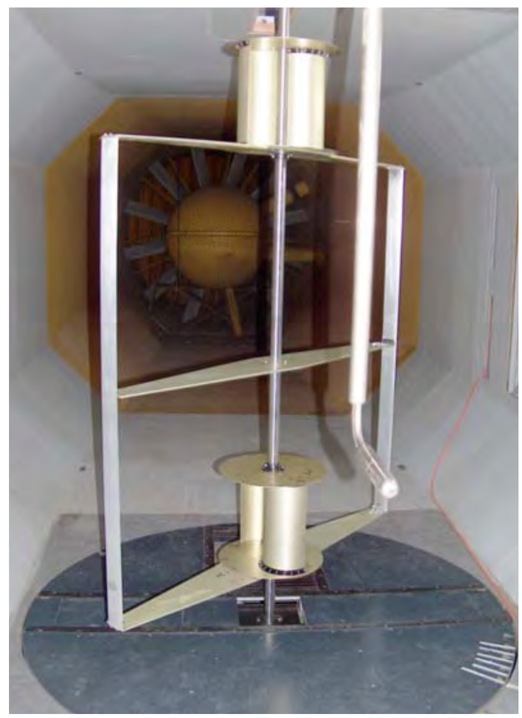
3. Research directions

The main research activities are focused on the following topics:

- *Wind turbines for electric energy generation*
- *HSSA hydraulic snubbers for nuclear power plants. Integrated engineering services for Nuclearelectrica*
- *Ensuring and maintaining the safety of nuclear power plant equipment and installation*

a. Projects

Some of the projects where the team is involved:

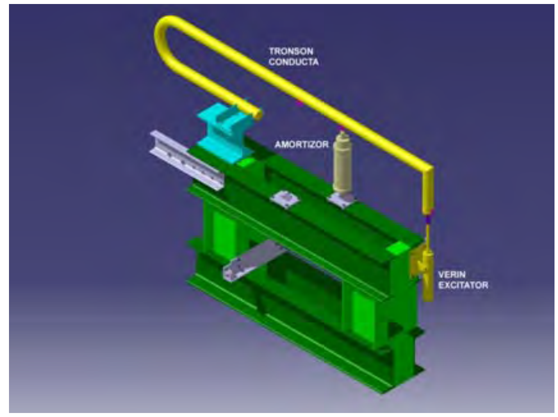


- Research and development of an eolian plant for irrigation of climatically deficient agricultural lands. Experiments, certification and manufacturing
- Mitigation of Drought in Vulnerable Areas of the Mures Basin
- Research and Development of an Innovative System for Damping of Oscillation Movement of Pipes and Equipment from CNE
- HSSA hydraulic snubbers for nuclear power plants

b. *Main Results*

The group activity was successfully integrated into several patents, as follows:

- Patent for a damper for low frequency oscillations – equipment used for damping oscillations in nuclear power plants (CEEX project)
- Patent for a wind plant for generating, storing and converting electric energy
- Patent for a mechanical wind plant for the extraction of water



4. Interdisciplinarity

The study and design of wind turbines requires the collaboration of multiple specialties including electro-mechanics, theoretical and experimental aerodynamics, data acquisition and processing.

The design and testing of hydraulic snubbers requires the collaboration of multiple specialties including mechanics, hydraulics, data acquisition and processing.

The integration of all of these specialties requires knowledge from many professional domains which must be put together to work synergically.

T6 - Atmospherical Environment Research

Team leader:

Mihai FLORIEAN

1. Team Status

This team is newly created and it is based on a European funded projected "Airborne Laboratory for Environmental Atmospheric Research". The efforts to establish this new laboratory go back to 2008 when INCAS started to show interest in this direction. Now the team is in its beginnings and its aim is to become a regional leader as being one of the only 5 such aircrafts in the European Union. The aircraft represents the bond between ground ,satellite and airborne research, being the only way to make in-situ research.

ATMOSLAB objectives are:

- To provide scientists with easy access to the most complete panoply of research infrastructures
- To develop trans-national access to national infrastructures
- To reduce redundancy and fill the gaps
- To improve the service by strengthening expertise through exchange of knowledge, development of standards and protocols, constitution of data bases, and joint instrumental research activities
- To promote the use of research infrastructure, especially for young scientists from countries where such facilities are lacking

The documents that guide the activities of the team are:

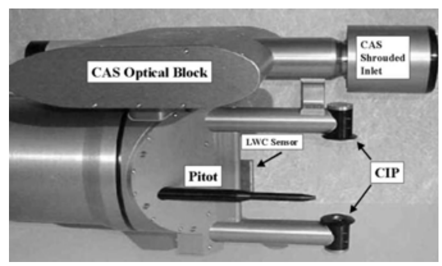
1. IPCC Expert Meeting on Detection and Attribution Related to Anthropogenic Climate Change 2011
2. IPCC Expert Meeting on Detection and Attribution Related to Anthropogenic Climate Change 2009
3. IPCC Expert Meeting on Detection and Attribution Related to Anthropogenic Climate Change 2007
4. Community heavy-Payload Long endurance Instrumented Aircraft for Tropospheric Research in Environmental and Geo-Sciences.
5. SEVENTH FRAMEWORK PROGRAMME Capacities Specific Program   Research Infrastructures 2010

2. Human resources

Regarding the objective of this team human resources are critical: it is necessary to use a mix of specialists in order to make the experiments, data acquisition, post-processing and customization, as a result a mix of engineers, physicists, pilots and technicians are necessary to keep the laboratory going.

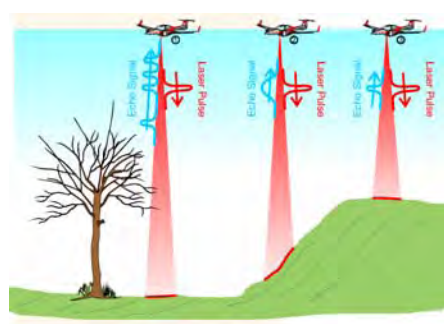
3. Research directions

***Cloud and aerosol properties measured from aircraft* -** continues to have a very strong empirical component. In situ observations from aircraft are indispensable for documenting the composition of clouds and thereby providing diagnoses of the processes within them. A new airborne particle spectrometer has been developed with the same measurement capabilities of the Forward Scattering Spectrometer Probes (FSSP) models 100 and 300 (FSSP-300 and FSSP- 100), two-dimensional optical imaging probe (2D-OAP), the Multiangle Aerosol Spectrometer Probe (MASP) and hot-wire liquid water probe, but with a single integrated system. The cloud, aerosol and precipitation spectrometer (CAPS) measures particles from 0.35 mm to 1.55 mm in diameter and liquid water content (LWC) from 0.01 to 3 g m_ 3. In addition to combining five probes into one, it measures airspeed at the sample volume and transmits a data stream that requires no special interfaces to communicate with most computers.



Airborne Laser Scanning - Airborne laser scanning is a rapid, highly accurate and efficient method of capturing 3D data of large areas, such as agricultural or forestry sites, urban areas, industrial plants, etc.

The long-range *RIEGL* LMS-Q680i airborne laser scanner makes use of a powerful laser source, multiple time around (MTA) processing, and digital full waveform analysis. This combination allows the operation at varying flight altitudes and is therefore ideally suited for aerial survey of complex terrain. The instrument makes use of the time-of-flight distance measurement principle of infrared nanosecond pulses. Fast opto-mechanical beam scanning provides absolutely linear, unidirectional and parallel scan lines. Full waveform analysis for unlimited number of target echoes.



4. Interdisciplinarity

The team itself is a mix of specialits qualified in various scientifical or technical areas which implies a strong interdisciplinary coordination: theoretical physics (theoretical approach of the physical phenomena), optoelectronics (plasma, laser, spectroscopy, photonics), atmospheric physics (cloud aerosol interaction, precipitations, climate change), enviromental physics (air pollution, air quality, ice forming), aeronautical engineering, electronic engineering, computetional fluid dinamics, data acquisition, data processing, 3D reconstruction and mapping.

Starting 2012, following a successful application in 2011, ATMOSLAB team will be involved in HAIC project, a EU FP7 IP project dedicated to high altitude icing conditions and particle characterization, with effects in aeronautics, under Airbus leadership.

T7 - Clean Sky Flight Demonstrator – BLADE

Team leader:

Alexandru COPAESCU

1. Team Status and Objectives

BLADE, meaning Breakthrough Laminar Aircraft Developed in Europe, represents a test of innovative green technologies for future aircraft in large scale tests under operational conditions. It includes novel technologies on large transport aircraft that require a very high level of maturity to guarantee the benefit in performance, while offering long endurance and stability as well as efficient maintenance and repair and of course a fully secure operation of the overall system. Environmental effects and benefits have to be judged and balanced on overall aircraft level against technological efforts, risks and different types of cost.

INCAS has enabled a complex team in charge with developments for BLADE. This is part of Clean Sky - Smart Fixed Wind activities for 2009 - 2016. It is well judged that this large scale flight demonstrator testing of novel technologies will provide the essential difference to other major R&T projects that has existed before. The substantial risks which are present when introducing step changing technologies into products at large industrial scales can be analyzed and judged, and decisions for a new generation of greener technologies in aeronautics can finally be taken.

2. Human resources

Regarding the objective of this team, human resources developed as it was necessary starting with requirements in SFWA. From the beginning there was a number of experienced engineers involved, having a strong professional background and a large experience in their specialty. Also, a number of young engineers that worked side-by-side. So, the team is composed of the following researchers from the involved departments:

Design: Ilinoiu Viorica, Mihailescu Paul, Pescarus Cosmin, Ionel Alexandru, Soare Valentin, Miler Corina, Balmus Elena

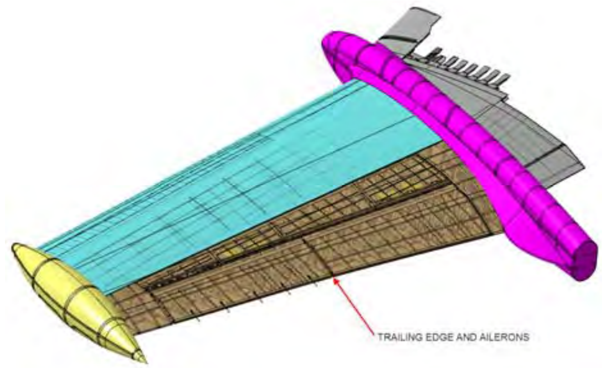
Stress: Lozici Dorin, Bisca Radu, Duta Alexandru, Nistor Octavian

Board of directors/ BLADE Management: Nae Catalin

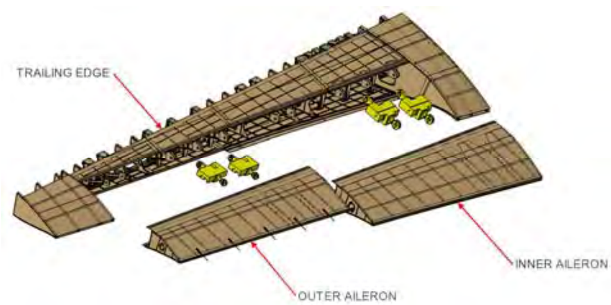
which fulfill the necessary requirements for the BLADE activities.

3. Description:

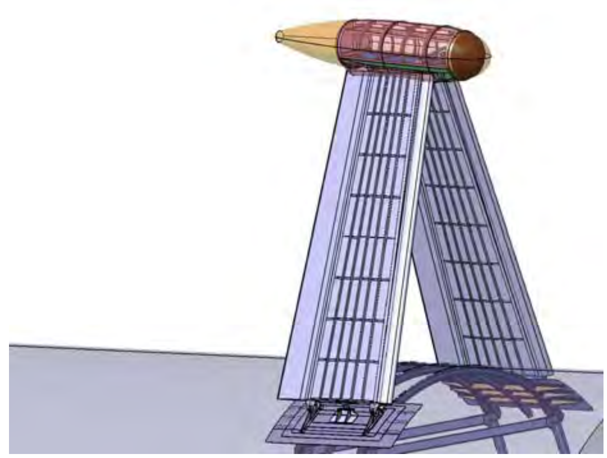
In the SFWA-ITD WP3.1 the major two subjects selected for an ultimate effort of R&T are development of an all new "Smart Wing" and the integration of innovative concepts in a flight demonstrator.



BLADE demonstrator represents an all new "Smart Wing" Laminar High Speed Flight Demonstrator . All key performance data of this Smart Wing, featuring a new set and combination of passive and active flow and loads control technologies shall be exploited under full operational conditions, at relevant Reynolds – and Mach numbers, at realistic Lift Coefficient and wing loading conditions.



INCAS BLADE Team is in charge of designing and stressing the Fixed Trailing Edge and Ailerons, and the Camera Pod. The Fixed Trailing Edges and Ailerons, Port and Starboard, are metallic structures. As well the Camera pod is a metallic structure mounted on the fuselage that provides necessary space for the Flight Test Installations. It is used to make several types of measurements that validate the technologies intended to be demonstrated.



T8 - Conceptual Design for a New Generation of Air Vehicles

Team leader:

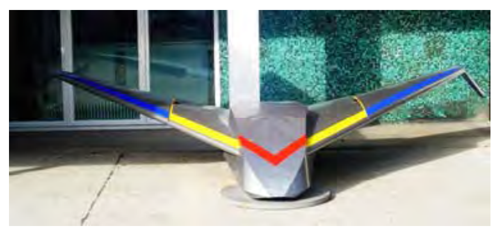
dr. Eduard POPA

1. Team Status - Objectives

This team was established considering the trends and the development directions identified and stated by the official documents of European Commission, ACARE and EREA for future ATS vehicles. Lately, the conceptual design team has made remarkable efforts to achieve further aircraft concepts that meet the market requirements in the current social and economic environment.

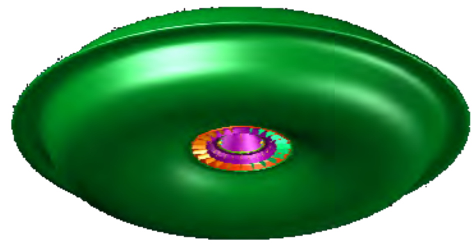
The results of this research team has been materialized in a large number of industrial models and patents, most of which are made in terms of construction as scale models and even as functional models in real-scale within some of the PNCDI (National Plan for Research, Development and Innovation) or structural funds projects. Moreover, based on some ongoing contracts - e.g. Clean Sky - or contracts that are under negotiation - for example, Helena - solutions for aircraft configuration that meet the requirements of major European manufacturers such as Airbus, Saab or Dassault have been proposed within this team. The result of these collaborations is innovative projects that have been patented as inventions, such as joint controlling the Kruger flap in GRA or SFWA concept aircrafts.

A management structure has been created which is dedicated to the conception and design of the project SIMCAN financed through the OP 2.2.4. As an implementation example of this management structure, two projects PO 2.3.1 based on industrial models of two aircraft, an airplane and a helicopter, respectively, have been accepted. These aircraft were designed in the SAMO and CAD-CAS projects within PNCD.



Given the practical results, directly implementable in series production, the problem of air traffic management and air monitoring has also been addressed. The result of this research is a hybrid aircraft that can replace, at very low prices, artificial satellites with the same functions.

During the development of the projects exemplified above, the Institute has created the necessary infrastructure for the development of aircraft technology demonstrators, with prototyping and scaled unique items achievement sections of scale. Also following this direction, by means of the AMTA project an aircraft structure was performed, whose components are interchangeable aiming to lower costs throughout the process of aerodynamic optimization.



2. Human resources

Regarding the objective of this team human resources are critical. There are necessary engineers (and some physicists) having a strong professional background, a large experience in their speciality and in other connected domains.

The team is composed of the following researchers from the involved departments:

General aerodynamics: Valentin Butoiescu, Mihai Neamtu, Patru Spataru, Daniela Baran, Cornelia Nita, Alexandru Andreev, *Numerical simulation:* Victor Pricop, Niculae Apostolescu, Lozici Dorin, Radu Basca, *Systems dynamics:* Andrei Neamtu, Florentin Sperlea, Ioana Gogu, *Design:* Ion Sasu,Vasile Turcanu, Radu Bogateanu, Ilinoiu Viorica, Ababei Dan, *Onboard systems:* George Tecuceanu, Adrian Toader, Elena Dragoman, Panait Livia, *Technical documentation*: Stefan Nebancea, Lavinia Bosilca, which fulfill the necessary requirements for the ATS activities.

3. Research directions - Projects

Some of the projects the team is involved:

- Methods and Software for Calculation and Definition of Subsonic Aircraft Configuration in The Pre-Concept Phase Adapted to Collaborative Work in an Enhanced Aeronautical Enterprise, - CADCAS
- The Multifunctional Advance Trainer Aircraft Pre-Concept, - AMTA
- Vortex Methods for Simulation of Unsteady Incompressible Flows about Wings, - VORTEX
- Airborne complex with combined action against atmospheric phenomena regime, - COMAEROPREC

- Aero-Mechanical Analysis And Synthesis Of A Flapping Wing Mav; Demonstrator, - FLAWIAS
- EREA study ATS 2050
- EREA for UAS -E4U- “Study support to the scoping and prioritisation of topics for the launching of a European Framework Cooperation on Unmanned Aerial Systems”
- CNTAR –National Company for Regional Air Transport
- VISUALLAND –Advanced system based on artificil relief for guidance and assistance of aircraft
- AUTONOM - Integrated system of equipments for autonomous flights in predefined conditions

Some of these research results have been integrated at European level too, by the program - ATS and UAS for which our institute is a full member. Thus, by European consortia that are to be achieved based on these concepts, the institute will be an important partner on the European level, in terms of aircraft design activity.

