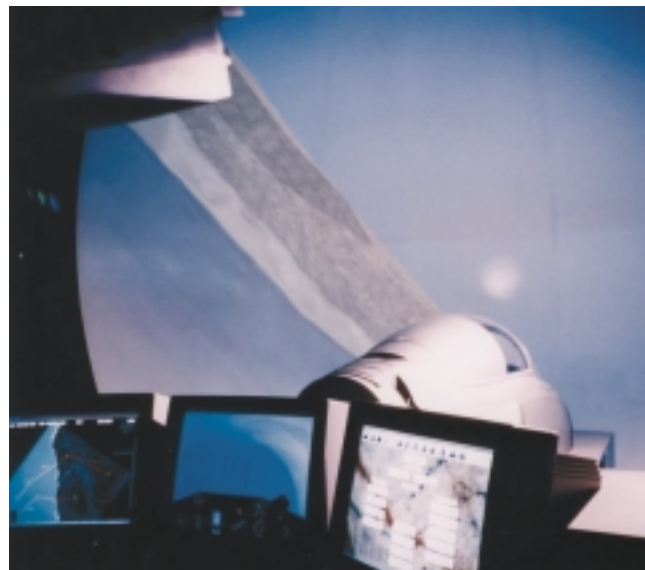


# Full-Mission Simulator for MiG-29

## 1. INTRODUCTION

VRM FMS-M29 Simulator can be manufactured basically in two ways, either as a quite new system or as a complete upgrade of the older Russian KTS-21 simulator or cabin of MiG-29 aircraft. Taking the price of the cabin, instrumentation, simulator building and other aspects into account, such design is more convenient for the customer. Only the cockpit and complete instrumentation are used from the original simulator. The instruments in the cabin have been modified and a system for their control, which is a part of the cabin, has been developed. All the other devices of the original simulator have been replaced with an up-to-date simulation technology. The display system has been modified substantially, in which a single-channel collimator has been replaced with a high-power 6-channel projection system. This system can display virtual environment onto a spherical screen within the range 180° horizontally and 90° vertically. The simulator is of a fixed base type. The system contains a helmet mounted aiming device and a real HUD, because of a real combat use. That is why the projection system is big enough and its placement onto a moving platform would not ensure real simulation of acceleration and overload of MiG-29. Originally, this product was developed for the needs of the Slovak Air Force and was put into service with the Slovak Army in 1997 using the name LTV-29 or FSM-29. For this simulator, VRM has offered an optional vibration platform since 1999 or better simulation of overload and vibration.



## 2. USE

The FMS-M29 simulator covers a whole complex of combat and flight training for pilots of MiG-29 aircrafts. It can operate in several modes, in which it truly imitates operations and functions of a real MiG-29 aircraft. In principle, the goal of the system of which is to configure, monitor, evaluate and record the task being trained is of prime importance. The FMS-M29 simulator is a visual

simulator, which displays surrounding environment and objects in it with high accuracy. Contrary to lower types of simulators, the pilot can also solve the task using a view from the cabin, which was not possible previously. Thus the system approaches real conditions substantially.

The system of SAU-29 flight aiming device is closely linked with the displayed environment and the objects in it. The pilot aims at and detects airborne and ground targets in the same way as in a real aircraft.

The instructor's station, designed as an independent subsystem working in several modes as an independent flight simulator, is a very important part of the simulator. The instructor can follow the task being practiced, interactively change some parameters (special cases during flight) or actively enter into the task using his own controls functionally equal to those in the cabin.

The goal of the projection system is to display computer-generated environment onto a spherical surface in the centre of which there is a cabin with the pilot there. The projection system consists of 6 high-power projectors, which can display a compact image with high resolution and in true colours on a spherical screen.

