T-72/ATGM “FAGOT”
Force-On-Force Simulator

Simulator main characteristics

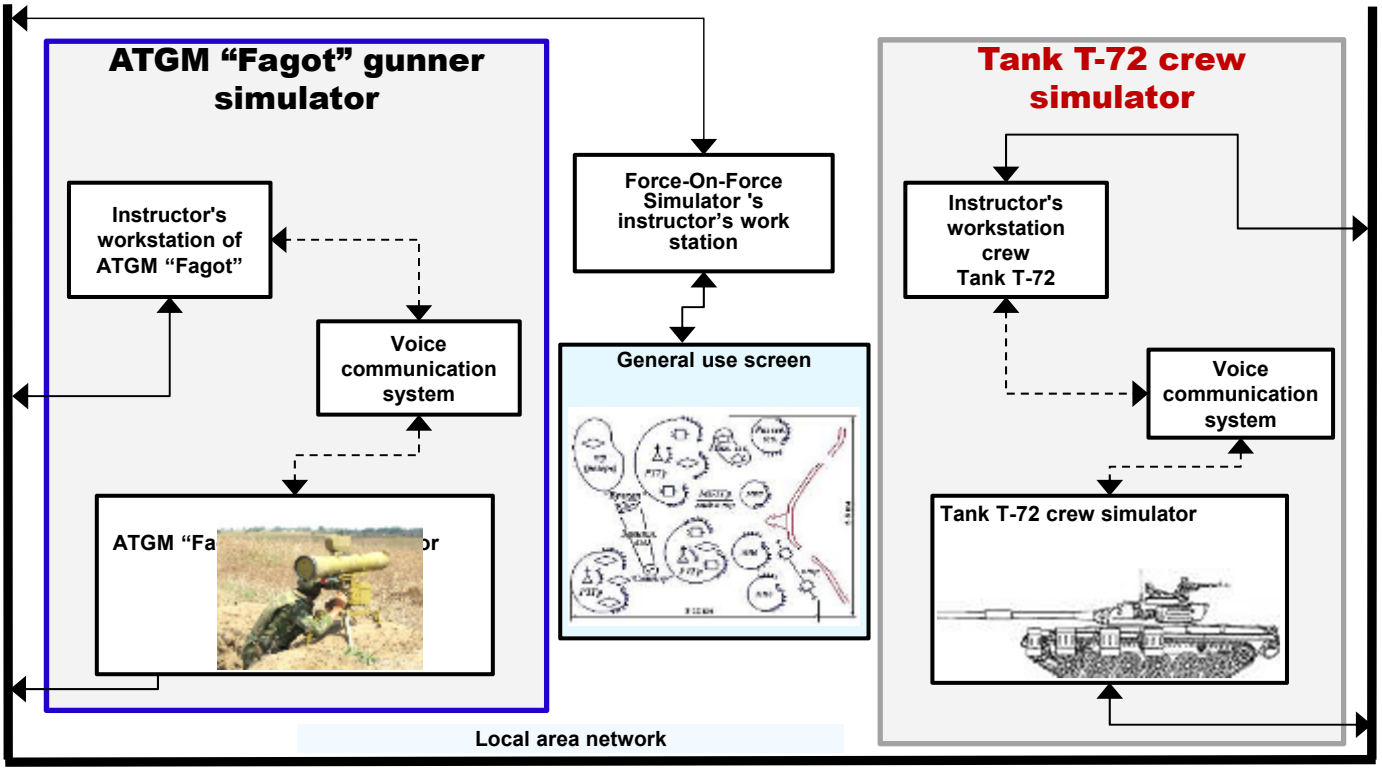
- Constructive adequacy of the tank crew vs ATGM gunner simulator
- Simulators functional adequacy
- High level of visualisation
- 3D models of firing range, tank driving range, and tactical field
- 6DOF dynamic platforms
- Full range of exercises from Driving and Gunnery Curse
- Wide range of conditions of training events and training sessions
- Objective evaluation of trainee’s results
- Results documenting

Simulator's purpose and composition

T-72 (T-72Б, T-72A, T-72M1, T-72C) tank crew training to fight an enemy equipped with ATGM weapon systems “Fagot’, “Konkurs-M”, “Kornet-E” type

Simulator's composition

1. T-72 tank crew simulator. Instructor’s work station of tank crew simulator
2. Antitank weapons system ‘Fagot’ gunner's simulator. Instructor’s work station of ATGM gunner’s simulator
3. Instructor's work station of Force-On-Force Simulator