Hybrid aircraft replacing the artificial satellite - subject of two patents and an industrial model has been developed. For this project the participation in the competition under the PO 2.3.1 is envisaged. Also, a ¼ scale model and 1 / 1 scale model of an aircraft with double application, as one-seater ultra light aircraft and as a UAV, respectively. This plane is the subject of two industrial models registered at OSIM and obtained funding through the PO 2.3.1.

4. Interdisciplinarity

The team consider that an aircraft must be seen as a Flight Vehicle System and so all of its sub-systems must operate in a coordinated manner to accomplish the flight missions. This vision implies a strong interdisciplinarity which is emphasized even by a list of sub-systems:

1. Avionics, 2. Cockpit Systems, 3. Navigation / Flight Management, 4. Warning System, 5. Electronics & Microelectronics for on-board systems, 6. Sensors integration, 7. Flight Data/Flight Recording, 8. Communications Systems, 9. Identification, 10. Avionics Integration, 12. Electronic Library System, 13. Aircraft health and usage monitoring system, 14.Smart maintenance systems, 17. Electrical Power Generation & Distribution, 18. Pneumatic systems, 19. Hydraulic power generation & distribution, 20. Passenger and freight systems, 21. Environmental control System, 22. Water and waste systems, 23. Fuel systems, 24. Landing gear and braking systems, 29. Recovery systems.

T9 - Experimental Aero-acoustic

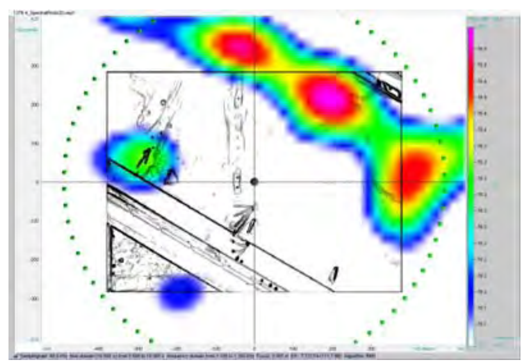
Team leader:

Corneliu Stoica

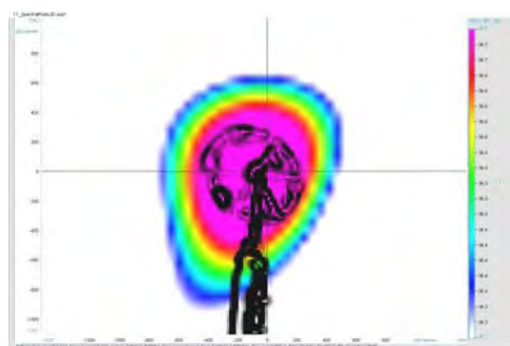
1. Team Status - Objectives

This team was established mainly considering the new aircraft concept with lower emissions including lower noise. While the take-off engines are still the dominant noise source, the airframe noise is as significant as the engine noise on approach when engines are operating at low thrust. The main components of the airframe noise are the high lift devices and the landing gears. As a result, the high levels of radiated noise have a significant impact on community noise. Thus, it is essential to identify the components that are mostly responsible for the flyover noise emissions and correlate the design of the noise control devices to those identified gear components. The second reason was the development and implementation of wind turbines which also have a considerable impact on communities.

This team has its origins in national projects started in 2007. Then and the two next years afterwards, we've made the first studies related to noise. The main focus of the project was development of improved prediction methods and technologies for lower noise, lower emissions, and higher performance for high-lift profiles. Advanced measurement techniques and experimental methods are then required. Following our main goal, to develop and update the data acquisition systems, enhancing the investigation techniques of INCAS wind tunnels, during HiLon project a high-end beam-forming system was integrated in our subsonic wind tunnel.



Although our team for this project is not large, the experience and a wide sphere of knowledge make it competitive. Also, the small number of people from our team allows us to be flexible and thus we can adapt to new situations faster. Our strategy is to maintain the high level of performance for our team, gain experience in international projects and in the same time to expand our team with new young researchers. We also aim to make good investments in high-tech equipments.



From the perspective of experimental application our foals are: reducing the testing time and increasing the safety in the carrying out of the tests, the research projects offer the chance of limiting the negative effects. The major focus is on the development of improved prediction methods and technologies for lower noise, lower emissions, and higher performance aircraft.

2. Human resources

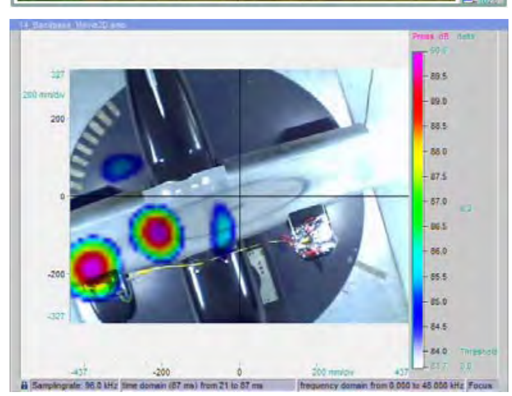
To achieve all this objectives we need high level technical capabilities but also well trained engineers and technicians with long testing experience; nevertheless young skilled people with will to learn new technical information. During aero-acoustic tests activity two young researchers were involved which offered the opportunity for them to interact with such kind of state of the art technology. Also this project was a good opportunity for us to practice our skills and improve our knowledge. INCAS has coordinated outdoor test measurement in collaboration with other partners.

This team is composed by following researchers from different departments:

- Experimental aerodynamics: Cornel Stoica, Bobonea Andreea, Ionut Lom, Banu Aurel, Zahiu Marian, Vaetis Doru, Munteanu Florin, Brinza Ionut, Marius Panait
- Design department: Adrian Dobre, Costian Leonard, Radu Bogateanu
- CFD department: Victor Pricop, Niculescu Mihai, Claudiu Vadean, Gabriel Cojocaru

3. Research directions - Projects

The main research activities are focused on the reduction emissions (Noise, but also CO_2 and NO_x) and contribute to the achievement of the ACARE 2020 environmental targets. These targets are the results of the introduction exclusively of new airframe technologies in the next generation green A/C. For example large improvements on environmental impact are expected in aerodynamics not only for drag reduction (laminar flow, turbulent skin friction) but also for noise reduction. In summary the main top level GRA tasks are to demonstrate technologies for future regional aircraft aiming at the reduction of fuel consumption, pollution and external noise. These goals will be achieved by means of mature, validated and demonstrated technologies in the aerodynamics and acoustics (Low Noise domain) on which this team has an important contribution with experimental results. As a second objective we consider the research and development of quieter wind turbines in partnership with other collaborators in the field.



This team is involved in different national and EU noise related projects:

- HiLon "Hi-Lift Low-Noise" – national project
- "Infrastructure development for aero-acoustic experiments in subsonic wind tunnel" – national projects
- CleanSky – Green Regional Aircraft (EU JTI))

Some results from this group include:

- A hybrid aerodynamic and aero-acoustic modeling framework for small wind turbines
- Aero-acoustic Techniques Used for Noise Source Identification on Complex Bodies
- State of the art techniques used for noise source identification on complex bodies

Our team considers that the impact on the environment is very important, and the aircraft must meet all existing and future regulations. Considering the new testing technology approach, strong interdisciplinary knowledge is necessary like:

Aerodynamics, testing methodology, acoustics, electronics, optics (LASERS), materials, sensors integration, measuring techniques, software development, computational fluid dynamics, CAD and mechanical design.

The integration of all this fields requires high level of technical capabilities, knowledge form may area which must be put all together to work accordingly.

T10 - Flight Dynamics Guidance and Control

Team leader:

dr. Sorin RADNEF

1. Team Status - Objectives

During the past 4 years the team (8 resources) this team has been involved in solving various issues and participating in international level cooperation actions able to create the starting points for new approaches and partnerships in fields o great interest both in the internal and external environments.

The activities in which the compartment was involved had a special focus in the engaging the young researchers so that their experience would grow, thus providing the entire group with the necessary infusion of fresh perspective that is required to be able to tackle new and complex problems. Of particular relevance are the collaborations with internationally renowned aerospace entities involving Andrei Neamtu (University of Florence, Italy) and Alexandru Andreev (Aenia Aeronautica, Torino Italy).

Generally speaking, during the past 4 years the activity of the Flight Dynamics Compartment was focused on three main areas: *projects with international collaboration*, *partnership projects on the national scale* [as a result of the excellent grades earned in the call for proposals organized by the National Authority for Scientific Research (ANCS)], *projects dedicated to the infrastructure development and professional growth* associated to the NUCLEU program.

2. Human resources

Regarding the objective of this team human resources are selected from many other departments. There are necessary engineers and mathematicians having a strong professional background, a large experience in their specialty and in other connected domains. So, the team is composed of the following researchers having professional degrees from the scientific researcher to senior researcher I:

Systems dynamics: Sperlea Florentin, Neamtu Andrei, Dumitrache Mircea, Nicolae Apostolescu, Oprisiu Cornel, Radnef Sorin, *Aerostructures*: Cezar Banu, Paul Mihailescu, *General aerodynamics*: Claudiu Vadean, Cornelia Nita, Nae Catalin, *Materials*: Cristina Ban, *Mechatronics*: George Tecuceanu, Adrian Toader, *Young Researchers*: Ioana Gogu

These researchers cover a wide field of specialities required by the very difficult problems of steering the aircraft considering given missions to be accomplished.

3. Research directions - Projects

The activities of the team is centered around the works of the department “Systems Dynamics”. Tacking into account the report Flight Path 2050, the ACARE - SRA, EREA vision for future and the final report of CREATE project the research activities cover the following areas:

a. Studies for *aircrafts configurations* from FQ viewpoint

b. Mechanical *models and algorithms for flight control*, flying qualities (FQ) and performances, considering the aircraft as a technical system, having a definite structure of subsystems

c. Development of a *3D flight simulator to analyze FQ* and critical flight phases

d. Research concerning the *permanent assistance of flight* pilotage

e. *Integration of onboard subsystems* to give full control to Flight Management System (FMS)

f. *Autonomous flight*

g. Investigations of *flight incidents* and their expertise

Being concerned on these topics, the team proposed projects and carry out activities that were of significant importance for the high scientific and technical level of the final results of INCAS contracts. Some of the main projects are listed below:

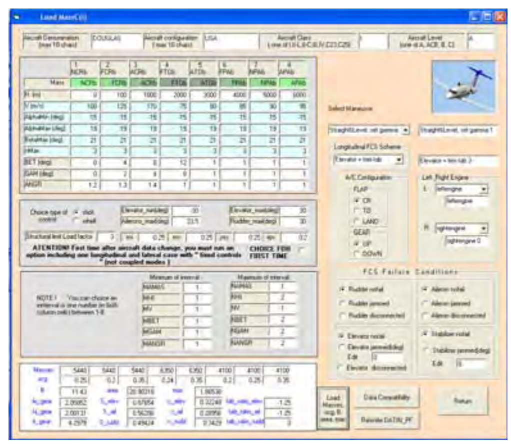
CESAR (Cost Effective Small Aircraft) is mentionable as part of the European research projects competition (EU Framework Program FP6) organized by the European Commission – Research and Innovation – Transport. As part of this project, the participation of the INCAS Flight Dynamics Compartment alongside partners such as DLR Germany, FOI Sweden, PIAGGIO Italy, VODOCHODY the Czech Republic, aimed at creating the proper working instruments which would allow a unified approach and analysis of the flight qualities of aircraft.

ESPOSA: ”Efficient systems and propulsion for small aircraft” is a second project (start time: Oct 2011) is in which the Flight Dynamics department will be involved in the work package regarding the requirements of regulations for the engine characteristics. As a special investigation is to derive requirements on the propeller-engine group considering the requirements for FQ and performances of a given type of airplane.

SISATJA -“Controlled Trajectory Permanent Satellitary System at Low Altitude” - The costs of maintaining satellites in low orbit – operating altitudes: 100-200 Km – are high mainly because of the short operational life due to the friction interaction with the atmosphere. As part of the project which aimed at designing and experimenting at laboratory level with an ionic engine able to work with the surrounding environment plasma, the “Flight Dynamics” team has performed studies regarding the configuration, positioning and integration of the grid panels defining the ionic engine as well as the orientation of the solar panels and general altitude control (orbit stability and orbital plan corrections).

Three fairly different design schemes are put forward, each possessing detailed mechano-functional characteristics so as to cover a large area of interest with regards to thrust vectoring. The main objective was obtaining a set of control algorithms for the satellite's orbital trajectory and their implementation to the on-board computer and sensor system (PC/104 type CPU, 3DM-G – MicroStrain).

SILROS -"Synergic system for satelitary objects dynamical launch/recovery" - Placing satellites on low and medium orbits requires great financial and technical resources. A good part of this costs is due to launching and accelerating through the thick atmosphere (up to about 20-30km) when most of the fuel is consumed, returning, eventually, down to 20-30km, which requires heat shielding and mechanical strength and also to lose of the not reusable stages of the carrier rockets. This project wants to do the fundamental research needed to establish solutions that solve, between the boundaries of existing technology, the cost and risk reducing problem mentioned above.



SAMO -"Interest zones aerial monitorisation endurance system" - The project consists in the making of an unmanned aerial vehicle (UAV) capable of ensuring the video monitoring of areas of interest for long durations of time (8+ hours), on a preprogrammed or commanded flight path. The contribution of the "Flight Dynamics" compartment is represented by an important research aim which refers to the definition and implementation of the automatic control system of the platform dedicated to following a prescribed flight path.

SAMASCAM -"Long endurance aerial multifunctional system for environment quality monitorisation" - This is a project similar to SAMO but having a different partnership formula where the main contribution of INCAS's "Flight Dynamics" was in evaluating the performance of the airplane design. The same activity of airplane performance evaluation has been performed also in the ***Training basic airplane with double utilization - civilian and military, built in modular concept*** project.

3D Stereoscopic Simulator for Controled Flight, Navigation and Qualitative Analisys of Flight - The project activities consist in defining systematic and technological development of a functional-demonstrativ model, as an integrated sistem, for a flight simulator with: (algorithmic) generation of ambiental stereo image, creating a virtual reality flight control, monitoring "on line" flying qualities essential for piloting, mathematical model of the movements, with the movement kinematics separation along the path of motion. These features simulator proposed, confers it novelty in the field and provide logistical support for: analysis of critical flight situations, parametric synthesis of structural characteristics (of the aircraft) in order to obtain the desired/prescribed flying qualities; development of projects and integrated products for monitored control by current flight qualities. Beside dinamic characteristics, the objective of qualitative analisys of flight is the capability to estimate maneuver capacity, understood as the ability of the aircraft to perform an evolution with constrains, concerning, mainly the completion of a desired trajectory with a move specified towards this path.

4. Interdisciplinarity

Because of the strong dependencies of flying qualities and of performances on the every susbsystem that is involved in a given mission, interdisciplinarity is implicitly found in all the team activities.

Activities developed in the projects mentioned have led to the development of articles, attending conferences. It also opens new perspectives of collaborations embodied by new projects proposal, such as the realization of autonomous flight through the use of alternative software solutions (shifting the effort towards the inverse problem “trajectory-commands” and thus by-passing the classical steps to building an auto-pilot), which represents a priority both nationally and internationally. One might appreciate the generality of the proposed method (no requirements for the aircraft to be of a certain model, or even from a certain class) and the speed with which the equipment capable of providing autonomous flight can become operational (once the equipment is on-board the aircraft, only a single flight is necessary for the creation of the primary database).

T11 - Flow Control Technologies

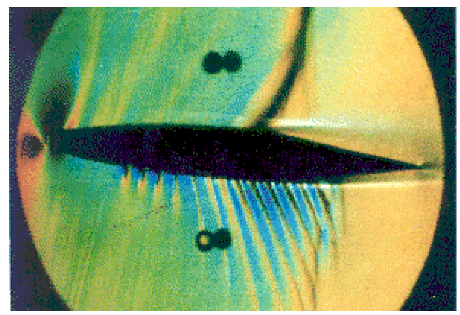
Team leader:

dr. Catalin NAE

1. Team Status - Objectives

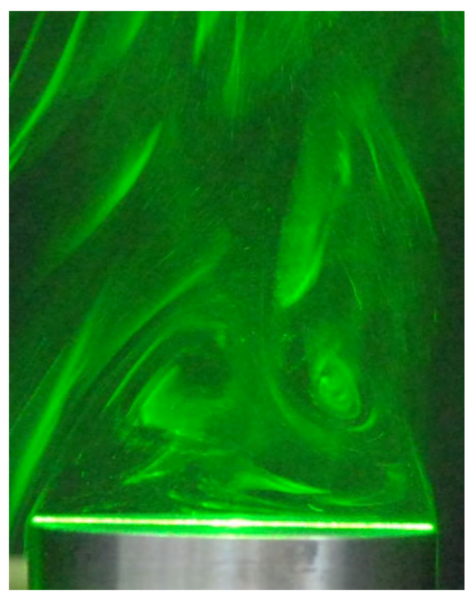
The research team for Flow Control Technologies has been formed using outstanding experience in fluid mechanics at INCAS and as a necessity imposed by the participation to several important national and international research projects.

