IAR-XT/New Generation

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Abstract: *The program IAR 99 SOIM was start in 1991 as an integral Romanian program for aviation in witch 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.*
This development team was established according to the trends and the development directions identified and stated by the official European documents of E.C-ACARE and EREA.

Key Words: *modernize airplane, Airborne Radar, air patrolling.*

Abbreviations:

ACARE	*Advisory Council for Aeronautics Research in Europe*
Aft	*After*
ATA	*Air Transport Association*
COTS	*Commercial Off - The Shelf*
EREA	*Association of European Research Establishments in Aeronautics*
FLIR	*Forward Looking Infrared Radar*
Fwd	*Forward*
GPS	*Global Positioning System*
HOTAS	*Hands-On Throttle-And-Stick*
INS	*Inertial Navigation System*
IR	*Infrared*
MFCD	*Multi Function Color Display*
MFD	*Multi Function Display*
MMRC	*Modular Multi Role Computer*
R&D	*Research & Development*

1. INTRODUCTION

In the year 1996 a program in order to modernize the systems of IAR 99 SOIM was started. The specialists of INCAS work now in this new program of development named IAR-XT/NEW GENERATION in order to modernize the IAR 99 SOIM airplane and to offer others possibilities of using and developed this Romanian product. The program will assure:

- 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.

2. DESCRIPTION

The program IAR 99 SOIM was start in 1991 as an integral Romanian program for aviation in which the specialists from National Institute for Aviation Bucharest (INCAS) have 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 series.

In his evolution he was highly appreciate by the Romanian and foreign pilots. In time the necessity of technological development and the idea to raise the reliability of this airplane has imposed an upgrade of the equipment and systems.

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 occurred 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.

3. AIRCRAFT UPGRADE

The specialists of INCAS are involved now in a new program of aircraft upgrade named IAR-XT/NEW GENERATION in order to modernize IAR 99 SOIM and to offer others possibilities of using and developed of this Romanian product.

One main objective is to use this aircraft for Air Police missions. The Air Police activities are dedicated to protect the national airspace through patrolling and to act with specific armament against a designated enemy in order to maintain the Air Space Control, into the Romania and NATO Airspace boarders.

The specific tasks in these missions are:

- the participation at the general activities for protection of European Union and country borders by air patrolling;
- to survey and control in short time large areas on land and see and monitor efficiently the borderlines and other country limits;
- to participate at the positive identification, tracking and survey of the flight evolution for an aircraft nominate by an agency with the authority and responsibility in this area;
- to detect illegal entities from crossing the borders between the ports and border control points of entry on ground and on air;
- to provide well documented alerts in order to be used for an optimal deployment and usage of the different human and technical resources;
- to send specific data, communications and messages about possible targets in operational combined missions in ground and coastal maritime borders survey.