Simulator's capability

a) tank commander's and gunner's individual training
b) tank driver's individual training
c) ATGM gunner's individual training
d) tank crews collective training
e) ATGM gunner's individual training (anti-armour platoon gunners collective training with use of additional simulators)
f) Tank crews collective training in fighting against ATGM units under various tactical conditions

Simulator's technical characteristics

№	Characteristics		Measuring unit	Characteristic's value
1	Number of simultaneously trained trainees Military specialists		---	4 1) driver 2) gunner 3) tank commander 4) ATGM "Fagot" gunner
2	Minimal clss room area		$м^2$	40
3	Simulator warm-up time after switching-on		minute	up to 5
4	Continuous work time		hours	at least 12
5	Electric power supply	voltage	V	220±10%
		frequency	Hz	50±1
6	Maximum power consumption		kW	18
7	Operating temperature range		C^o	from +5 to +40
8	Simulator's diagnostic system		---	Built-in semi-automatic
9	3D driving range model dimensions		km	2x4
10	3D firing range model dimensions		km	2x4
11	Tactical field dimensions		km	5x5
12	Quantity of types of terrain		---	3 (plane, deserted, mountainous)
13	Assessment of actions of trainees and documenting		---	Automated, in compliance with Driving and Gunnery Course requirements
14	Development of tactical scenario capability		---	With use of in-built editor
15	Exercise terms and conditions		---	Day, night, winter, summer, sunder storm, fog, varies optical visibility range, ambient environment temperature range from - 20 C^oup to +50 C^o
16	Tank equipment faults and failures injection capability		---	realised
17	error-free running time		hours	at least 1000
18	Specified lifetime		years	at least 8
19	Warranty period		years	3

Simulator general view

Instructor’s work station of tank crew simulator

Functional capabilities
- Selection of training scenario
- Selection of pre-set exercise from the simulator's library
- Development of new exercise terms and conditions
- Trainee’s action supervision
- Diagnostic of simulator's technical status

Instructor assistance

Simulator switching on/off

Training results printing

Instructor's workstation

Exercise performance evaluation

Injection of equipment of simulated tank and ATGM faults and failures

Modes selection
- Initial data
- Training
- Ground situation editor
- Training results

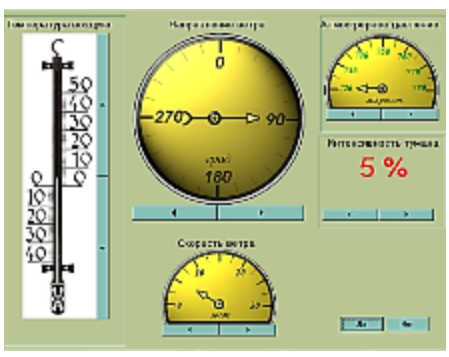
Training period results data base development