Flow control by active and passive methods has always been pursued as a way to improve the performances of the aerodynamic configurations as for instance increasing the lift at take-off and landing, avoiding stall, preventing boundary layer separation by suction or vortex generators, control of shock wave – boundary layer interaction, alleviation of buffet, etc.



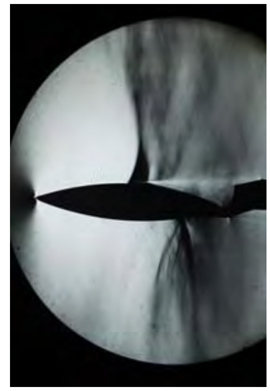
2. Human resources

The flow control is a complex inter-disciplinary investigation which requires specialists from many domains:



- Flight physics, aircraft aerodynamics
- Numerical simulations
- High speed Wind Tunnel testing
- Instrumentation, data acquisition, signal processing
- Control laws (open / closed loop)
- Piezoelectric materials
- Electric / pneumatic actuators

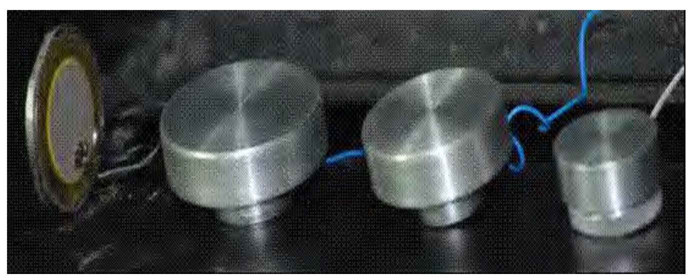
The research team for flow control technologies includes specialists in the following domains: flight physics (dr. Catalin NAE), aircraft aerodynamics / numerical simulations (Victor PRICOP), wind tunnel testing (Florin MUNTEANU, Cornel STOICA), model design (Adrian DOBRE, Leonard COSTIAN), instrumentation / data acquisition (Anton IVANOVICI, Marius PANAIT, Cornel STOICA), SJA actuators design and installation (Cornel STOICA), and others.



3. Research directions - Projects

One example of INCAS studies on active flow control techniques are the Synthetic Jet Actuators (SJA), also known as Zero Mass Flow devices, which create small jets without any fluid supply, only by the movement of a piezoelectric membrane. Such devices were investigated by the research team within the **UFAST European project** as means of controlling the buffet phenomenon.

This flow control technique will be used within the Clean Sky Smart Fixed Wing Aircraft (SFWA) project, Work Package WP 1.1.2 - Active Technologies for Laminar Flow and Buffet Control, under the leadership of ONERA – France. The SJA actuators will be installed on a half-model with a laminar wing to be tested at transonic Mach numbers in buffet conditions at natural (free) transition and also off-design regimes. The objectives are the detection of transition locations on the wing and also buffet control for turbulent (off-design) flows.



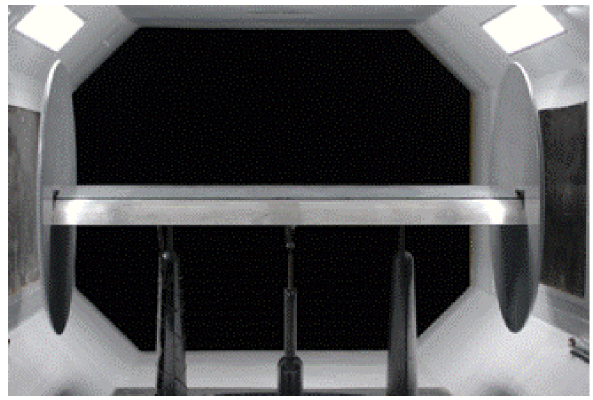
Another example of Active Flow Control (Flap Gap Oscillatory Blowing) for High Lift systems, at high Reynolds (2.5M), was performed in the **AVERT project** with the participation of specialists from both the Subsonic and Supersonic Wind Tunnels, from the Numerical Simulation team, model designers, instrumentation and data acquisition specialists and others. Integration of the AFC system was a challenge because of the limited available space in the flap. A pressurized air system was installed to feed the AFC devices, comprising: 22KW compressor with drying system, filter-regulator and flowmeter. Mass flow measurement is a key parameter of an active flow control demonstrator, since air consumption on board of a future airplane is a constraint.

AFC characterization included the response at a range of pressure, frequency and flap setting. An optimal frequency was found, together with a in increment in global lift coefficient of 18%.

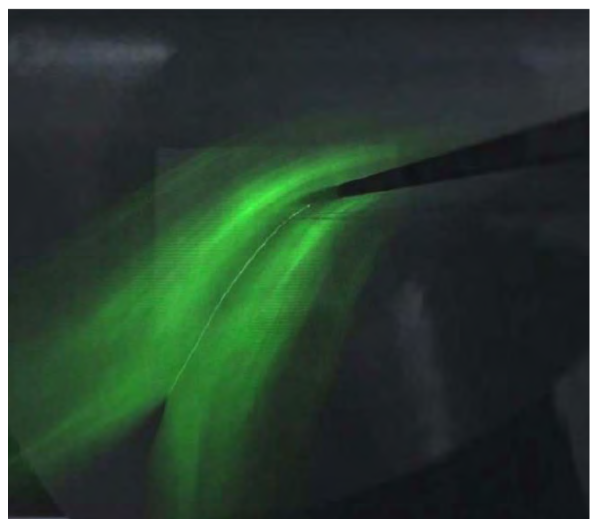
The group has applied for a number of 3 patents with respect to active flow control technologies and specific devices (synthetic jets).

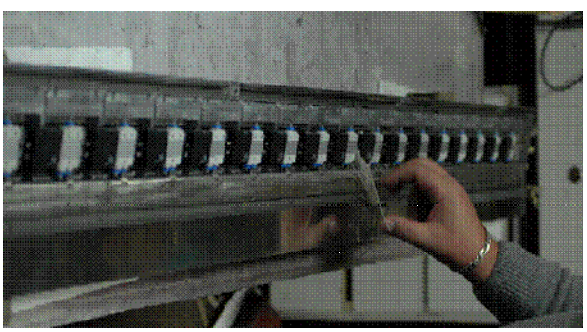
4. Interdisciplinarity

The team consider that flow control is the most promising technology able to be demonstrated at TRL 4 and higher using INCAS labs. This vision implies a strong interdisciplinarity which is emphasized even by a list of sub-systems at aircraft level:



1. Sensors integration, 2. Flight Data/Flight Recording, 3. Communications Systems, 4. System Identification, 5. Electronic Library System, 6. Wind tunnel testing, 7.Smart maintenance systems, 8. Electrical Power Generation & Distribution, 9. Pneumatic systems, 10. Hydraulic power generation & distribution, 10. Environmental control System, 29. Recovery systems.





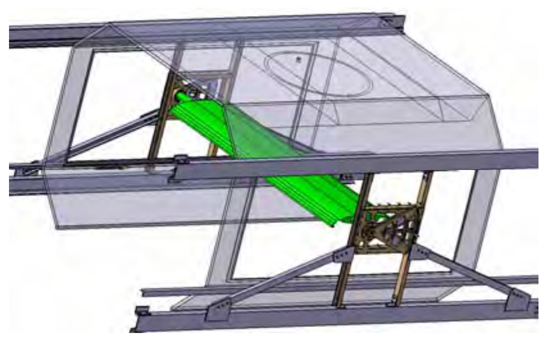
T12 - GRA-Low Noise

Team leader:

Corneliu Stoica

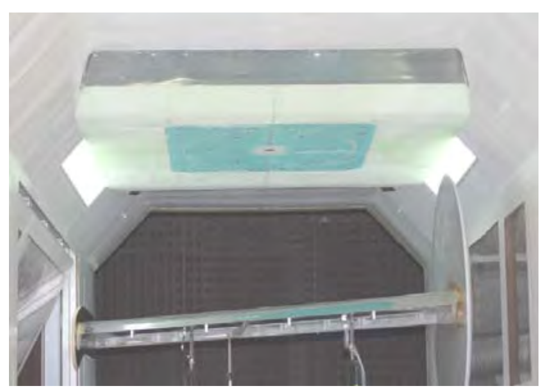
1. Team Status - Objectives

This team was established considering the direct requirement of ACARE. Considering the new testing technology approach, this impact can be evaluated from two different perspectives, emphasizing the importance of the proposed research. This team has its origins in national projects started in 2008. Then and the two next years we made the first studies related to noise. Although our team for this project is not large, the experience and a wide sphere of knowledge make it competitive. Also, the small number of people from our team allows us to be flexible and thus we can adapt to new situations faster. Our strategy is to maintain the high level of performance for our team, gain experience in international projects and in the same time to expand our team with new young researchers. We also aim to make good investments in high-tech equipments.



From the perspective of experimental application our foals are: reducing the testing time and increasing the safety in the carrying out of the tests, the research projects offer the chance of limiting the negative effects.

The major focus is on the development of improved prediction methods and technologies for lower noise, lower emissions, and higher performance aircraft.



2. Human resources

To achieve all this objectives we need high level technical capabilities but also well trained engineers and technicians with long testing experience; nevertheless young skilled people with will to learn new technical information.

This team is composed by following researchers from different departments:

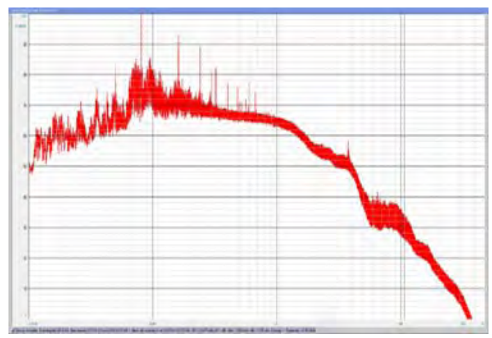
- Experimental aerodynamics: Cornel Stoica, Bobonea Andreea, Ionut Lom, Banu Aurel, Zahiu Marian, Vaetis Doru, Munteanu Florin, Brinza Ionut, Marius Panait

- Design department: Adrian Dobre, Costian Leonard, Radu Bogateanu
- CFD department: Victor Pricop, Niculescu Mihai, Claudiu Vadean, Gabriel Cojocaru

3. Research directions

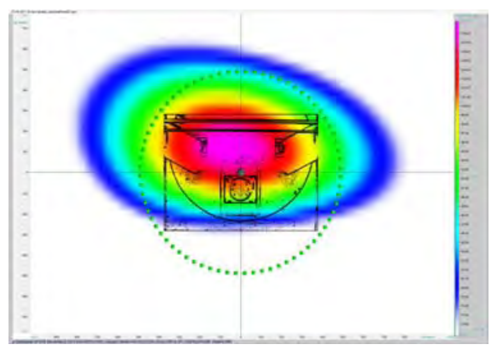
The main research activities are focused on the reduction of CO2, NOx and noise emissions and contribute to the achievement of the ACARE 2020 environmental targets. These targets are the results of the introduction exclusively of new airframe technologies in the next generation green A/C. For example large improvements on environmental impact are expected in aerodynamics not only for drag reduction (laminar flow, turbulent skin friction) but also for noise reduction. In summary the main top level GRA tasks are to demonstrate technologies for future regional aircraft aiming at the reduction of fuel consumption, pollution and external noise. These goals will be achieved by means of mature, validated and demonstrated technologies in the aerodynamics and acoustics (Low Noise domain) on which this team has an important contribution with experimental results.

This team was involved in different projects noise related:



- HiLon “Hi-Lift Low-Noise” – national project
- “Infrastructure development for aero-acoustic experiments in subsonic wind tunnel” – national projects
- CleanSky – GRA – international project (EU JTI)

The main results of this team



- A hybrid aerodynamic and aero-acoustic modeling for small wind turbines
- Aero-acoustic Techniques Used for Noise Source Identification on Complex Bodies
- State of the art techniques used for noise source identification on complex bodies

Our team considers that the impact on the environment is very important, and the aircraft must meet all existing and future regulations. Considering the new testing technology approach, strong interdisciplinary knowledge is necessary like:

Aerodynamics, testing methodology, acoustics, electronics, optics (LASERS), materials, sensors integration, measuring techniques, software development, computational fluid dynamics, CAD and mechanical design. The integration of all this fields requires high level of technical capabilities, knowledge form may area which must be put all together to work accordingly.

T13 - Clean Sky High Lift Active Control Technologies

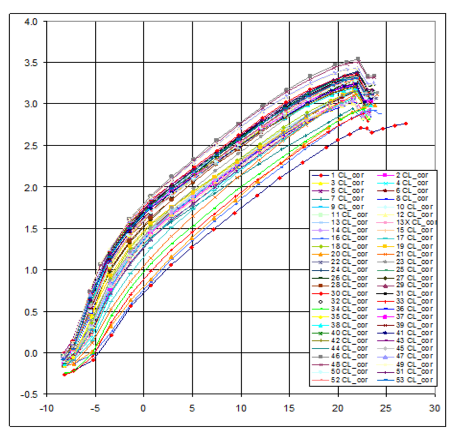
Team leader:

Mihai Victor Pricop

1. Team Status - Objectives

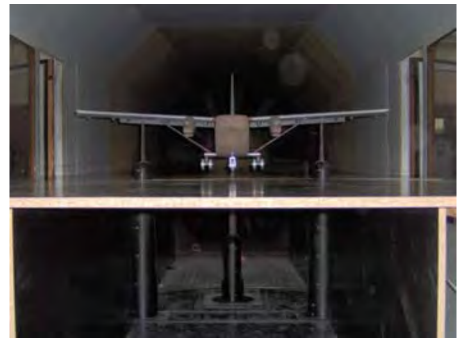
Teams from **Subsonic**, **Supersonic W**ind **T**unnel, **N**umerical **S**imulation, Wind Tunnel **M**odel **D**esign and **WT W**orkshop, work together as maybe the best integrated team from INCAS. The high level of integration is required by the nature and complexity of work: from CFD, WT model design, manufacturing, instrumentation, calibration of sensors, data acquisition, results post-processing (signal treatment, solid wall aerodynamic corrections – general data reduction with in-house numerical codes). The finality of this complex activity is always a **Wind Tunnel test campaign**, which is successful, only if all the preparatory steps are valid and properly coordinated.

2. Human resources



The present team started in 2005, with a national project related to a General Aviation small commuter Airplane – **AeroTaxi**. A full aircraft configuration was designed, including the high lift system. A significant wind tunnel test campaign followed. In 2009, within **CESAR**-Cost Effective Small Aircraft, a new wing, numerically optimized by the Swedish Aerospace Lab – **FOI** – was tested. Again, the high lift system was designed at INCAS. In 2007, a private company launched a complex test campaign at INCAS, including high-lift configurations. Ground effect testing of the high-lift configuration was a first for INCAS. A "bridge" was designed and built in the Wind Tunnel test chamber, to create the ground effect.

Team members are: Florin **Munteanu** (40 years experience in high and low speed industrial aerodynamics), Cornel **Stoica** (head of Wind Tunnels, data acquisition,

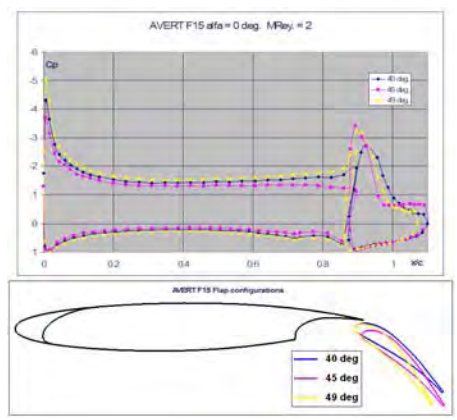


maintenance, **WT** operator, SJs, aeroacoustics), Andreea **Bobonea** (WT Eng. Post processing, WT operator), Ionut **Brinza** (**WT** flow visualizations, operator), Corneliu **Oprean** (data reduction, instrumentation, calibration), Anton **Ivanovici** and Marius **Panait** (data acquisition, post processing, instrumentation), Marius **Cojocaru** (data correlation, post-processing, CFD) and Mihai Victor **Pricop** (project coordinator and more).

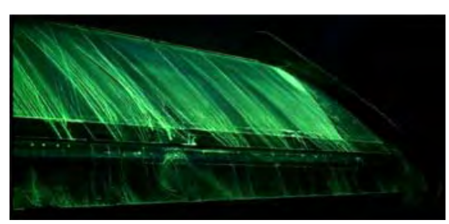
Two indispensable engineers make possible all the wind tunnels. They belong to the design department: Adrian **Dobre** and Leonard **Costian**. They work in close connection with tunnel technicians: Aurel **Banu**, Mihaita **Eftimie**, Doru **Vaetis**, Paul **Defta,** Ionut **Lom** and Ionut **Sava**.

3. Research directions

High Reynolds and high scale, detailed WT models and testing dedicated to high lift systems, were in three projects: CESAR, AVERT, JTI-SFWA WP 114. Ongoing projects are at even larger Reynolds and scale, within JTI-GRA: two configurations: TP – Turboprop (turbulent airfoil with Active Flow Control on the flap) and OR – Open Rotor (laminar airfoil with Active Flow Control on the Leading Edge).



