Basic Flight Simulator for MiG-21

1. INTRODUCTION

The Basic Flight Simulator for MiG 21 MF aircraft (BFS-M21) is a low cost training tool developed in 1998 and put into service with he Slovak Air Force in 1999. The product has been sold under the name "MiG-21 Smart Target". It has been connected to an internal DIS simulation network of the Slovak Air Force Training Centre as a dog-fighting simulator to train air combat with a full-mission simulator for MiG-29 and an advanced flight simulator for Su-25.

The BFS-M21 can be manufactured either using a cabin and instruments of the old simulator or using a cabin and instruments from a real aircraft put out of service.

The cockpit and instruments from KTS-4 Russian old-fashioned simulator were used to manufacture BFS-M21 simulator. The cockpit has been modified so that it met the needs for installation of new cables and electronic blocks necessary to control the instruments and monitoring controls in the pilot's cabin. All the blocks and instruments have been modified for a new method of control and monitoring.

The virtual reality environment is generated using graphic computer and image generation software by Thales Training and Simulation. This environment is projected onto a spherical half-transparent mirror of a collimator providing a field of view 45 °x 30 °to the pilot.

This version for the Slovak Air Force exceeds the basic flight simulation category. Especially the mathematical models of the most important systems are highly accurate, and the weapon system and the radar related systems work like a full-mission category. All weapons and radar controls are highly accurate similar to that in a real aircraft.

Certainly, it is also available in the advanced network version for any user as a combat simulator to train combat tactics and interoperability. Because of modularity of individual components, it is easy to upgrade BFS-M21 to an Advanced Flight Simulator.

2. USE

The BFS-M21 simulator covers the basic set of tasks for combats and flight preparation of pilots of MiG-21 aircrafts. It can operate in several modes in which it truly simulates operations and functions of a MiG-21 real aircraft.

Many different Air-to-Air and Air-to-Ground training scenarios are implemented including training of a basic set of emergency procedures during the flight. Virtual air and ground targets are available via DIS connection. Basic weather and visibility conditions are also included.

In principle, the system the goal of which is to configure, monitor, evaluate and record the task being trained is of prime importance.

The BFS-M21 simulator is a visual simulator, which displays surrounding environment and objects in it with high accuracy. Although the collimator provides only a limited field of view, an experienced image depth originating during image collimation compensates this drawback.

So the pilot can solve the task using a view from the cabin, as well. This way, the system substantially approaches the real conditions.

The weapon and aiming systems in this version operate in the same way as those in a real aircraft.

The instructor's station is a very important part of the simulator. The instructor can follow the task being practiced; interactively change some parameters (special cases during flight).

Individual computers of the simulator are interconnected via data lines because of a standard modularity and mutual communication.

The networking software used is compatible with DIS protocol. The Slovak advanced version of BFS-M21 works connected with the full-mission simulator for MiG-29 and the advanced flight simulator for Su-25 at the Sliač Air Base of the Slovak Air Force. This is the first virtual air-to-ground training environment of the former eastern block ever created.

The simulator is ready for a simple upgrade to a higher category simulator.

3. TECHNICAL PARAMETERS

- Projection using a collimator displaying in true colours
  - Pilot's horizontal angle of view: 45°
  - Pilot's vertical angle of view: 30°
- Real fixed base type cockpit (made from KTS-4 or from the original cockpit of MiG-21)
  - Equipped with instruments, indicators and controls, a rudder lever and a seat of a real aircraft

- The mock-up of the cockpit contains a full set of instruments with real operation
- Basic set of the buttons and switches needed to fulfil the extended basic training mission has real functions
- The control equipment (throttles and sticks) as well as pedals work like those in a real aircraft, but the feedback forces are provided only by metal springs
- The seat is identical with that in a real aircraft and provided with real belts
- The audio equipment integrated inside the cockpit provides the following sounds: engine and alarm signals, landing gear retraction sounds, flaps
- The audio system is also used for communication between the trainee and the instructor

- Computers
  - Industrial computer for cockpit data collection and management
  - Image generating computer for virtual reality graphic generation
  - Computer for the instructor's operating station
  - Host computer

- **Application Software:**
  - **Image generation software** is used to generate 1 full-coloured image of virtual reality environment in high-resolution 3D graphic
  - **Mathematic simulation software** provides a real time flight model of the aircraft
  - **Navigation software generates** navigation data, which is generated on relevant instruments in the cockpit (navigation systems of close navigation, a radio skylight turret, systems of far navigation)
  - **Weapon system management** includes complete ballistics of fire, provides inputs for aiming and fire, simulates cannons, and missiles. The system cooperates with visualization and audio systems to simulate by-effects associated with fire -explosions, smoke, trajectory, sounds, etc.
  - **Network operation including DIS** manages all data operation in an internal and an optional external network
  - **The virtual terrain** for an air-to-ground training includes 2 airports, buildings at the airport, hills, rivers, roads, navigation objects, radio-electronic and 3D visualization and navigation objects
  - **Optional real terrain** created from imported real digital terrain data delivered by the customer
  - **Database of 3D graphic objects** includes all flying and/or moving or stationary targets, enemy or allied forces represented in virtual environment
  - **Software for cockpit equipment control and testing** is used for cockpit data collection and management
  - **Software package for the instructor's operating station (PRCIN)** provides a set of tools for management of the whole simulation process