General view of Instructor’s work station

External controllable camera view display at the Instructor’s work station

Monitor of current controls status in driving compartment

Meteorological conditions setting menu



Tank Driving Compartment Cabin

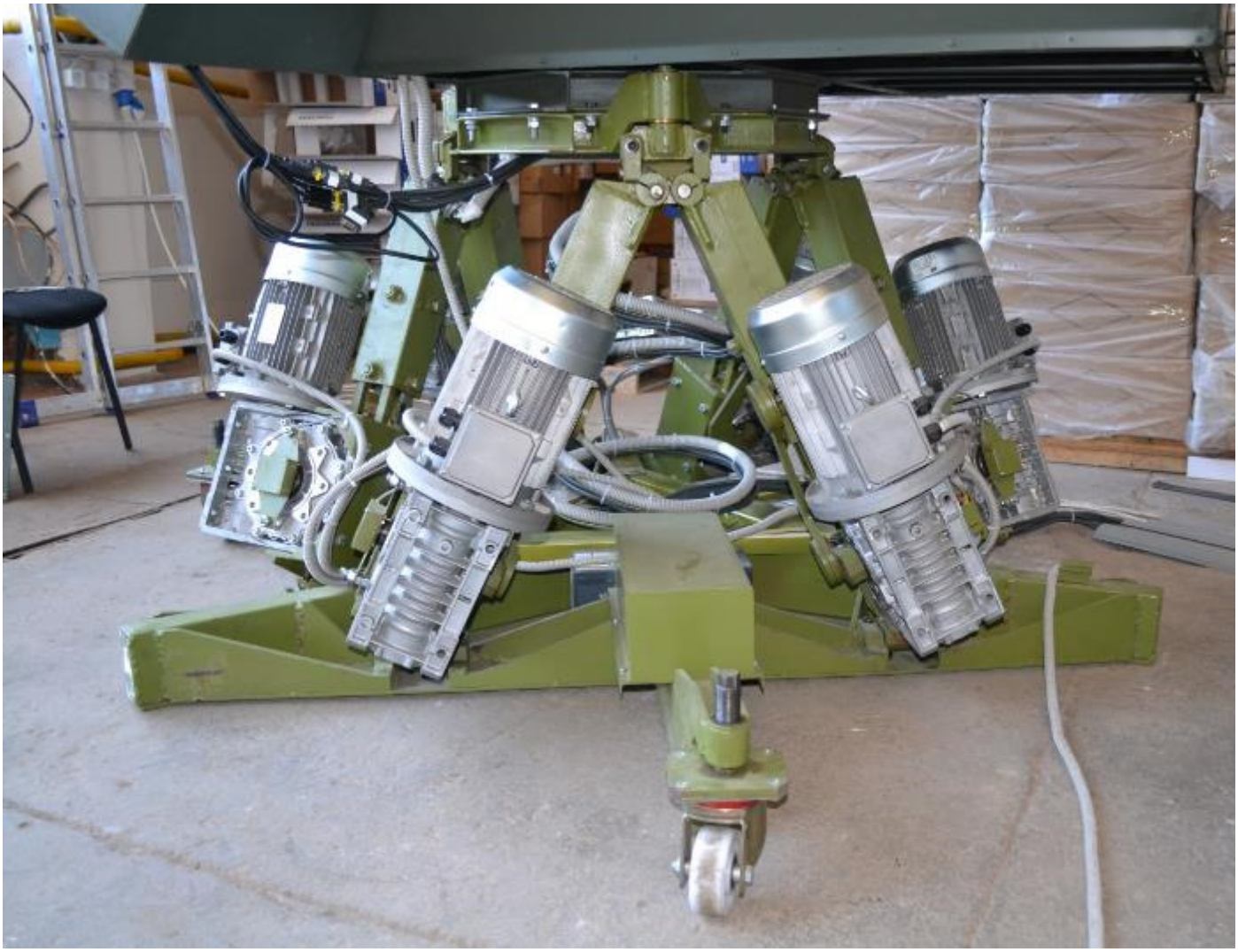
- constructively, simulator fully corresponding to driving compartment of real tank
- equipped with full set of controls and indicating means
- mounted on 6DOF dynamic platform, providing inclination characteristics of moving tank
- provides occupation of driver's work seat through the hatch or opening

Driving compartment mock-up composition

№	Title	Quantity pcs.
1	*The Simulator of Driving compartment*	1
2	*Controls and indicating means mock-ups, set*	1
	TNPO-168 observation device	1
	TVNE-4B night vision device power box	1
	Instruments panel	1
	Compressed air cylinder	2
	Hand fuel supply pump	1
	Fuel supply pedal	1
	Turning operating lever	2
	clutch pedal	1
	Throttle Pedal	1
	Gear shift lever	1
	parking brake	1
	Jalousie drive handle	1
	Fuel distributing cock	1
3	*Equipment, set*	1
	Combat vehicle crewman communications helmet	1
	Driver’s seat	1
	Interior lamp	1
	Fan	1
	Audio system	1

Dynamic platform

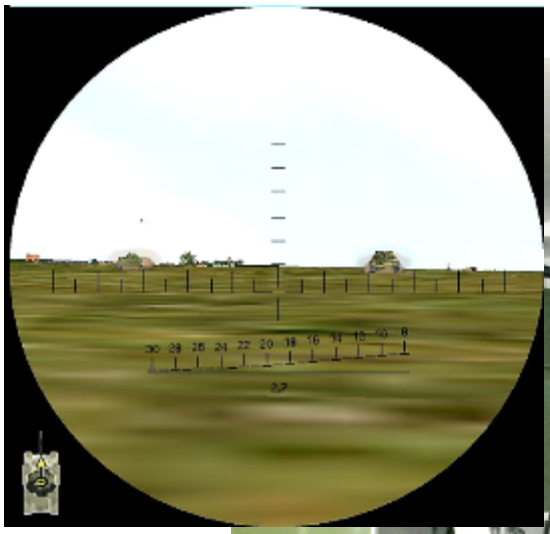
6DOF dynamic platform provides inclinations of tank hull during movement with respect to terrain features, as well as accelerating effects when breakaway, speeding up, deceleration, and turning