The first high Reynolds/scale model was in CESAR – Reynolds = 2M. A careful design, manufacturing/finishing, instrumentation was performed in order to achieve a laminar WT model. Results confirmed numerical predictions from VZLU – partner and leader of the project. Flap settings for landing and takeoff were assessed. Oil-pain flow visualizations were performed, to capture boundary layer transition. Large endplates were specifically developed, to be interoperable with other models. Flap fixing with continuous variation of 3 Degrees of Freedom was a requirement. A good cooperation was the key of success. Numerical Analysis lab did a part of CAD design for the main element of the wing, issued requirements for the endplates and pressure tapping instrumentation.



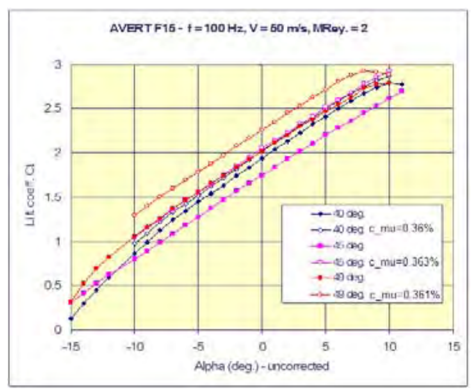
The Supersonic WT team provided their expertise in instrumentation, calibration, validation of pressure distributions, as well as flow visualizations. **Nae** Catalin did data reduction and various aerodynamic evaluations.

The first Active Flow Control (Flap Gap Oscillatory Blowing) test campaign for High Lift systems, at high Reynolds (2.5M), was performed in AVERT. Designers from both subsonic and Supersonic Wind Tunnels, as well as the Numerical Simulation team worked together. Integration of the Active Flow Control system was a challenge: the available space in the flap is not generous. Pneumatic lines, pressure measurement tubing, actuator chambers, electro-valves, electric wiring all have to live in a small space.

The largest High-Re high-scale WT test camp is in JTI-CleanSky SFWA, WP 114. It is dedicated to the Passive Flow Control for a high lift system of a future business jet – the wing is swept at 30 deg. Smart kinematic flap design is the technology under investigation, together with the classical VGs – Vortex Generators. Dassault Aviation and NLR are the direct partners in this activity. Mainly, smart kinematics consists here in the chord extension, which proved to deliver a linear increment in CLmax.

4. Interdisciplinary

The team is the most integrated one from INCAS. The assigned task ranges from design of WT Models/experiments, to manufacturing, instrumentation, calibration, testing and data post processing. Five departments contribute to this enlarged team: Subsonic Wind Tunnel, Supersonic Wind Tunnel, Model Design Department, Model Workshop and Numerical Simulation Lab. All the activities/steps towards wind tunnel testing are concurrent, so that every step must be properly performed. This team requires skills as: flow understanding, mechanical engineering for model/tunnel design/modification, electrical engineering, optical engineering, structural analysis, signal filtering/processing, aerodynamics post-processing. The ongoing and future projects are demanding and will contribute to a better integration/performance of the team.



T14 - IAR-XT/NEW GENERATION

Team leader:

Simion TATARU

1. Team Status - Objectives

The program IAR 99 SOIM was started in 1991 as an integral Romanian program for aviation in which the specialists from Institutul National de Cercetare-Dezvoltare Aerospatiala "Elie Carafoli" INCAS developed a trainer aircraft realized at the best aeronautical level; the airplane being used for the training of the Romanian pilots. The prototype flew in the day of 21 december 1985, at 15.17 hour, and after this remarkable flight the airplane IAR 99 was produced. In his evolution he was highly appreciate by the Romanian and foreign pilots. In time the necessity of technological development and the idea to rise the reliability of this airplane has imposed an up gradation of the equipment and systems of this aircraft. This is part of INCAS mission as a national research establishment.

2. Human resources

The work team in this project is formed by high qualified specialists as: ing. Simion Tataru, Dr.ing.Constantin Olivotto, ing.Vasile Stefan, ing. Dan Ababei, drd.ing. Dorin Lozici Branzei, Dr.mat.Daniela Baran.

3. Objectives. Research directions

In the year 1996 a program in order to modernize the avionics and weapon system of IAR 99 SOIM was start and his main purpose was to assure the compatibility of this aircraft with the MIG 21 LANCER. The first flight of IAR 99 SOIM was done on 22 May 1997, the new avionics installed on the aircraft being compatible with new operational characteristics according to NATO compatibility and with avionics of MIG 21 LANCER or American F-16.

The specialists of INCAS work now in a new programs of development named IAR-XT/NEW GENERATION in order to modernize IAR 99 SOIM and to offer others possibilities of using and developed this Romanian product. The program will enable :

- new capabilities for this aircraft;
- important economy of fuel and resources;
- a versatility for different missions allocate to the same aircraft;
- a better tool for training.

The specialists of INCAS are focused on two main directions in order to modernize and optimize the performances of this aircraft:

- one of the objectives is to change the engine and his placement in order to raise the action range, and minimize the fuel consumption;
- other objective is to modernize the avionics and other equipments in order to allocate some new missions, specially in air police field.

The engine replacement will provide the aircraft with a Rolls Royce VIPER 680-43 engine in order to reduce the fuel consumption. Some modifications will be done:

- The new engine will assure 10% rise in thrust and will optimize the performances in flight;
- The air intakes will be modified in order to assure a bigger quantity of air, raised with 7,6%;
- The engine attachment points will be redesigned;
- The aft fuselage in area of the engine exhaust will be modified in conformity with the new pipe configuration.

The second main objective of the development of in this program is to prepare the aircraft for the Air Police Missions. The Air Police activities are dedicated to protect the national airspace through patrolling and in case to act with specific armament against a designated enemy in order to maintain the Air Space Control, in the Romania and NATO Airspace boarders. The main tasks in air police missions for this aircraft are:

- to be capable to participate in specific surveillance and patrol missions for air control of some parts of a territory;
- to be able to cooperate with others air, land and maritime forces and users of airspace in order to maintain a good interoperability in the following fields:

(a) Communication/ message significance;
(b) Navigation/geographic referencing;
(c) Identification procedures and procedure coordination and actions;
(d) Coordination and control of weapons use according the right of self-defense of the national territory;

- to be capable to act on order and according to the specific rules with specific armament against a designated target.

In order to cover the new missions, in this IAR – XT/NEW GENERATION program will be assured some important changes in the existing avionics equipment:

- Airborne Radar installation;
- More accurate GPS – INS System installation;
- New container containing video and infra-red cameras installation;
- The modification of the data – link used in the past for virtual radar communication and the conversion for transmission in real- time of the data obtained from the radar and other sensors to a terrestrial station.

The IAR-XT/NEW GENERATION aircraft will be equipped with a new weapon system adaptable for the future missions (including different type of missiles) and special containers for visual and IR- cameras, night recording systems and other navigation and targeting capabilities. A special program was dedicated in order to synchronize the emergency ejection of the pilots from both cockpits named SINCAT - (The Synchronized ejection from the two seats in two places cabin). The project was finalized in 2007, in the Romanian R&D program for innovation. In future to obtain others better performances a program for modernize the landing gear and main landing gear will be started. To prepared the airplane for all these modifications and in order to rise the resources of the structure for this airplane three projects was developed:

- EVAPRED (PREDICTED EVALUATION OF AIRCRAFT STRUCTURE FOR SECURITY OF THE CREW) from the Romanian Program: PARTENERIATE, finalized in October 2011;
- Endurance Program in order to redefine the technical resources of airplane IAR 99/2010;
- Evaluation and specific tests for IAR 99/2011.

At the same time, the group has prepared a patent - EVAPRED – Procedure for fatigue analyze with finite elements for an sub-assies in aeronautical structures.

T15 - International cooperation: Young researchers' education and training

Team leader:

Claudia DOBRE

1. Establishment; objectives

International Cooperation team is managing the cooperation with international partners, such as research centers, universities and industry all over Europe.

INCAS is full member in one of the most prestigious aeronautical organizations in Europe: Association of European Research Establishments in Aeronautics – EREA. This team is managing the participation of INCAS in all the working groups of EREA: EREA Executive Secretariat - ES, EREA Aeronautics Research Group – ARG, EREA Security Research Group – SRG. INCAS has a representative in the ES group, which acts as a permanent contact point within the institute; ES coordinates all the EREA activities.

INCAS has also a representative in each of the other 2 working groups: ARG and SRG, which are more focused groups, ARG contributing in the field of aeronautics and air transport and SRG contributing in the field of security research.

All representatives are serving as a liaison with the European Commission, the European industry (ASD, IMG4) and other interested research organizations.

Also this department is managing the European projects and meeting, seminars and conferences related to the European cooperation.

The documents that guide the activities of the department are:

1. European Commission, European Aeronautics-A Vision for 2020/ Meeting Society's Needs and Winning Global Leadership – report of the group of personalities, January 2001
2. ACARE - Aeronautics and Air Transport: Beyond Vision 2020 (Towards 2050), June 2010
3. CREATE – Creating Innovative Air Transport Technologies for Europe, October 2010
4. EREA vision for future – Towards the Future generation of Air Transport System, October 2010
5. Flight Path 2050 – European Commission, High Level group on Aviation research, 2011
6. Aeronautics for Europe-A Partnership for Research and Technology and Europe Growth – European Commission, External Advisory Group for Aeronautics, April 2010

7. ACARE – Strategic Research Agenda, 2004-2008
8. 2008 Addendum to the Strategic Research Agenda, April 2008

2. Human resources

Regarding the objective of this team human resources are critical. There are necessary engineers having a strong professional background, a large experience in their specialty and in other connected domains. So, the team is composed of the following researchers from the involved departments:

International Cooperation Department: Claudia Dobre, Veronica Frent, *General aerodynamics*: Pricop Victor, *Experimental Aerodynamics*: Stoica Corneliu, Munteanu Florin, Ionut Brinza, Andreea Bobonea, *Board of directors*: Nae Catalin, Radnef Sorin, Oprisiu Cornel which fulfill the necessary requirements for the activities in the international cooperation.

3. Research directions

Being a full member in EREA, INCAS has a representative in the ES group, which acts as a permanent contact point within the institute; and a representative in each of the other 2 working groups: ARG and SRG, which are more focused groups, ARG contributing in the field of aeronautics and air transport and SRG contributing in the field of security research.

All representatives are serving as a liaison with the European Commission, the European industry (ASD, IMG4) and other interested research organizations.

The team is also involved in the young researchers education and training. In the summer of 2011, a group of 10 students from the University Politehnica of Bucharest, the Faculty of Aerospace Engineering fulfilled a three month stage at INCAS. The persons in charge with this stage were: Claudia Dobre, Veronica Frent and Vasile Stefan.

Raising **E**uropean **St**udents Awareness in **A**eronautical **R**esearch **T**hrough **S**chool-Labs – REStARTS is an EC founded project through the Aeronautics and Air Transport theme of the FP7and it is lead by Von Karman Institute for Fluid Dynamics.

The partners of REStARTS are aeronautical research institutes in Europe (VKI in Belgium, CIRA in Italy, DLR in Germany and INCAS in Romania) which have considerable experience in this field. Additionally, an educational partner, the School of Education University of Leicester in UK, will supervise the accessibility and the impact of the resulting product toward teachers and students. The project started in March 2009 and it will end in April 2012. The person in charge from INCAS is Claudia Dobre.

INCAS is involved in all the work packages, starting with the management of the project. In the second WP, "Scientific Documentation", INCAS wrote the documentation for teachers treating subjects like: drag and how can drag be reduced; noise and noise reduction, flow phenomena: laminar and turbulent flow and safety statistics. In the 3rd WP INCAS developed experiments for classroom for subjects like noise, drag and flow (Claudia Dobre and Cornel Stoica). In the 4th WP, INCAS collaborated with 3 school classes: one primary school class, one secondary and one high school class, for doing the experiments in class. In the 5th WP, INCAS invited all the classes to visit the institute, where the colleagues from Experimental Aerodynamics explained them about the subsonic wind tunnel (Cornel Stoica) and trisonic wind tunnel (Florin Munteanu) and Victor Pricop made demonstrations with the airplane models.

CEARES – Central European Aeronautical RESearch initiative: FP7 project founded by the European Commission, the main objective is creating a network of research centers and universities in the aerospace field in the central and south-east of Europe. INCAS was partner in this project with Slot Consulting (Hungary) – coordinator, Eurocontrol (Hungary) and the University of Zilina (Slovakia).

4. Interdisciplinarity

International cooperation team involves colleagues from many departments, because the participation in the European meetings and project needs people with strong professional background, different specializations and experience.

T16 - Material sciences: Thermal shock analysis

Team leader:

Gheorghe Ionescu

1. Team Status - Objectives

The first attempts to structure such a team comes from 2003, when INCAS was involved in a FP5 contract -"Thermal testing (conductivity, dilatometry) and thermal shock testing of some TBC layers on super alloys and cooper alloys base", Aerospace and Space Materials Technology Test house, AMTT, Seibersdorf, Austria – MRI no. HPRI-CT-1999-00024, FP 5, 2003; The INCAS team, Mr. Victor Manoliu and Mrs. Adriana Stefan together with the specialist of AMTT and other participants in the field of materials testing for aviation purposes concluded that is necessary to start the conceiving and achievement of a new quick thermal test shock installation to respond better to the requirements of the manufactures and universities involved in material science.

This team was established considering above mentioned contract, the trends and the development directions identified during the contract. Further to the efforts of the INCAS team, a FP7 proposal CHARMEXT – Characterization of materials under extreme environments –was elaborated. In the proposal an important part referred at a method and an installation for quick thermal test shock of materials for space and aeronautical domain and also for domains like energy, chemistry or automotive. The participants were: ARC- Austrian Research Centers GmbH; CIRA- Centro Italiano Ricerche Aerospaziali; DIAA- La Sapienza University, Aerospace and Astronautic Engineering Department; IMMG-Institute of Mechanics of Materials and Geostructures s.A.; INCAS - Institutul National de Cercetari Aerospatiale; DLR- Deutsche Zentrum für Luft- und Raumfahrt; ONERA- Office National d'Etude et de Recherche Aéronautique; TECNA- TECNALIA-Inasmet; GRANTA- Granta Design Limited.

Now the team is well stated as an advisory group for testing of the materials in extreme thermal conditions.

We must mention that there are only two European standards involved in the thermal shock for thermal barrier coatings: ISO 13123 - Metallic and other inorganic coatings — Test method of cyclic heating for thermal-barrier coatings under temperature gradient and ISO 14188 - Metallic and other inorganic coatings — Test methods for measuring thermal cycle resistance and resistance to thermal shock for thermal barrier coatings

2. Human resources

Regarding the objective of this team human resources are critical. There are necessary engineers (and some physicists) having a strong professional background, a large experience in their specialty and in other connected domains. So, the team is composed of the following researchers from the involved departments:

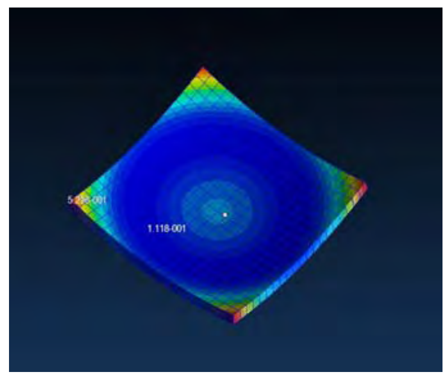
Materials: Ionescu Gheorghe, Adriana Stefan, Manoliu Victor, Mihailescu Alexandru

General aerodynamics: Pricop Victor,

Board of directors: Nae Catalin, Radnef Sorin, Marin Nicolae, Oprisiu Cornel

3. Research directions

The main research activities are focused on the following topics:

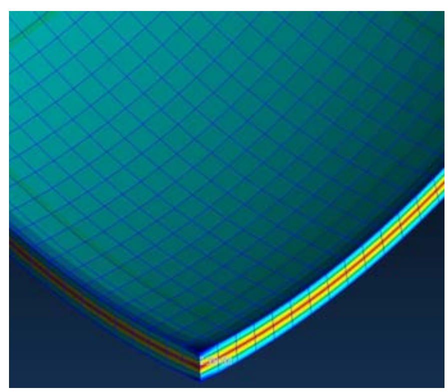


Layer deposition, nanotechnologies for advanced engine components

Quick thermal test shock

Mathematical-physic analyze of the heating-cooling processes thermal shock type

Element finite analyze of the thermo-mechanical phenomena during the heating-cooling process



Numeric models of the heating-cooling process in the thermal shock systems

The analyse of the thermal transfer by conductivity, convection and radiation associated the experimental models

Internal tension analyze of the deposited layers and of the metallic support (temperature, tension distributions; critical values determination; theoretical and experimental data correlation.

Some of the projects the team is involved:

ESPOSA- *Efficient Systems and Propulsion for Small Aircraft* contract 284859-FP7-2011-2014

The ESPOSA project will develop and integrate novel design and manufacture technologies for a range of small gas turbine engines up to approx. 1000 kW to provide aircraft manufactures with better choice of modern propulsion units.

Within the aims of the project we mention: development of progressive coating solutions for engine parts (WP3.3)-new TBC (Thermal Barrier Coatings) achievement and testing.