- **Instructor's Operating Station - PRCIN**
  - Easy-to-use user-friendly interface operated by a mouse click to control operation of the simulator

- Display of cockpit instruments for the instructor to monitor the actual condition of the instruments, indicators and controls in the cabin
- Scenario set-up (the running scenario can also be changed)
- Flight conditions set-up including the basic emergency procedures
- Records of the tasks that the pilot trains and recording, evaluating and searching them for mistakes that the pilot did during the flight
- Debriefing system used for a formal evaluation of each exercise
- The pilot's communication with the instructor
- DIS module for tactical training

4. FUNCTIONS

Basic Features:

- Realistic mock-up of the cockpit with completely realistic instruments
- Flight control equipment with basic feedback forces given by metal springs
- Dynamic mathematic model of MiG-21 aircraft
- Weapon systems simulation including full ballistics
- Aiming system simulation
- Simulation of navigation and intercommunication systems
- Instructor's operating station with full control of training possibilities
- Powerful graphic system providing the virtual reality environment
- Collimated display system
- Modular architecture makes it possible for future upgrade and addition of further functions
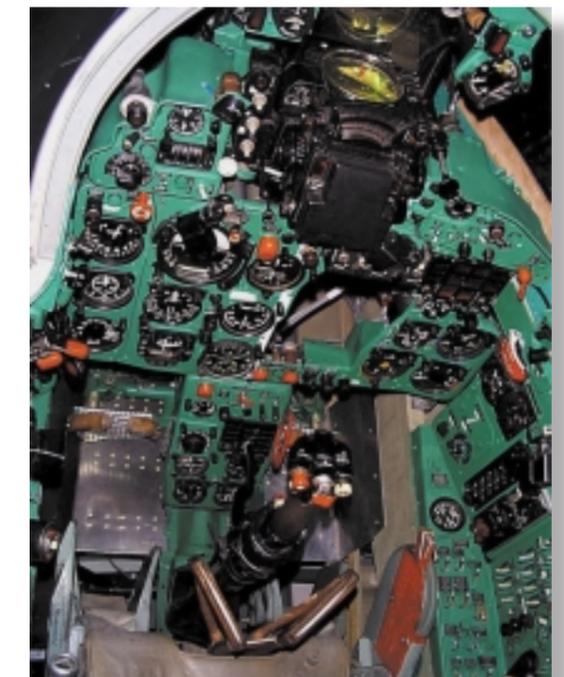
MiG-21

BFS-M21

Mission:
- To provide a training tool for the pilots of MiG-21 aircrafts
- To train basic flight technique
- To train navigation flights
- To train group flying
- To train attacks onto ground or airborne targets
- To train manoeuvring airborne combat
- To create a new opportunity for interactive training of combat tactics
- To prepare a condition for future exercises in a simulation network (interoperability)
- To simulate special cases during flight with an option to control the pilot's activity by the instructor
- To change the flight conditions:
  - Daytime
  - Visibility
  - Clouds
- To set the weapon configuration
- Visualisation of special effects: explosion, condensation lines and smoke

Classification:
- The product is compatible with the visual simulation category
- The product has a technological capability for future unification to a simulation network

Conditions for Use:
- This product is designed for use in out-of-battlefield conditions
- Use in the same operating conditions as the most modern computer technology

5. BUILDING PREPARATION

A raised floor and an air-conditioning system are required. The building renovation is not required. The customer needs to find an appropriate room and prepare it. Project documentation is available as a part of contract documentation. Construction work can be either done by the customer or provided by VRM.

6. POWER SUPPLIES AND REQUIREMENTS FOR OPERATION

BFS-M21 uses modern low consumption power supplies. The following supply voltages are used for the simulator: 3 x 380V, 50Hz (supply for the cabin) and 220V, 50Hz (supply for the computers and the collimator).

Storage temperature is +5 to +35 °C, operating temperature is +18 to 24 °C. Air humidity is from 30 to 80%. It is crucial to place the system into an air-conditioned room to ensure required parameters.

7. DELIVERY DATE

The average production time is 12 months starting from signing a contract. The last month includes factory acceptance tests. Next 1 month is reserved for transportation, on-site installation and on-site acceptance tests and additional two weeks for training of the customer. Total average delivery time is 13 months and 2 weeks.

QUALITY AND SATISFACTION

sales representative

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