Parameter	Value
Driving motors type	Non-synchronous with short-circuited rotor
Driving motor control	Frequency-response according to speed and position
Pitch angle	+/- 20 degrees
Roll angle	+/- 20 degrees
Heave	+/- 100 mm
Yaw angle	+/- 30 degrees
Surge	+/- 300 mm
Sway	+/- 300 mm
Angular velocity of displacement along the axis	0-20 degrees/s
Accuracy of control signals tracking	<0,2 angular degrees
	<<10 mm by position
Power consumption (average)	12 kW

Tank fighting compartment mock-up

T-72 fighting compartment mock-up



Fighting compartment mock-up composition

№	description	Quantity pcs.
1	**Fighting compartment mock-up**	
2	**Controls and instruments mock-ups, optical observation and aiming devices mock-ups, indicating means mock-ups, set, including**	**1**
	1A40-1 sighting system with stabilizer command console	1
	1K13-32 sight-aiming device (or night sight TPN3-49)	1
	Distribution box left	1
	Autoloader control box	1
	KA-1C block	1
	Control panel of Smoke grenade launch system	1
	Hand wheel of gun lifting mechanism	1
	Hand wheel of turret traversing mechanism	1
	Turret stopper	1
	Rounds of ammunition quantity indicator	1
	Azimuth pointer	1
	Breech assembly with breech block wedge handle	1
	Commander's observation device TKN-3B	1
	Autoloader command console	1
	Distribution box right	1
	Adjustments potentiometer	1
	R-123 (full-scale mock-ups) radio station	1
	Intercommunication system box	1
	PKT machine gun receiver	1
2	**Equipment, set, including**	**1**
	Headset with breastplate switch	2
	Commander seat	1
	Gunner seat	1
	doom interior light	2
	Fan	2

Tank crew simulator's functional adequacy

Tank mathematical models
provides

- adequacy of functional algorithms of equipment and systems mock-ups, tank controls in organic and emergency modes, as well as simulator's reaction on trainee's controlling actions
- adequacy of tank movement over relief features with respect to route conditions, type of ground and surface characteristics
- tank hull inclination adequacy when delivering gun fire
- inclinations and acceleration effects of tank during movement, overcoming obstacles, speeding up, deceleration, and turning
- correct considering of gun wear effect, the type of ammunition, wind speed and direction, air pressure, air and charge temperature on shells and bullets firing range
- surveillance with use of optical and electro-optical devices
- imitation of firing with use of all types of ammunition with respect to optical visibility range, obscuration of field of vision of optical devices
- adequacy of aerial and ground targets angular dimensions, painting, character and parameters of movement, impact or missing effects registering when gun and machine-gun firing
- taking into account terrain conditions, time of year, or day, air temperature, and its influence on tank systems and equipment operations

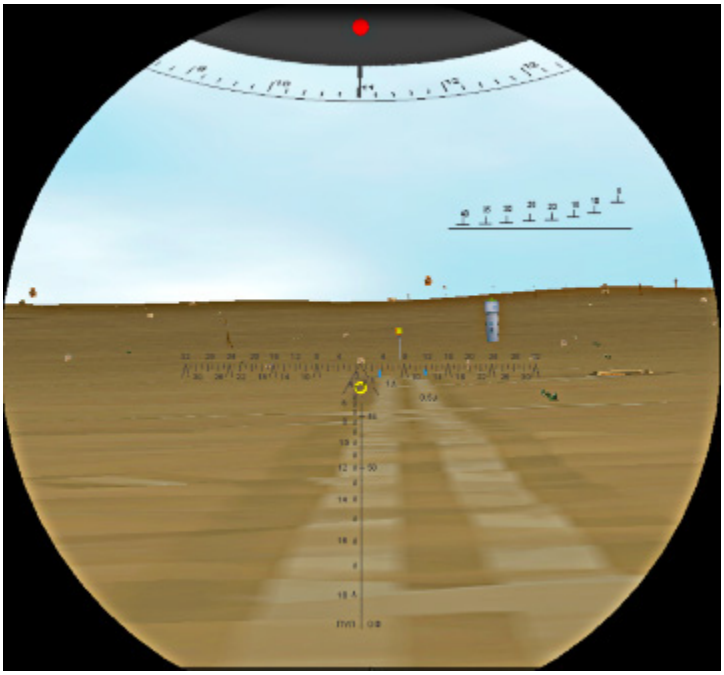
The level of operating procedures covered in simulator

> 90%

Visualisation within field of vision of T-72 optical observation and aiming devices