HYDRA - ***Hybrid ablative development for re-entry in planetary atmospheric thermal protection*** - FP-7 – SPACE-2011-1/283797-2012-2014

The aim of this project is the development of TPS for the use in space applications with extreme oxidative environments and high temperature resistance such as hot parts of space vehicles for orbital entry (ARV), planetary probes and NEO exploration. Previous studies on ARV vehicle have shown that TPS hybrid systems based on ablators integrated with thermo-structural materials are good candidates. As expressed in the work program 2011, the space sector is contributing to the independence, security and prosperity of Europe. The development and testing of ablative materials has not been intensively studied in European in the last 10 years, and few producers have been manufacturing the capabilities for dual applications.

This technical approach is focussed on a Hybrid TPS based on ablative/thermo structural assembly and their further testing.

Three new proposal:

NANOFUTURE ***- Environmental friendly nanostructured materials for the development of thermal barrier coatings (TBCs) for co generation energy systems-*** Bilateral proposal Romania/Greece-2010

The proposed project focuses on the improvement of energy generation systems (e.g. turbines) by the application of advanced Thermal Barrier Coatings (TBCs) prepared using nanostructured materials. The investigation will be directed in the preparation of nanostructured materials to be used for the development of advanced Thermal Barrier Coatings capable of operating at high metal temperatures while resisting high temperature oxidation and hot corrosion attack. For the preparation of the materials care will be taken for the application of more “green” synthesis conditions (e.g. water based systems).

The aim of this project is the utilization of environmental friendly nanostructured materials synthesis and thermal spraying techniques in order to develop advanced thermal barrier coating systems with enhanced properties able to withstand extreme conditions during energy generation (turbines).

The concept is the development of:

- New TBC formulations more resistant to high temperature corrosion processes thus the maximum application temperature will be higher and so performance during energy generation.
- Flexible and cost effective production systems based on thermal spray in order to realize patterned functional TBCs with improved properties.
- Environmentally friendly process using chemical formulations avoiding hazardous and toxic precursors and solvents, for the protection of both workers and environment.

The development departs from state of the art YSZ towards new thermal barrier coatings by zirconate materials, like $La_2Zr_2O_7$ type (pyrochlore structure), doped $SrZrO_3$ (perovskites) or NZPs layered coatings.

The BarCode - ***Development of multifunctional Thermal Barrier Coatings and modeling tools for high temperature power generation with improved efficiency FP7*** proposal-FP7-NMP-2012-SMALL-6 Work program topic addressed: NMP.2012.2.2-3 Advanced materials for high-temperature power generation.-2011

This proposal is focused to advance considerably the efficiency of power generation in gas turbine processes by the development of advanced parts or components of significantly improved performance as well as software products providing optimized process parameters.
The aim of the project is the development of materials, methods and models suitable to fabricate, monitor, evaluate and predict the performance and overall energy efficiency of novel thermal barrier coatings for energy generative systems. By the radical improvement of the performance of materials "in service", by the application of novel thermal barrier coatings, structural design and computational fluid simulation a significant improvement in energy efficiency and cost effectiveness will be achieved.

TEAM - *Integrated System for **TE**sting and **A**nalysing the Interface Processes in **A**dvanced **M**aterials for Aeronautics*

The general idea of the project is to set-up a modern system of synthesis, structure analysis and testing of advanced materials for aeronautics. This project focuses on two classes of functional materials, both of high interest for the aeronautic industry, but, also for related industries like transportation, co-generative systems in the energetic industry, steel industry, machines manufacturing industry, in Romania or abroad: i. Thermal barrier coatings; ii Shape memory alloys.
In both cases, interface phenomena occurring at microscopic level play a major role in tailoring their macroscopic properties and the functionality. Knowing the intimate structure of materials, down to atomic resolution, represents the starting point in understanding the physical properties of the advanced materials studied nowadays.

Patent proposal: Installation and method to test materials at quick thermal test shock OSIM register number A/00752/20.08.2010 Authors: Victor Manoliu, Gheorghe Ionescu

4. Interdisciplinarity

The team considers that the materials are the key for achievement good products both in aerospace industry and other industry branches.

The vision implies a strong interdisciplinary cooperation of specialists in materials, physics, chemistry, mathematics, numeric simulation, etc.

T17 - INCAS Mechatronics and Adaptronics Research Team (MART)

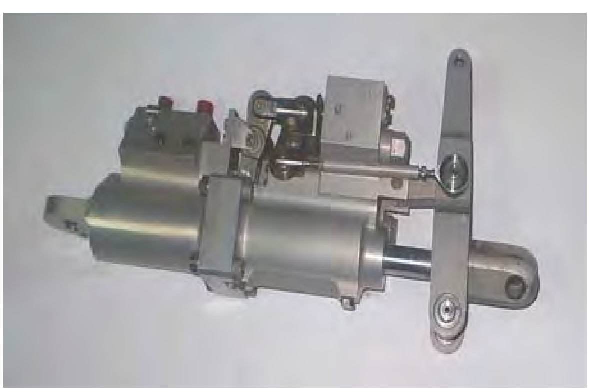
Team leader:

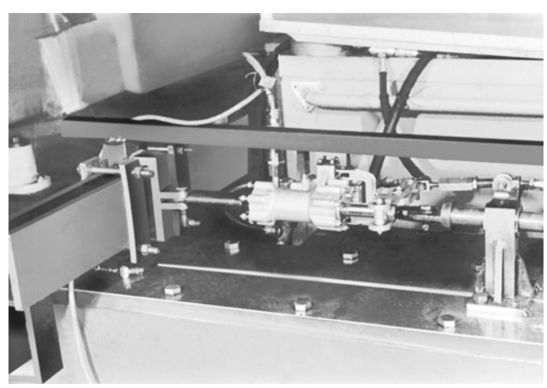
George TECUCEANU

1. Team Status - Objectives

The activity of INCAS System Analysis Laboratory is practically superposed over the more than 40 years of its history as the Institute of Aviation, founded in October 1968 and operating under the names (in that order): ICPAS, IMFDZ, INCREST. These years are linked to the concept and design in the years 1970-1980 of overall hydraulic equipment and systems (it is noted in passing the achieving of the mechano-hydraulic SMHR for the ailerons of the jet IAR 99 and the performing of other three aviation servomechanisms) for two planes, IAR 93 Eagle and IAR 99 Hawk, to the participation in the development and assimilation of hydraulic subsystems for helicopters IAR 330 and IAR 316B, to the design and production of flight simulators SIAR 93, SIAR 99, SIAR 330, SIAR 316 and then to the launching of new aircraft projects IAR 705, IAR S.

The present **Mechatronics and Adaptronics Research Team (MART)** has its origins in this System Analysis Laboratory, and coagulated in response to recent challenges faced with recent **PNCD projects.** More than 10 projects have been won and implemented by INCAS MART until the competitions in 2007. Other four PNCD2 projects were done by INCAS MART in conjunction with other teams belonging to Systems Department, primarily with the teams Structure Health Monitoring Research Team and Morphing Research Team. The team is also present in the National Program NUCLEU, and in the EU Projects FP6 CESAR and FP7 Cleansky SFWA.





2. Human resources.

Today, INCAS MART is composed of **the PhD Student Eng. George Tecuceanu, leader of the team, PhD Student Eng. Adrian Toader, Eng. Vladimir Berar, Eng. Minodor Arghir, Eng. Mariana Costache, Eng Cristian Valeanu and PhD Mathematics Ioan Ursu.** The team collaborated in these years with PhD in Mechanical Engineering Lucian Iorga, former member of them, which followed a doctoral internship at Rutgers University. The most experienced team member, Dr. Ioan Ursu, has over 40 years activity in the field.

3. Research directions

Adaptronic structures (also referred to as **smart materials** or **intelligent structures**) are “material systems that have intelligence and life-like features integrated in the microstructure of the material in order to reduce the total mass and energy and produce an adaptive functionality”

The main issues approached by the INCAS MART group were related to following projects.

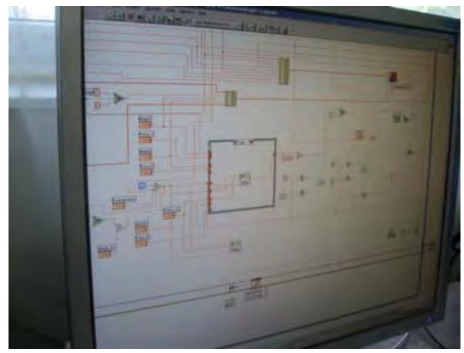
1. PNCDI2 Project 71 028 – “Development of complex active and semiactive control systems-DESCAS”, 2007-2010, Project Director Dr. Ioan Ursu.

The project has had as object the development, both from theoretical and experimental viewpoint, of some complex active vibration systems. In the project have been proposed efficient and robust solutions and associated algorithms for semiactive and active vibration control, and also the experimental models for testing. Thus, three mechatronic laboratory test systems have been realized, two active systems and a semiactive one. The studies and experimental results showed that the neuro-fuzzy control provides excellent control performance on contrast with various classical control strategies.

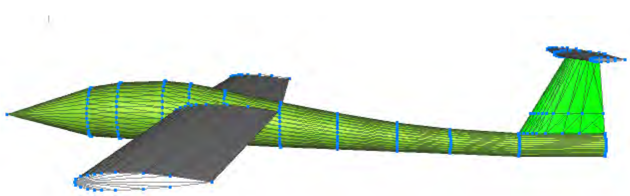
2. PNCDI2 of Project 81 036 – “Designing of a hydrostatic servoactuator for aircrafts-SAHA”, 2007-2010, Project in the framework of PNCDI II Program of Ministry of Education and Research, Project Director Dr. Ioan Ursu.

The hydrostatic servoactuator is one based on the direct connection of the hydraulic cylinder to the pump. Adding an external position loop, a servomechanism (a tracking system) is obtained.

The usual internal loop for pump angular speed was avoided in this project by static error decreasing reasons. The external loop was initially studied and then synthesized and simulated by various control laws, classical or unconventional (neuro-fuzzy). The studies showed that the ***neuro-fuzzy control*** *not only extends the system bandwidth, but also provides excellent control performance on contrast with various classical control strategies in hydraulic servo position systems. The most meaningful feature of the nonconventional controller, is the following: because is in fact a free model strategy, this methodology ensures a reduced design complexity and provides antisaturating and antichattering properties of the controlling system, thus favourising its robustness.*



3. PN-II UEFISCSU ID 1391/2008 – "Researches concerning robust and antisaturating control using fuzzy logic and neural networks, with applications-1391", 2008-2011, Project in the framework of PNCDI II IDEAS, Program of Ministry of Education and Research, Project Director Dr. Ioan Ursu.



Another ongoing project in INCAS is the development of autopilots for small Unmanned Aerial Vehicles (UAVs). Control of UAVs presents unique challenges not only in the design of control algorithms, but also in the strategies and methodologies used to integrate and implement those algorithms on the actual vehicles. Small UAVs, like all aerial vehicles, are underactuated systems.

4. Multidisciplinarity

INCAS MART is involved in some complex project proposals in recent National Research Calls wich are close to Mechatronics and Adaptronics. The current MART will be enlarged, with the employment of young graduates. The development needs are linked essentially by INCAS quality of associate partner in FP7 Cleansky SFWA Project.

T18 - INCAS Morphing Research Team (MRT)

Team leader:

Adrian TOADER

1. Team Status - Objectives

In 2006, a project proposal called "Morphing Structures for Applied Airspace Design", acronym SMART, with INCAS as Coordinator, and Eng. Paula Copaescu as Director, managed to win in the competitive funding "Research of Excellence (CEEX)", under the auspices of the Romanian Ministry of Education and Research, National Authority for Scientific Research. This moment marks also the birth of **INCAS Morphing Research Team (MRT)**, appointed for finishing the winning project, indexed code 3942 Project, Contract X2C12/2006, and having Polytechnic University of Bucharest (UPB) as a partner.

2. Human resources

Naturally, Mrs. Copaescu would lead the project as a whole, but also naturally in INCAS was formed a research team – MRT – whose leadership was entrusted to young PhD Student Adrian Toader, fresh Master in Aerospace Engineering Faculty, UPB. The team has remained, more or less, in the same structure: PhD Mathematics Ioan Ursu, PhD Student Eng. George Tecuceanu, PhD Eng. Eliza Munteanu, Eng. Vladimir Berar, Eng. Vasile Turcanu, Eng. Paul Defta. The team worked in collaboration with Lucian Iorga, PhD in Mechanical and Aerospace Engineering at Rutgers University (Piscataway, NJ, USA). In 2000-2001 Eng. Iorga was employed at INCAS, and since then has remained in constant touch with the INCAS team. Dr. Iorga has an wide experience as a structural engineering, solving problems in domains like vibration analysis and vibration reduction, using both classical methods and state-of-the-art active control approaches, calculation of loads, structural optimization and stress analysis. So, the team, beyond the difficulties inherent in the project, was ready to face successfully ambitious targets.

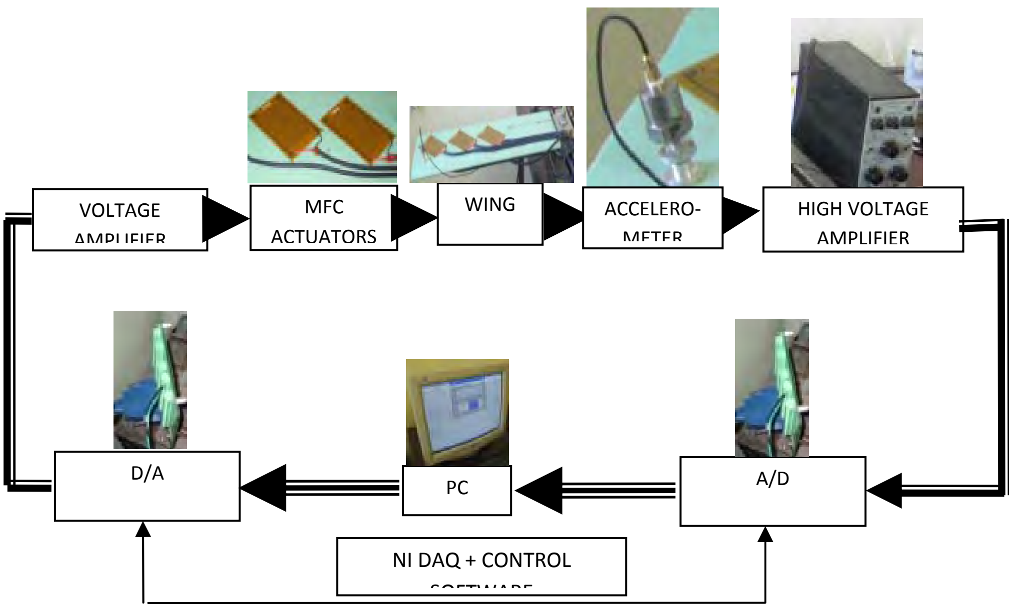
3. Research directions - Projects

Morphing is a field of current research and applications in aircraft wing. Morphing wings are the latest trend in aviation. Morphing, when applied to aerospace vehicles, is a technology that allow its characteristics to be changed to achieve better performance or to allow the vehicle to complete tasks it could not otherwise do.

The project theme was a part of the Operational European Plan "The Strategic Research Agenda", 2nd edition, published in October 2004 by ACARE (Advisory Council for Aeronautical Researches in Europe).

The main issues approached by the project SMART were:

- •studies, analyses and assesments of the state of the art of the intelligent materials which are applicable in morphing structures development;
- •researches on morphing configurations that could generate global/local aerodynamic effects for the optimization of the taking-off/landing and cruise flight of a light aircraft;
- •methodologies for morphing structures;
- •experiments on simplified structural models for morphing applications.