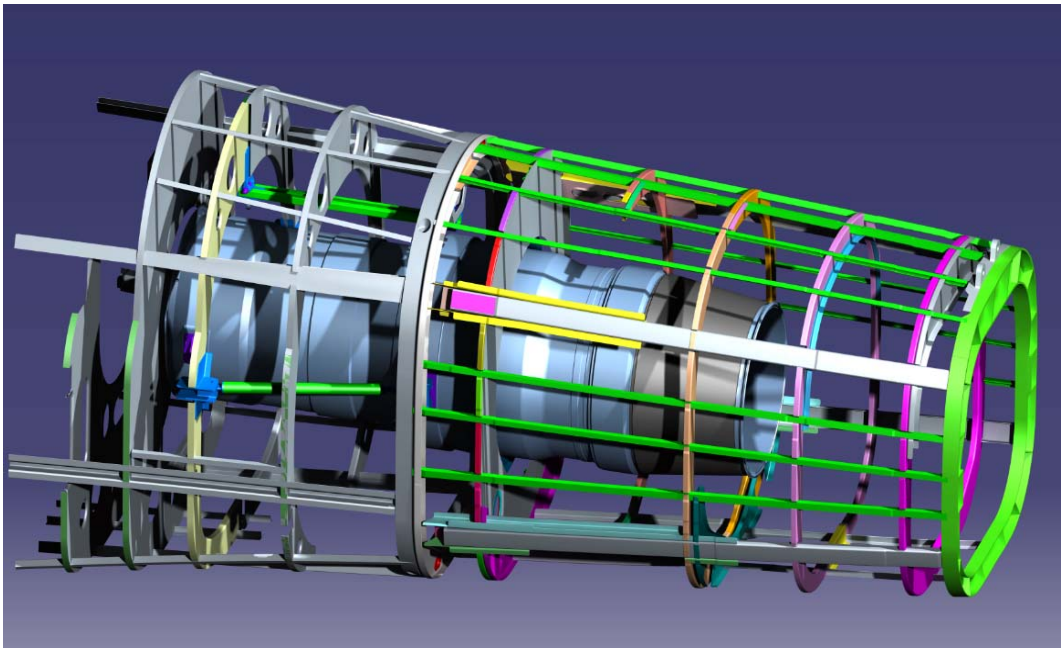
The new program will assure too:

- new capabilities for this aircraft;
- important economy of fuel and resources;
- 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 and 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 and according to those modifications better performances will be obtained.

Rolls Royce VIPER 680-43 Engine



Engine Installation in Fuselage

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% and 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 in this program is to prepare the aircraft for the Air Police Missions.

IAR-XT Air Police Missions

IAR-XT equipped with missiles

The main target of the program for the Avionic System is to equip the aircraft with capability in order to sustain in good condition the missions for surveillance of the territory, data communications with terrestrial entities and to be equipped in order to cooperate with others forces involved in border control.

The aircraft architecture is the conceptual model that defines the structure, and more views of systems partition. An architecture description is a formal description and representation of the aircraft, organized in a way that supports reasoning about the aircraft content which comprises structure, systems and internal arrangement.

The architecture will follow the numbering imposed by the ATA 100 and ATA 2200 specifications. This means that is a common referencing standard for all aircraft. The ATA numbering system is organized as hierarchical number space covering the entire aircraft. The basic four digit number format provides a unique address for each ATA chapter/sub-chapter.

The project major objectives are to define an avionics systems architecture, to select, choose and provide the equipment for a demonstrator aircraft.

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

- Airborne Radar installation;
- a more accurate GPS – INS System installation;
- a new container containing video and infra-red cameras installation;

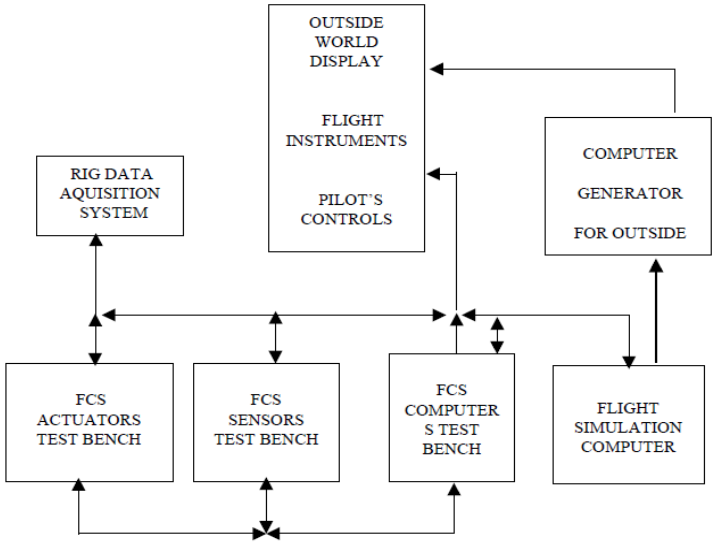
This new configuration will conduct to a modification of the data – link used in the past for virtual radar communication and the conversion for this transmission in real- time of the data obtained from the radar and other sensors to a terrestrial station.