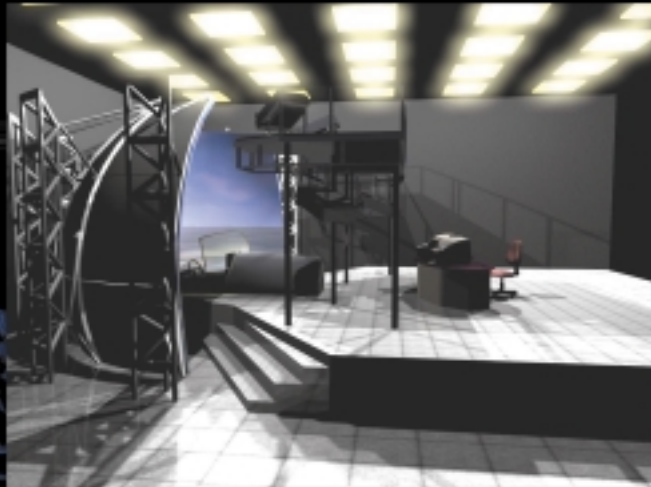
## 3. TECHNICAL PARAMETERS

- Projection with 6 projectors onto a Half-Dome type spherical screen, 3.6 m in diameter
  - Pilot's horizontal angle of view: 180°
  - Pilot's vertical angle of view: 90°
- Real fixed base type cockpit, optionally with a vibrating platform (made of KTS-21 or a real aircraft cockpit and instruments)
  - The mock-up of the cockpit contains a full set of instruments with real operation
  - All the buttons and switches that should operate during the training checks and procedures have real functions
  - The controls (throttles and sticks) and pedals, as well, are fully operational and look like the ones in a real aircraft
  - Control loading system
  - The seat is identical with that in a real aircraft and provided with real belts
  - G-suit or pressure trousers or high fidelity of pilot's feelings working with a dynamic valve system and compressed air (G-force simulation)
  - The audio equipment integrated inside the cockpit provides the following sounds: engine and alarm signals, landing gear retraction sounds and flaps
  - The audio system is also used for communication between the trainee and the instructor in the same way as between the pilot and the ATC tower, or communication with the homing system operator
  - Optional vibrating platform to improve simulation



- Computers
  - Set of industrial computers for cockpit data collection and management
  - Image generator - a graphic computer for generation of 6 channels of 3D graphic
  - Host computer or hosting the real time simulation software
  - Set of computers or the instructor's operating station
- Application Software:
  - **Image generation software** is used to simultaneously generate 6 full-coloured images 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, missiles and bombs. 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 (size of about 150 x 120 km)

- **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
  - **Software for simulation of data received from PANDA** post flight-debriefing system, which is used to display and simulate the data from a flight data recorder of a real aircraft on the screen, instruments and controls
- **Instructor's Operating Station - PRCIN**
    - Easy-to-use user-friendly interface operated by a mouse click to control operation of the simulator
    - Schematic 2D flight maps of the operational space, to monitor an actual condition in the scene on a map
    - Display of cockpit instruments for the instructor to monitor the actual condition of the instruments, indicators and controls in the cabin
    - Pilot database
    - Scenario set-up (the running scenario can also be changed)
    - Flight conditions set-up (weather conditions - clouds, height and thickness, day and night time, fog, etc.)
    - Records of the tasks that the pilot trains and recording, evaluating and searching them for mistakes that the pilot did during the flight
    - Emergency procedures, such as an engine failure, low battery, high/low pressure, fire on board, etc.
    - Debriefing system used for a formal evaluation of each exercise with all data of scenario, type of mission and progress of the exercise
    - The pilot's communication with the instructor - the instructor can simulate a control tower or the other pilot in the cabin
    - 2 in 1 solution or the instructor's station, which switches the PRCIN into a simulation mode and is used to:
      - Present the exercise being trained to the trainee from the instructor's place
      - Train group flying and tactical training together with the trainee
      - Simulate the trainee an interactive target, which is controlled by the instructor
      - Fight against each other using the instructor's simple weapon system
    - Integrated module simple CGF (Computer Generated Forces) with an upgraded option
    - DIS module for tactical training



## FMS-M29



#### 4. FUNCTIONS

##### Basic Features:

- Realistic mock-up of the cockpit with completely realistic instruments simulating all functions
- Real forces are fed into the flight control equipment (sticks and throttles) by the control loading system
- Dynamic mathematic model of MiG-29 aircraft for simulation of all subassemblies of MiG-29
- Weapon systems simulation including full ballistics
- SAU-29 aiming system simulation with fully functional helmet mounted aiming device and real HUD
- Simulation of navigation and intercommunication systems
- Instructor's operating station with full control of training possibilities
- Powerful graphic system providing the virtual reality environment
- High-resolution display system
- Modular architecture makes it possible for future upgrade and addition of further functions
- Simulation can be used for a post flight debriefing system of a real aircraft

##### Mission:

- To provide a training tool for the pilots of MiG-29 aircraft
- To train basic and advanced piloting 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
  - Wind speed and direction
  - Temperature and pressure near the ground
  - Fuel quantity setting
- To set the weapon configuration

##### Classification:

- The product is compatible with the visual full-mission 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, an air-conditioning system and optimum renovations are required from KTS-21 customers. More construction work is required from new customers. In any case, 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

FMS-M29 uses modern low consumption power supplies. Total consumption is max.52 kVA. 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 2 months are 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 14 months and 2 weeks.

#### QUALITY AND SATISFACTION

sales representative



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VRM Hungaria Kft., Budapest, Hungary  
VRM Inc., Pensacola, Florida, USA