So, for the team, the project has meant a success, ending with the realization of a morphing wing **demonstrator (**incorporating major acquisitions, among which is mentioned first multi-functional board PXI-6259 National Instruments, and a Dynamic Solutions Shaker)

4. Interdisciplinarity

Based on the close ties the MRT has developed with other Departments in INCAS (in FP6 and FP7 projects CESAR and Cleansky-SFWA) and with traditional partners in Romania (UPB, IMSAR , ASRC,and others), we are directly involved in three complex project proposals in areas close to morphing and control technologies:

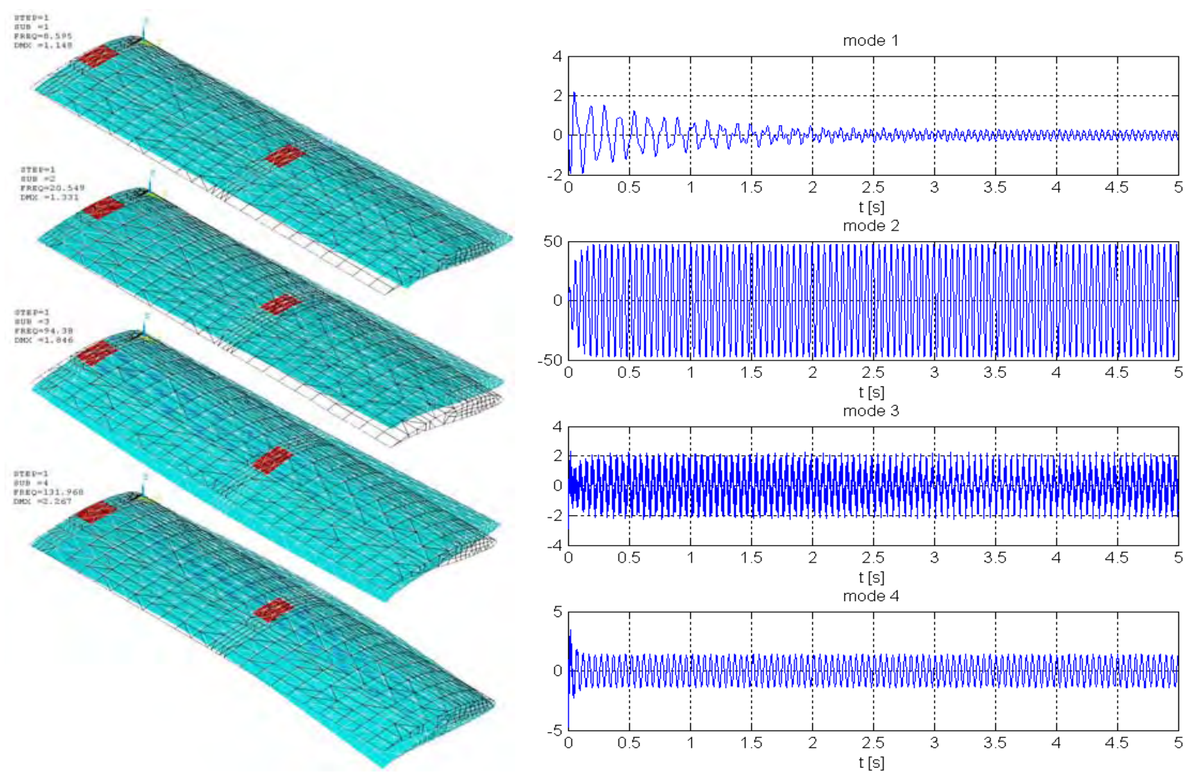
1) Funding Application for Complex Exploratory Research Projects - PN-II-ID-PCCE-2011-2: **“Health Monitoring For Active Smart Structures – HMASS**”

2) Funding Application for Joint Applied Research Projects PN-II-PT-PCCA-2011-3: **Advanced technologies for Predictive Maintenance based on Health Monitoring systems – PdMHM**

3) Funding Application for Joint Applied Research Projects PN-II-PT-PCCA-2011-3: **Innovative strategies for high performance Indoor Environmental Quality in Operating Rooms – EQUATOR**

6. The evolution oh human resources, the development of the MRT

The current MRT will be enlarged, with the employment of young graduates. The development needs are linked essentially by INCAS quality of associate partner in FP7 Cleansky SFWA Project.



T19 - New Experimental Techniques in Aerodynamics

Team leader:

dr. Florin MUNTEANU

1. Team Status

The research team for New Experimental Techniques in Aerodynamics has appeared as a necessity imposed by the participation of INCAS to the international high-speed aerodynamic research and also to the new national and European research projects. At the same time, the preservation of the existing high level of scientifical and technical capability and performance at our wind tunnels is not possible unless continuous efforts are made to develop and improve our knowledge and skills.

The renewed membership of INCAS Trisonic Wind Tunnel to the Supersonic Tunnel Association International (STAI) means, among other things, full access to the proceedings of the biannual conferences of the organization where all members present their newest test methods, techniques and results and at the same time the obligation to share with the partners our best results and methods. In fact many of the improvements achieved at the Trisonic Wind Tunnel over the years were inspired by the papers presented at the STAI conferences at which we took part.

2. Human resources

This team is composed by following researchers from different departments, with extensive experience in wind tunnel testing:

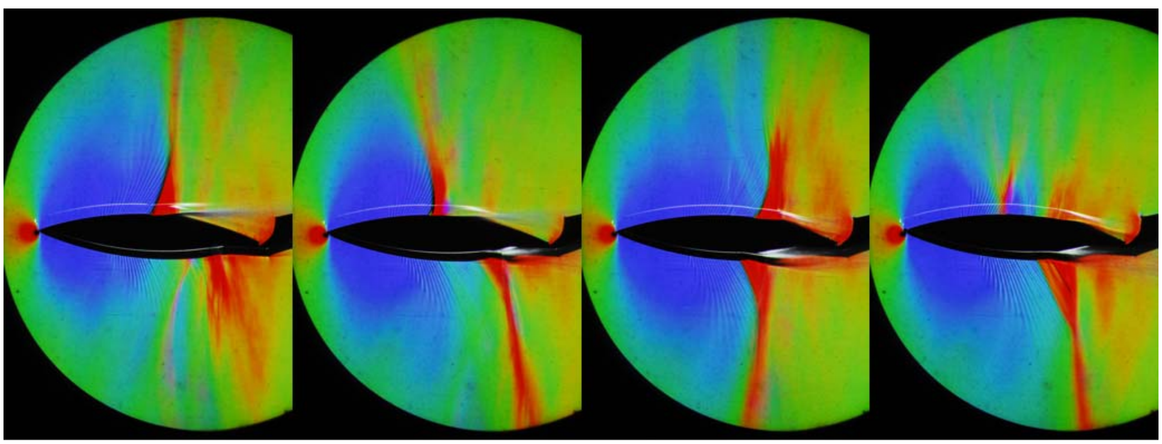
- Experimental aerodynamics: Munteanu Florin, Catalin Nae, Cornel Stoica, Anton Ivanovici, Demetrescu Teodor, Bobonea Andreea, Ionut Lom, Marius Panait
- Design department: Adrian Dobre, Costian Leonard, Radu Bogateanu
- CFD department: Victor Pricop, Niculescu Mihai, Claudiu Vadean, Gabriel Cojocaru

3. Objectives. Research directions

The major change in the experimental activities at the INCAS wind tunnels in the last few years was from industrial testing for aircraft and missile projects to experimental investigations as part of advanced research projects concerned with new aircraft concepts or flight physics phenomena. This dynamics of the research directions required the development and implementation of new experimental techniques for fast and precise measurements of dynamic, fast-changing parameters and modern methods for qualitative and quantitative investigation of the unknown phenomena.

Most research wind tunnels have distinct data acquisition systems with different hardware and software for steady (low data sampling speed) and unsteady (high data sampling speed) operations. The data acquisition of fast changing parameters – which is not usually required for industrial-type wind tunnel tests – implies special requirements for the instrumentation and data acquisition systems as compared with the classical, steady testing. The instrumentation (including the cables) must be adapted for high frequency signals, high sampling rates, proper anti-aliasing filtering. The amount of data increases with the frequency multiplied by the number of channels.

One example of new research direction for the INCAS experimental aerodynamic laboratories was the Shock Wave – Boundary Layer Interaction (SWBLI) with its important effects on the high speed flight, such as the buffet / buffeting phenomena. The objectives of research are not just the characterization and prediction of buffet onset for a particular aircraft configuration in order to allow the aircraft designer to avoid and prevent the devastating effects of the phenomenon. Today the European and world-wide research aims at means of alleviation and control of the shock wave – boundary layer interaction by passive and active methods and devices for flow control.



The research team within the INCAS experimental aerodynamics laboratories has initiated experimental investigations and also CFD simulations of buffet phenomena within the “Unsteady effects of shock wave induced separation” (UFAST) European project as partners in a consortium of 18 research organizations from 10 European countries. INCAS was the leader of one of the test cases and its contributions consisted in:

- Experimental investigations on a circular arc symmetric airfoil at buffet conditions – establishing the reference regime, configuration and parameters which allowed the partners to perform CFD simulations of the flow
- Numerical simulations of the reference test case using RANS, URANS and LES methods which succeeded in predicting the unsteady flow regime including the buffet phenomena

- Attempted active flow control of the buffet phenomena by means of synthetic jet actuators with piezoelectric membranes.

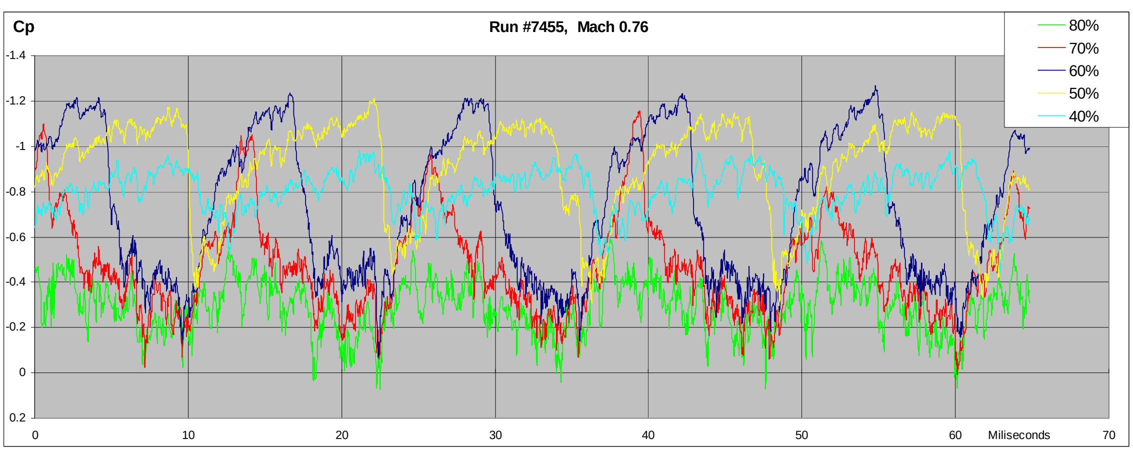
The results obtained by INCAS are presented in the following volumes:

- "Transonic Interactions – Biconvex Airfoil", in the volume "Springer series – Notes on Numerical Fluid Mechanics and Multidisciplinary Design (NNFM)", ISBN 978-3-642-03003-1, 2009
- "Experiments – Biconvex Airfoil", in the volume "UFAST Experiments – Data Bank", IMP PAN Publishers, ISBN 978-83-88237-46-1, Gdansk 2009.

The research activities oriented towards the active control of buffet phenomena by means of the synthetic jet actuators is being continued within another European project – Clean Sky - Smart Fixed Wing Aircraft, where a new half-model of a laminar wing aircraft will be designed, manufactured, instrumented and tested in the Trisonic Wind Tunnel as part of work package 1.1.2 – Active Technologies for Laminar Flow and Buffet Control, under the leadership of ONERA – France.

The investigation of unsteady phenomena required the replacement of the slow electro-mechanical scanivalves with modern electronic pressure scanning devices capable of speeds a thousand times greater than the classical devices. To record the unsteady pressure variations due to the shock wave motion in buffet flow it was necessary to install special fast response pressure transducers. The implementation of these new technologies has led to the in-house development of original electronic circuitry and computer software for the control and data acquisition of the new electronic scanning devices and to valuable lessons regarding modern measuring instrumentation technologies.

The synchronous acquisition of high frequency signals from the unsteady pressure transducers required rewriting of the data acquisition and wind tunnel control computer software. The data reduction software was also rewritten to include the necessary signal processing procedures – Fourier analysis and others – necessary for the detection of buffet frequencies.



The high speed data acquisition systems are usually synchronized with high speed video cameras which gather images of the investigated phenomenon from Schlieren, PIV or LDV systems. Synchronization based on a very precise time reference allows the quantitative analysis (based on measured data) of the qualitative information from visualizations. The Schlieren visualization method has been used intensively for the study of unsteady shock wave – boundary layer interaction. However, for fast changing flow configurations the need for fast video cameras and correspondingly intense light sources has become obvious. The use of modern techniques as the laser sheet in combination with a smoke generator has provided very spectacular images of the vortices in the airflow around aircraft models in the subsonic wind tunnel.

The use of hot wire and hot film thermo anemometry has allowed the investigation of boundary layer characteristics and turbulence levels in the INCAS wind tunnels and also velocity measurements in many configurations (e.g. pulsed jets for active lift control, synthetic jet actuators etc.). However, requirements from the new projects already in progress show that it is necessary to implement new techniques for the detection of boundary layer transition from laminar to turbulent on models in both wind tunnels. One important feature of the evolution of the investigation methods at the most important wind tunnels in the world has been the ever larger adoption of numerical simulation methods for the needs of the wind tunnel testing. One example is the evolution of wall correction methods not only for the simple solid wall test section case but also for the transonic, ventilated test section walls. It must be mentioned that the INCAS Trisonic Wind Tunnel has one of the best transonic test section solutions for its variable porosity perforated walls, but this does not mean that corrections could not be applied. A first step in this direction was accomplished by the implementation of a wall signature pressure measuring system to be used for wall corrections calculations.

The cooperation between the wind tunnel experiments and CFD flow simulations was illustrated above by the contributions (both experimental and numerical) to the UFAST project. In other projects – like Clean Sky SFWA – the preparation of buffet control tests on a half-model in the transonic test section has been initiated by modeling the half-model and the tunnel geometry and by running numerical simulations in order to optimize the model geometry and test configurations.

The research team intends to maintain the high level of competence and performance of the INCAS experimental facilities by promoting the necessary investments in high quality technical and human resources.

T20 - Numerical Simulation for Large Scale Industrial Flows

Team leader:

Mihai Victor Pricop

1. Team Status

The group has been established in 2002, given the computing power required in external aerodynamics. First computing clusters were configured, tested and put in production. National and EU projects requested and stimulated the output of this lab. Code development took important time resources: 2D and 3D RANS/URANS/LES, both compressible and incompressible codes are the results of the effort. A new cluster has been introduced in the summer of 2011. It is finally configured, so that production status is reached at the end of 2011. The main objective is the high-fidelity numerical characterization/computation of the relevant industrial aerodynamic configurations: low-speed and high-speed for general aviation developments.

2. Human resources

The team has currently five research engineers: Mihai Victor **Pricop**, Dr. Mihai **Niculescu**, Claudiu **Vadean,** Gabriel **Cojocaru** and Cornelia **Nita**. The team is placed at the Subsonic Wind Tunnel, first floor. The team was initiated by Dr. Catalin **Nae**, developer of some of the CFD codes in use. All the team members are dedicated to numerical computations in fluid dynamics, covering all aspects: code and tools development both serial and parallel (OpenMP and MPI), commercial codes usage, mesh generation and post processing.

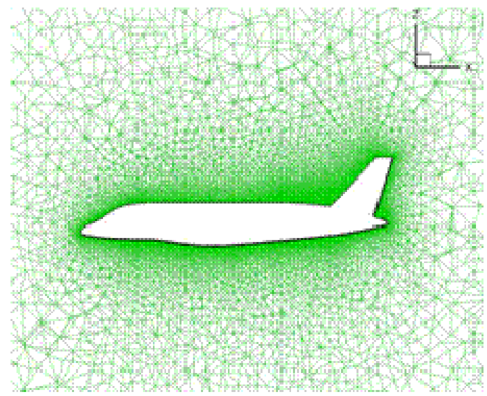
3. Research directions - Projects

Dedicated post processing routines are under development, especially for wing/body and high-lift systems assessment.

Currently the team is involved in more tasks of the Joint Technology Initiative – Clean Sky project. In Smart Fixed Wing Aircraft the ongoing activity is in tasks: 114 (Passive Flow Control for High lift systems), 112 (buffet investigation and active flow control), 213 (High Fidelity Aeroacoustics for Novel Empennage Concepts), 224 (Contra Rotating Flow investigation/prediction to assist large scale Wind Tunnel tests).

In JTI-CleanSky Green Regional Aircraft, the team is testing/analysis two 2D configurations, related to turbulent and laminar flow technologies. The team interacts with Stress Analysis and Structural Design Departments, delivering aerodynamic loads to size and verify their designs.

CFD codes in current use



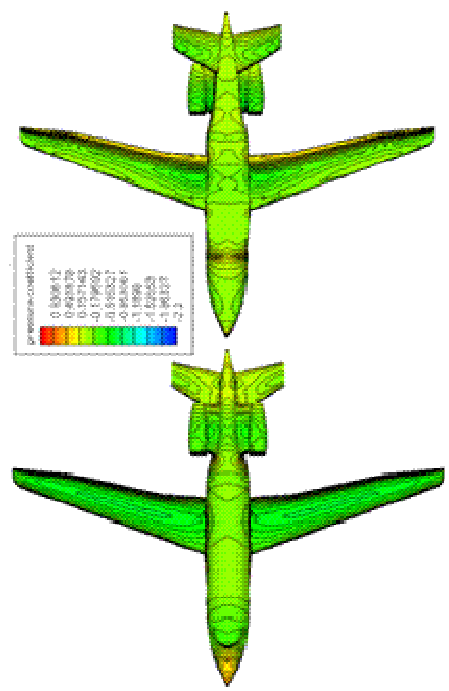
- Compressible 3D RANS D3uns

- Incompressible 3D RANS Diuns

- Compressible 2D RANS - NSC2KE

CFD codes under development

- Structured compressible RANS code, $k-\omega$, Spallart-Almaras, RNG $k-\varepsilon$.