The new avionics architecture will impose a new electrical primary distribution on the buses and also a new secondary distribution of loads and the review of The Electrical Load Profile (ELA).

The cockpit and panels configuration will be modified according with the new systems architecture.

In order to short the time to develop such a complex program some simulation techniques must be used. The aerodynamic models have a measure of uncertainty at this stage of the process and so each are represented by a nominal model together with a series of tolerances, which define the level of uncertainty of the particular aerodynamic coefficients. After having completed the initial design of the control laws using previous data, the full

aerodynamic models are installed on the flight simulator for evaluation by pilots and engineers. Clearly, the simulation models must be validated against the design models to ensure correct implementation onto the simulator, which may have its own set of time delays.



System Architecture for Test Rig and Simulation

Flight simulators are electronic representations of flying an airplane by replicating a generic cockpit. The principal task of flight simulation is to model the dynamic behavior of the flight vehicle - no matter whether an existing type or of a generic model. To achieve this goal, a simulator consists of different components. The first part is a model of the system simulated, in principal a mathematical description of an aircraft and its environment modeled as precisely as is necessary. The second element is the device through which the model is implemented. Today, this is obtained via a digital computer, running an operating system suitable for real-time operations used for deriving states from the aircraft model and its environment.

In order for this experiment to be effective, all the sensory inputs must be correctly timed and accurate, otherwise even the smallest of errors could break the illusion, causing confusion and thus preventing the required reflex pilot action. Consequently, sensory input cues must be catered for, specifically audio, motion and visual stimulus.

The core element of all simulation is held within the software code based inside the computers network.

The most significant area of software will be the part used to calculate the aircraft flight dynamics and the part to simulate the environment and malfunctions.

The generic simulator will be an extremely useful tool for the configuration of the avionics architecture, for new components integration and a capability to demonstrate the performance of the new equipments and capabilities of the plane.

Other concept will be the use of an **Advanced Avionics Concept Demonstrator** (AACD), a second step in the simulation who provide the use of the proposed new avionics capabilities on a real aircraft by combining the real avionics devices and simulation facilities. The AACD is connected to the real aircraft on the ground with operating real avionics. Pilot will seat in the cockpit and work with booth the real avionics and simulated sensors.

The simulation facilities will include PC computers (laptops) providing simulation and image of the advanced sensors (like radar, IR cameras, etc.). The generated images will be shown to the pilot on the real cockpit displays MFD and MFCD.

Pilot will control the simulated advanced avionics sensors by HOTAS from the cockpit. For this provision, the HOTAS signals that are coming to the avionics computer MMRC will monitored by the AACD. Some few changes should be done in A/C avionics wiring for AACD connection

The AACD will be designed for the following major tasks provision:

i) Development of operational concept

ii) Evaluation of the required performance

iii) Demonstration of proposed system configuration

The advanced simulation of radar and FLIR will be based on the former experience in simulation of the avionics sensors. The models will include also the video generation capabilities for presentation of the radar and FLIR pictures to the pilot on real avionics displays. The AACD development can be continued and extended in next stages of the project. This technique with the use of the two types of simulators using COTS components before implementation of new avionics on real avionics computer will be a very cost effective stage and will provide the possibility to early evaluation of the utility of the new avionics concepts.

The use of two stages of simulation for the demonstrator will conduct to important economies and to cover a considerable numbers of experiment for this project, regarding the capabilities of the aircraft, the possibilities to use radar and others new elements and to permit to the pilot to be better trained for a flight with this demonstrator.

4. CONCLUSIONS

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.

The hydraulic item for Fwd Landing Gear give the possibility on the ground to actuate the rudder and the steering of wheel accordingly with the pilot command.

The shocks and vibrations can appear during the landing runway due to the hydraulic shock absorbers with a single chamber. This impose theirs replacement with the shock absorbers with two chambers.

To prepare the airplane for all these modifications and in order to rise the resources of the structure, 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.

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