- Structured incompressible RANS code, classical $k-\varepsilon$

- Agglomeration multi-grid for tetrahedral meshes;

- Compressible RANS code (tet);

- Compressible RANS code (hexa);

- Hybrid mesh 2D code;

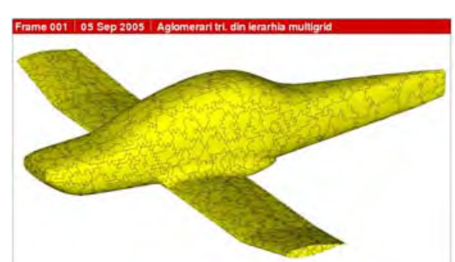
- Acoustics applications: finite difference, volume and finite element applications;

- Mesh generation/modification tools;

- Structured compressible Navier-Stokes parallel code;

- Proper Orthogonal Decomposition tool for multidimensional analysis – applied for centrifugal compressor, combustion chamber, shock tube, 2D incompressible;

- TetGen mesh generation + in house tools to create boundary layer prismatic layers.

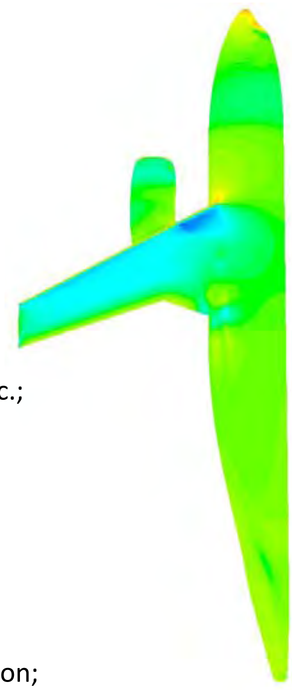


Libraries under development

- Limited surface block structured mesh generator;

- Mesh converting routines;

- Graph based partitioning for domain decomposition parallelization;



- Topological mesh routines;

- Preprocessing routines for CSM codes;

- AeroTaxi geometry;

- Generic configurations for business jet and regional turboprop;

- Aerodynamic design: flap and aileron airfoils design, wing-body fairings, etc.;

CSM expertise

- Fluid structure interactions with commercial codes;

- Pre-post processing routines in development;

- Linear elasticity finite difference codes for geometrically simple configuration;

- Spring analogy code for 3D structures;

- FEM dynamic analysis with LS-Dyna

Environmental aerodynamics

- Geometry for CFD, meshing and simulation;

- Wind tunnel tests/flow visualizations;

Hardware

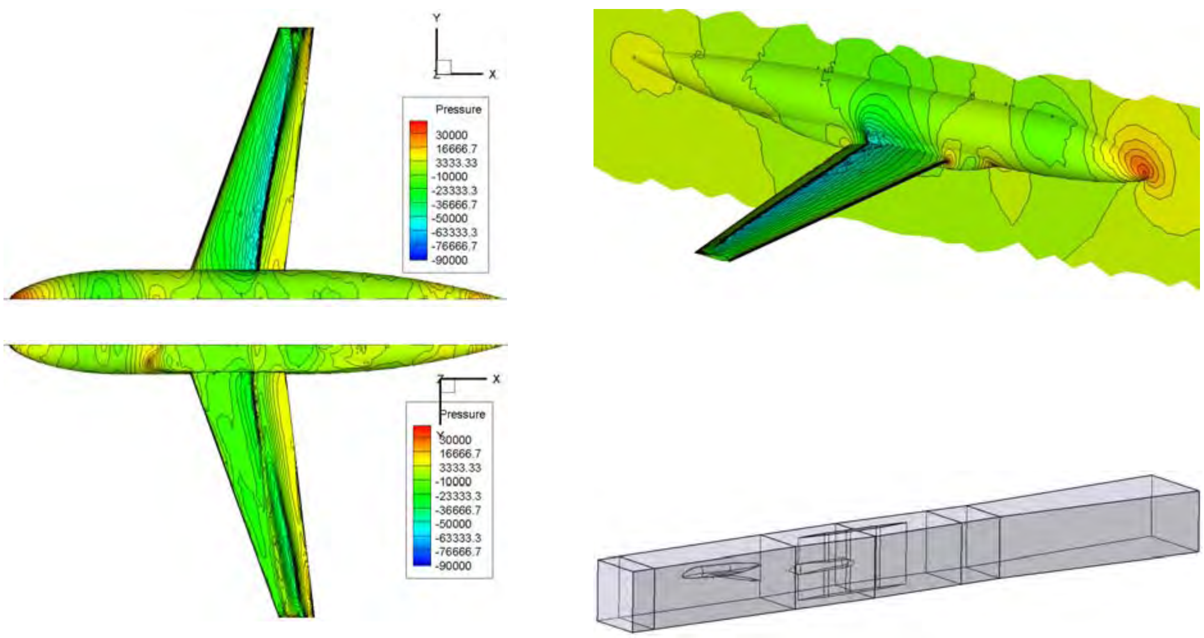
- Cluster Supermicro Twin Blade with 20 nodes, 160 CPU cores, 320 GB RAM, dual boot Linux/Win 7 64 bit
- Tyan Workstation, 8 CPU cores, 32 GB RAM
- PC Workstation, 4CPU cores, 32 GB RAM – Front End of the Cluster

4. Interdisciplinary

We work close with the Wind-Tunnel team, in low-speed projects: High lift configurations (Cornel Stoica, Florin Munteanu, Marius Panait, Anton Ivanovici, Ionut Brinza, Andreea Bobonea), Active and Passive Flow Control, standard experimental aerodynamics. Past projects are: CESAR, AVERT. In CESAR, a laminar airfoil with high lift system (flap) was tested as a 2D wing. Also an optimized wing for AeroTaxi, provided with high-lift system and ailerons was studied. AVERT is a project dedicated to Active Flow

Control for High-lift systems. UFAST project offered our team the chance to work with the Supersonic Wind Tunnel team, in an experiment dedicated to buffet investigation and control. Currently, activities in JTI SFWA WP 112, dedicated to buffet control are linking again the team to the Subsonic and Supersonic Wind Tunnels, to model design team (Adrian Dobre, Leonard Costian) and workshop (Ionut Sava, Ionut Lom). New manufacturing facilities are introduced in the workshop, to enhance quality of the wind tunnel models.

Our team also interacts with airframe design teams in high lift systems numerical assessment and stress analysis departments in wing and high-lift systems loads evaluation for both airframes and wind tunnel models. A very good interaction takes place with the Aerodynamics Dept.



JTI SFWA WP 112 High speed laminar wing configuration

T21 - Unconventional Aerodynamics for Micro-Air Vehicles

Team leader:

dr. *Valentin BUTOESCU*

1. Team Status

Four kinds of problems are intended to be solved:

- theoretical issues on the Aerodynamics and Mechanics of flapping flight;
- experimental issues on the same domains.
- wing and mechanism design of a flapping wing micro-air vehicles (MAV).
- design and construction of micro-air vehicles

Main goals of the group:

- to find some reliable methods of aerodynamic calculation for the flapping wing in the international context;
- to develop new computational methods specially designed for solving the same problem;
- to validate the computational methods previously developed;
- to solve the inverse problem, i. e. to find the flapping and feathering laws in order to achieve a certain purpose, say lift and thrust;
- to develop the basic features on the Flight Mechanics of a Flapping MAV;
- to study the "thorax mechanics", i. e. the mechanics of the part of the fuselage housing the flapping mechanism and wing connections.

2.Human Resources

The team is composed of the following researchers from the involved departments:

General aerodynamics: Butoescu Valentin, Nae Catalin, Neamtu Mihai, Nebancea Stefan, Patru Spataru, Pricop Victor, Nita Cornelia ;

Systems dynamics: Neamtu Andrei, Tudose Mihai,

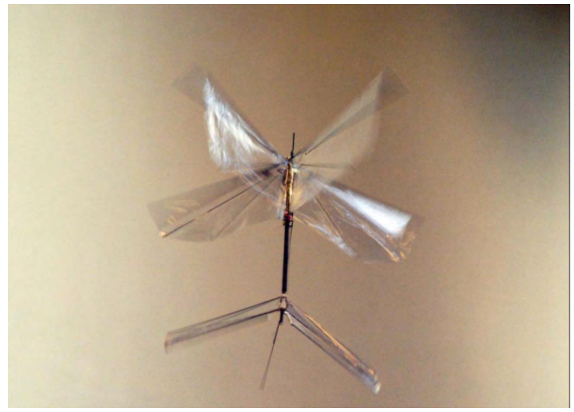
Aerostructures: Bogateanu Radu

Materials: Mihailescu Alexandru, Manoliu Victor,

Board of directors: Nae Catalin, Radnef Sorin, Marin Nicolae, Oprisiu Cornel

3. Research directions - Projects

There are many theoretical attempts to model the unsteady flow about the flapping wings. Some of them use the classical panel method (for example M. J. C. Smith and collab., from Purdue University). Other theoretical approach use CFD (see, for example A.P. Willmott's article "*Numerical modelling as a tool for investigating the aerodynamics of insect flight*", Fluid Dynamics Group). We intend to use the so called Vortex Method to solve the Navier Stokes equations (see, for example: G-H. Cottet, P. Koumoutsakos, *Vortex Methods*, Theory and Practice, Cambridge University Press).



<u>Experimental issues</u>

- to design a pair of wings and to build them in full size dimensions;
- to build a demonstrator and a test-bench for measuring the global forces acting on flapping wings;
- to test the wings in symmetrical flight conditions;
- to test the wings while performing asymmetrical flapping and/or feathering movements;
- to visualize the flow.

The experimental activity will allow us to validate the theoretical approach, to observe the aerodynamic phenomena and to build the so called "Force Map". The Force Map is an experimental way to get the force as a function of flapping and feathering laws. See for ex. J. Yan and R. S. Fearing "*Wing Force Map and Force Characterization and Simulation for the Micromechanical Flying Insect*".

<u>Wing and mechanism design of a flapping wing MAV</u>

- to design a wing and the flapping and feathering laws in accordance with the "reliable methods" mentioned before;
- to design the flapping/ feathering mechanism for the test-bench;
- to modify the wing and the flapping and feathering laws, taking into account the experimental results.
- to design a flapping/ feathering mechanism for a MAV.

The main research activities are focused on the following topics:

Theoretical research:

Development of codes for calculation of aerodynamic forces on flapping wings

CFD calculation of air forces on flapping wings (for both 2 and 3D cases)

Flight dynamics of a flapping air vehicle

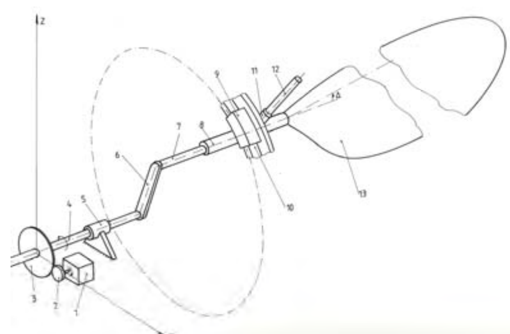
Strength calculation for a flapping air vehicle.

Experimental research:

Design and construction of experimental devices for both hovering and forward flight tests.

The tests will allow the measurement of instantaneous forces and moments at the roots of both wings. Theoretical estimation of the inertial forces will be previously done. So the aerodynamic forces will be obtained as a difference between the measured and the inertial forces.

Design and construction of mini/micro-air vehicles



The programme is intended to design the aerodynamics, mechanics and flight dynamics of a MAV. Its span must be of 10 inches (250 mm) or less, the weight of 50 g, the wing beat frequency of approximately 10-20 Hz.

The electronic control of the MAV is beyond the purpose of the programme. The subject of present activity will be an integrated theoretical and experimental programme. The theoretical study and design will be done using both results given in the relevant international works and original results. A configuration consisting of a thorax and a set of wings is then proposed. The final goal is to design and construct a MAV with the same wings and an suitable propulsion system.

Revolutionary mechanisms for wings:

We proposed a new type of micro-air vehicle that avoids the mechanical difficulties of a flapping system. It uses a modified design of cycloidal a propulsor. The modification regards the special setting of the wings that is intended to help to the formation of a stable leading edge vortex (LEV). It is known that the LEV is the main feature that allows the insects to achieve the necessary lift to fly.

AERO-MECHANICAL ANALYSIS AND SYNTHESIS OF A FLAPPING WING MAV; DEMONSTRATOR – FLAWIAS (Contract 113) The project was intended to open a new field of research in our country. The flapping flight is now the object of numerous studies performed in the most developed countries. The present project brings Romania into the advantageous position of taking part into future international co-operation on this field. Our first research was restricted only on the Aerodynamics and Mechanics of flapping MAVs.

The viability of the project is determined by its two components: the theoretical and experimental levels. The experimental work opens a new way for our research: unsteady, low Reynolds number flows.

4. Interdisciplinarity

The team contains specialists from different disciplines:

- aerodynamics;
- dynamics of flight;
- stress of materials;
- aeroelasticity;
- materials sciences.

T22 - Clean Sky biz jetafterbody

Team leader:

Dr. Daniela BARAN

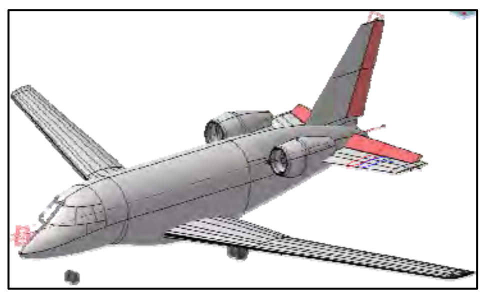
1. Team Status

The group has been established in 2008 in order to meet requirements for Clean Sky SFWA ITD, mainly with respect to biz-jet afterbody development. This highly specialized research team uses existing expertise at INCAS with respect to conceptual design and validation for transonic aircrafts. Also, this team uses extensive experience for industrialization of aircraft concepts, enabling customer satisfaction with respect to a very challenging R&D problem. The group has access to important computational and experimental resources at INCAS in order to perform requested activities.

2. Human resources

The team has currently five research scientists and 4 engineers: dr. Daniela Baran (group leader), Mihai Victor Pricop, Vasile Turcan, dr. Marcel Stere,, Claudiu Vadean, Gabriel Cojocaru and Dorin Lozici.

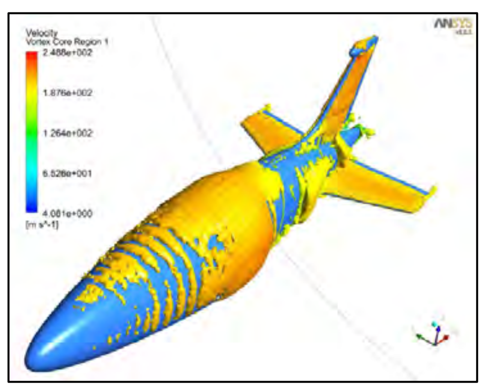
The team is placed in the Structures & Materials department at INCAS, in close connections with other teams working in Clean Sky activities (e.g. BLADE) in order to enable synergies. All the team members are dedicated to design (CATIA), validation (NASTRAN) and numerical computations in fluid dynamics, covering all aspects: code and tools development, commercial codes usage, mesh generation and post processing.



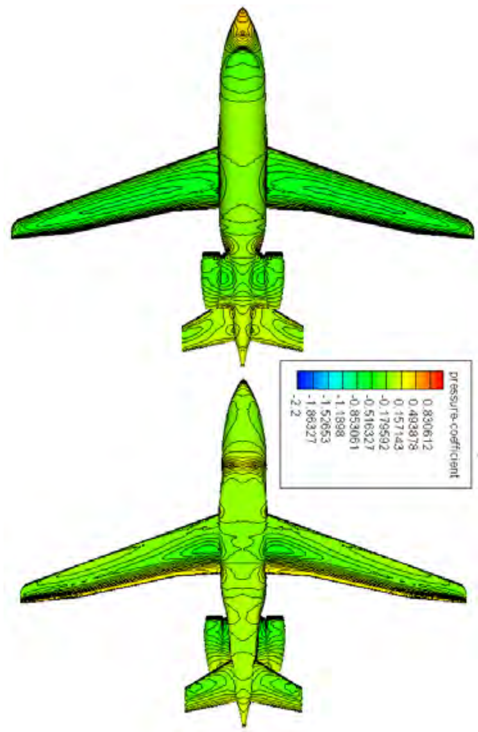
3. Research directions - Projects

Clean Sky biz jet afterbody is the main area for development. The group is devoted to a preliminary aeroelastic analysis of the low speed biz-jet (LSBJ) configuration. The configuration consists of a horizontal tail and a vertical tail in the presence of the aft body. The aerodynamic surfaces and the aft fuselage are interacting with each other but no other influence of the aircraft is considered (engines, wings, fore fuselage).

The design of the assembly has been supplied by the Structure Department of INCAS.

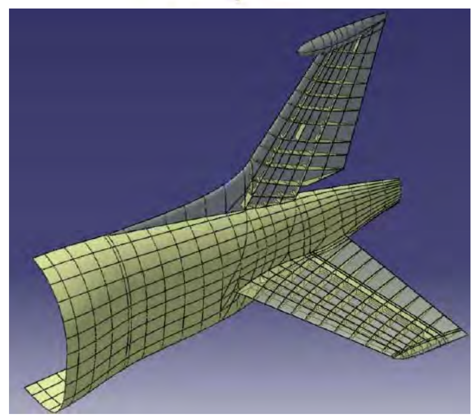


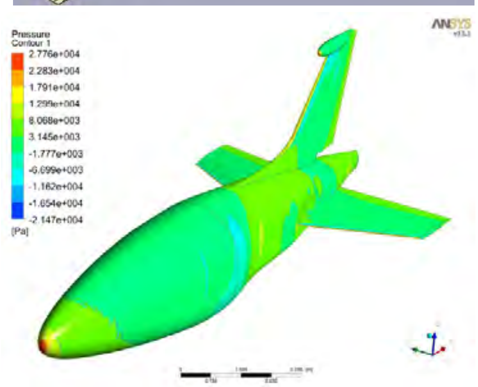
Analyses of fluid-structure interactions (FSI) including complex, instationary flows may be performed with partitioned or simultaneous solution strategies. In partitioned solution algorithms different solvers for fluid and structure are called sequentially. The introduction of an additional FSI-iteration loop in which the solution of fluid and structure is repeated until convergence of interaction forces and displacements, leads to strongly coupled (implicit) solutions. Loosely coupled, partitioned solution procedures are very efficient if the coupling is weak or if time scales of fluid and structure differ strongly. In contrast, for large structural displacements, incompressible fluids fully enclosed by deformable structures, or if a considerable fluid mass is moving with the structure, at least strongly coupled partitioned solution procedures (with FSI iteration loop) have to be applied.



INCAS team needs to evaluate the configuration options to accommodate alternative innovative power-plant solutions, coming from the SAGE ITD. From this input, the main activities are related to:

- Nacelle installation studies
- Assess high- and low-speed overall aircraft performance & handling quality implications
- Evaluate noise shielding strategies (in combination with rear end design WP2.2.2) studying different SFWA overall aircraft configuration options
- Detailed study of pylon concepts – including structures & systems architectures; address potential vibration & loads issues, as appropriate; investigate potential means of vibration suppression
- Address certification issues – e.g. investigate structural & system concepts in relation to fan blade / propeller blade-off, engine disc-burst





4. Interdisciplinarity

The team considers that the structural concept is the key for achievement good products in aerospace industry and other industry branches. The vision implies a strong interdisciplinary cooperation of specialists in structures, materials, flow physics, chemistry, mathematics, numeric simulation, etc.

2.4 Representative project

Joint Technology Initiative (JTI) "CleanSky"

Smart Fixed Wing Aircraft - Integrated Technology Demonstrator "SFWA-ITD"

Introduction

"Clean Sky" is the European aeronautics industry's response to citizens' needs for more environmentally friendly aviation in combination with sustained economic growth. This seven-year research program will combine public and private capacities to rapidly introduce advanced technologies for the next generation of aircraft. The aim of these new technologies will be to radically reduce noise and emissions in air transport, and reduce aircraft fuel consumption.

dr. Catalin NAE

The Clean Sky program will speed up the path from research to industrial application of innovative, greener technologies. Large-scale technology demonstrators are planned in order to validate research results both in flight and on the ground, notably in flight test vehicles created expressly for this program. This will enable a more rapid transition to full-scale flight tests, followed by the application of these new technologies in the next generation of aircraft. Clean Sky will be built upon six different technical areas – from innovative rotor blades and engine installations that reduce noise and fuel consumption, to ecologically friendly designs that help components last longer and use fewer non-renewable resources.

Clean Sky will bring public support together with industry funds in a risk-sharing structure that will accelerate the development and introduction of environmentally focused technologies in next generation air vehicles. The European Commission is investing 800M€ in cash, while industry will invest an additional 800M€ in kind. The CEOs of the major European aeronautics companies signed an MOU in agreeing to work together to fund and deliver the Clean Sky program in addition to their existing technology acquisition programs.

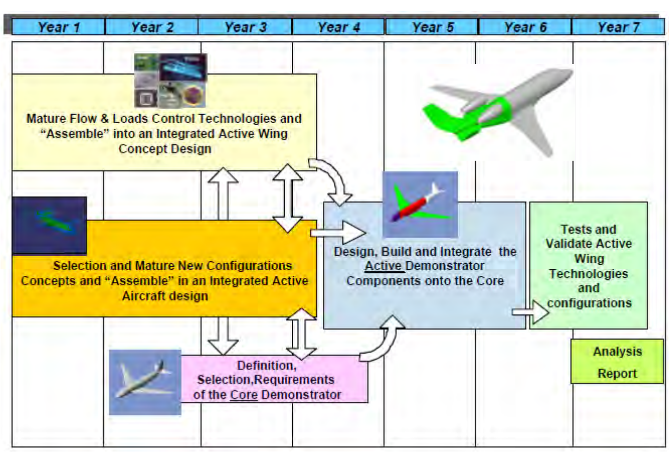
CleanSky is articulated around 6 Integrated Technology Demonstrators (ITD´s). Each of these ITD´s is representing a core technology sector in civil aviation providing major contribution to the Air Traffic System (ATS). Being formulated by a group of 12 leading large industries in aeronautics in Europe (CleanSky ITDleaders), each CleanSky ITD is co-led by two companies being a “prime” in the sectors of large aircraft, regional aircraft, helicopters, system for aeronautics, aero- engines and EcoDesign for aeronautics.

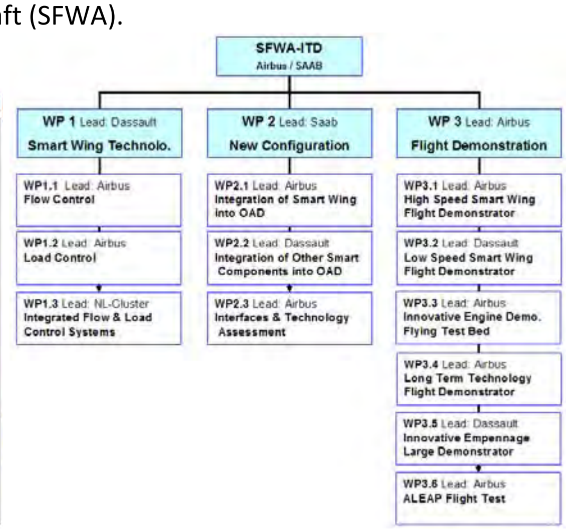
The sector of large civil aircraft, which is addressing large transport aircraft with a capacity typically larger than 150 passengers, is represented by Smart Fixed Wing Aircraft–ITD (SFWA-ITD), jointly led by Airbus Industries and SAAB AB. The SFWA-ITD is one out the six Integrated Technology Demonstrators in the CleanSky Joint Technology Initiative (JTI).

Major Objectives for SFWA Project

According to the ACARE goals for 2020, out of a target of 50% reduction in CO2, nearly half of the achievement should come from the airframe. A major reduction in weight will be achievable by extending the use of composite materials. However, this alone will not be sufficient to reach the 2020 goals. Step changes in aerodynamics and flight physics performance are also required. In this regard, the concept of active wing and new configuration is a promising and still unexplored field of serious investigation in an operational environment.

A step change in the performance can now only be achieved by rethinking the aircraft architecture and its components. The assessment of the benefits of such a radical change can only be validated on a representative flying vehicle via a multidisciplinary approach. This is the goal of the Integrated Technology Demonstrator (ITD) Smart Fixed Wing Aircraft (SFWA).



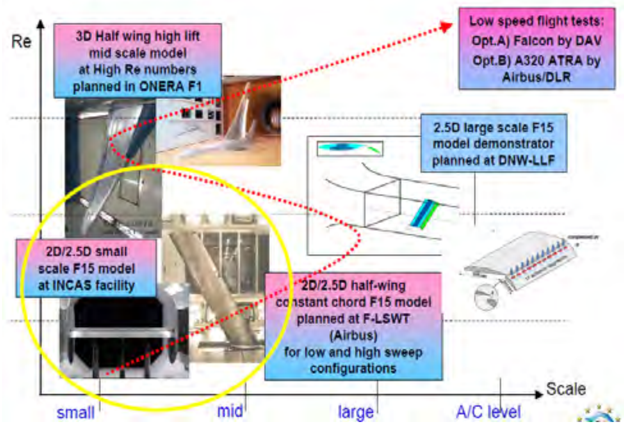


The purpose of the Smart Fixed Wing Aircraft flying demonstrator is to develop and validate up to Technology Readiness Level (TRL) 6 innovative technologies, concepts and capabilities currently investigated at TRL 3 and showing the potential to demonstrate a step change in the critical areas of fuel consumption and noise emissions. To this end the Smart Fixed Wing Aircraft ITD will integrate smart wing and innovative airframe concept technologies. This integration will be largely based on the results of other European R&T projects (mainly AWIATOR and NACRE) performed within the previous framework programs.

The merit of the active wing lies in its capacity to control loads and air flow and generate benefits in drag reduction and structural mass leading to a reduction of fuel consumption and gaseous emissions, noise, systems complexity and increasing ride comfort. Whereas a classical wing is passive with an optimized shape and high-lift devices, the active wing will sense the surrounding airflow, analyze and modify it to continuously seek optimum efficiency. This innovative approach and associated technologies will be integrated into a full-scale wing tested in a real operational environment on the flying demonstrator.

Major INCAS activities in SFWA ITD

INCAS, as associated member has a large share of activities in all areas of WP1, WP2 and WP3. The major interest from INCAS was to enable participation from lower TRL level of activities (as it is the case in WP1) up to the final validation of technologies at TRL6 in WP3, mainly with respect to BLADE flying demonstrator.



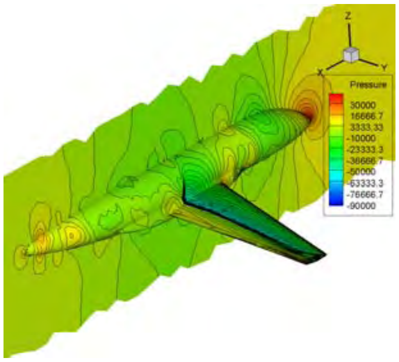
A task force was defined at INCAS able to participate in this very challenging project. All INCAS compartments are expected to be involved in various phases of the project. Starting from 2010 an equivalent number of 89 R&D personnel is fully employed in the SFWA activities.

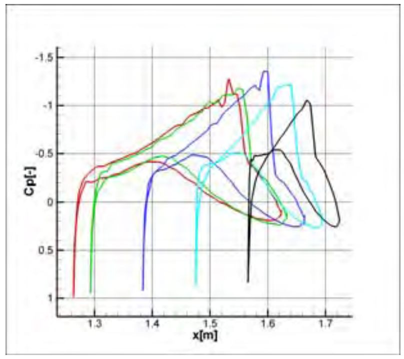
In this phase of the project (2011) INCAS has a direct leadership responsibility in WP 1.3.5 - Ground Demonstration, but the largest involvement is on the activities in WP3.1 and 114.

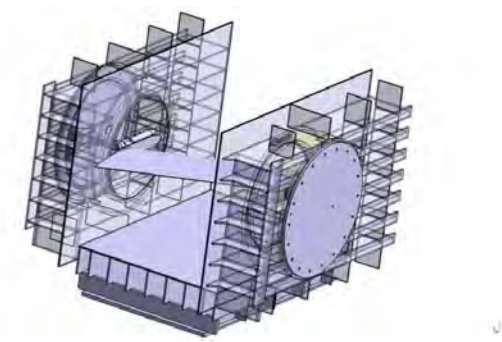
Activities in WP1 are mainly related to lower TRL level. INCAS assumed responsibilities are for those technologies where it has valuable knowledge and experimental capabilities for TRL4. It is the case for WP112 for buffeting control (as a follow-up of UFAST Project activities for synthetic jet actuators usage in SWBLI) and AVERT in WP 114 for high lift systems using oscillatory blowing in the flap. INCAS activities are to be further matured in larger experimental facilities, as it is the case with ONER F1 wind tunnel for the benefit of AIRBUS.

In 2010 various INCAS proposals for the geometry and design of a model to be tested in the INCAS transonic wind tunnel were discussed and analyzed. It was agreed to design and build a half-model with a geometry representative for a bizjet configuration.

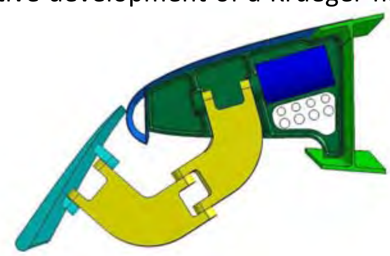
Dassault is the final customer for the global geometry with a 20° sweep, instrumented with SJAs and also unsteady pressure transducers, electronic scanning devices, accelerometers, strain gauges at the half-wing root, means of detecting the BL transition, visualizations etc. A joint activity with SAAB started in WP111 in order to define a laminar geometry to be used for testing in 2012.



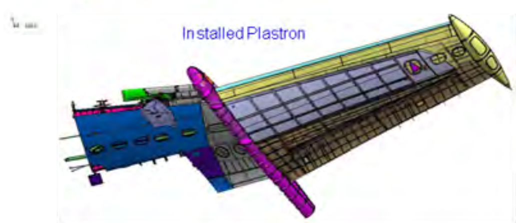




Activities in WP2 are mainly related to ground demonstration phases for innovative solutions, mainly with respect to several specific aircraft concepts. INCAS is involved in both large scale demonstrators for open rotor aircraft for Airbus interest, but mainly in the innovative development of a Krueger flap for a new generation of biz-jet for Dassault.



INCAS has already patented this innovative solution and is currently implementing this solution in a very complex industrial environment. A ground demonstrator made using rapid prototyping technology is available for kinematic testing at INCAS



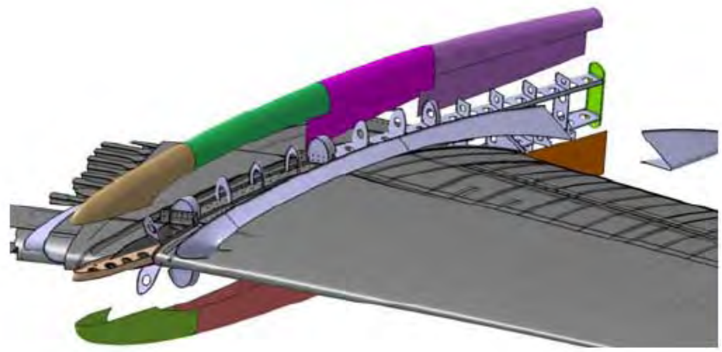
Another area of interest is the full aerodynamic evaluation for the high lift system including the new Krueger flap. This testing phase is foreseen in 2012, using a large scale demonstrator in INCAS Subsonic wind tunnel.

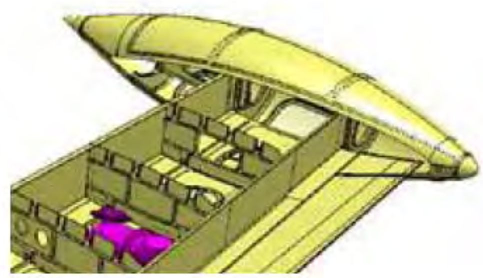
Activities in WP3 In the context of the JTI "CleanSky" SFWA, WP3 aims at testing innovative green technologies for future aircraft in large scale tests under operational conditions. Environmental effects and benefits will be then assessed and balanced on overall aircraft level against technological efforts, risks and different types of cost, to be able to bring to the market a new generation of greener technologies in aeronautics.

Among key technologies to be tested, WP3.1 BLADE (Breakthrough Laminar Aircraft Demonstrator in Europe) is dealing with "Smart Wing" Laminar High Speed Flight Demonstrator, aiming at integrating and validating flow control technologies developed in SFWA WP1.1 and WP2.1. More specifically, this is the FTD (Flight Test Demonstrator) that will validate efficiency, maturity, and robustness of selected technologies at high speed / cruise conditions.

with aim to demonstrate a step change achievements in fuel consumption, structural representativity of industrial processes for laminar wing manufacturing and demonstration of real operability.

For INCAS, activities in WP3 are the most challenging ones, since it involves real flying demonstrators with a very tight schedule for development and certification procedures. INCAS has achieved a special recognition from Airbus to act as design authority in this area, as a recognition of advanced capabilities for design and analysis in place. BLADE demonstrator will be a large Airbus A340-300 aircraft, where outer wings and a pod will be developed so that full test for laminar flow technology will be possible. Current development phase involved INCAS and major industrial partners like SAAB, Airbus and AERNOVA in a collaborative delocated working environment.





INCAS exploitation plans using SFWA ITD

Clean Sky is the type of project where INCAS has the possibility to fully exploit existing expertise and outstanding capabilities in aerospace engineering. Major benefit from this experience are linked to the basic role and mission of the Institute in national industrial environment. INCAS has structured a group of private companies as INCAS - Cluster, including STRAERO S.A. and two major primes, ROMAERO S.A. and AVIOANE Craiova S.A. This cluster has the capability to perform R&D at low TRL level, then to develop ground demonstrators and finally to demonstrate on large scale flying demonstrators innovative technologies. Clean Sky gives the possibility to the industry to reintegrate at prime level in aeronautics.

Also INCAS already patented several technologies with huge potential in respect to green technologies to be used in the new generation of aircrafts in 20 years from now. This enables a solid strategy for industrial technological transfer, at highest level (Airbus and Dassault).

Since this is an on-going project for another 5 years, with a future extension in a Clean Sky 2, INCAS is in a very good position for making the right strategy and ling term planning with respect to a high tech domain. Human resources policy and infrastructure technological development are the key areas for massive actions.