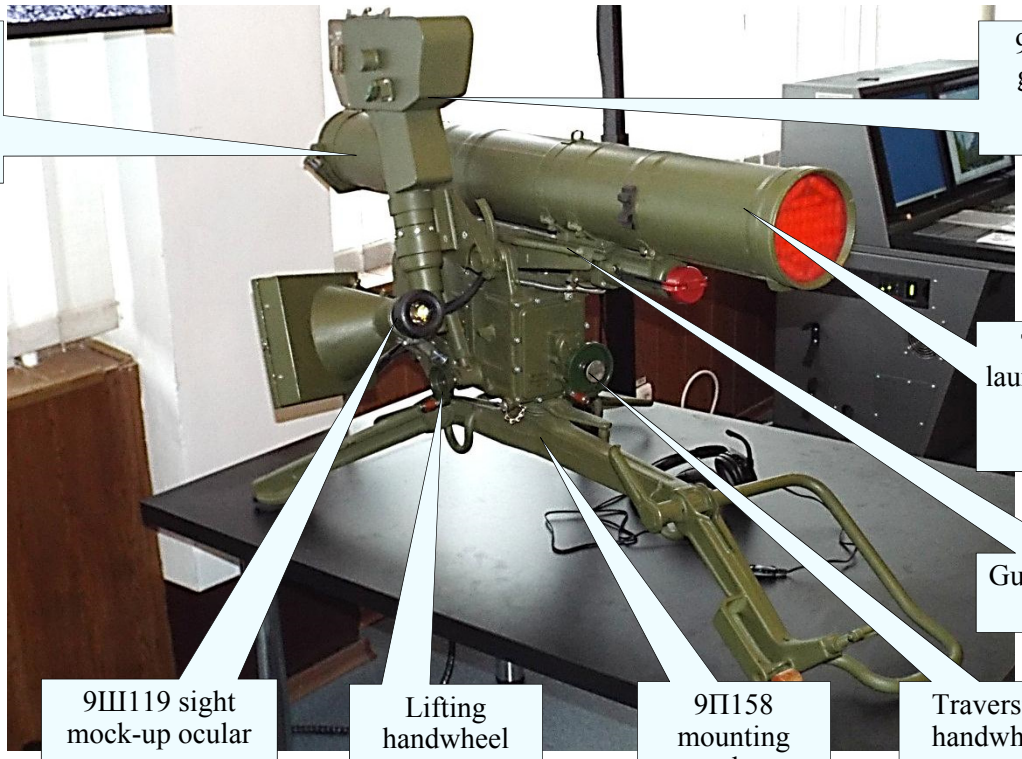
External controllable camera view display at the instructor's work station

Day and night sight's field of vision in the tank crew simulator



- detailed picturing of terrain features, correspondence of colour scale to real background
- compliance of angular dimensions, shape, colour, local objects contrast, vegetation, ground and aerial targets to real objects within field of vision of tank optical-electronic devices
- adequacy of visual, sound and dynamic effects of operating simulator and all types of ammunition firing

ATGM “Fagot” gunner's work place



9P135 launching mechanism composition

№	Controls and instruments mock-ups titles	Quantity, pcs.
1	9P135 launching mechanism	1
2	Lifting-traversing mechanism frame with hand wheels	1
3	The hull of ground control equipment block (full-scale mock-ups)	1
4	Trigger mechanism	1
5	Guide way	1
6	Transporter-launcher container (full-scale mock-ups)	1
7	9Ш119 sight-guidance unit, including	1

Gunner's simulator classroom

Instructor’s work station of ATGM “Fagot” gunner's simulator

Functional capabilities
- Selection of training scenario
- Selection of pre-set exercise from the simulator's library
- Development of new exercise terms and conditions
- Trainee’s action supervision
- Diagnostic of simulator's technical status

Instructor assistance

Simulator switching on/ off

Training results printing

Instructor's workstation

Exercise performance evaluation

Imitated ATGM equipment failures and faults injecting

Modes selection
- Initial data
- Training
- Ground situation editor
- Training sessions result

Training period results data base development

Field of vision visualisation within optical sight-guidance unit of ATGM “Fagot”

High quality visualisation of target environment is achieved due to:

- use of high resolution liquid-crystal array in 9Ш119 sight-guidance unit mock-up
- detailed picturing of terrain textures
- correspondence of colour scale of terrain an objects textures to real colours and contrast;
- compliance of angular dimensions, shape of local objects, vegetation, and ground targets to real objects within field of vision of optical observation devices.
- reproduction of guided missile flight and warhead impact effects

Field of vision of sight-guidance unit mock-up when target is hit

Tactical field view at instructor's work station from external controllable camera

VISUALISATION PATTERNS DURING FORCE-ON-FORCE TRAINING

ATGM “Fagot” crew position view from external controllable camera

Tank T-72 within field of vision of sight-guidance device of ATGM “Fagot”

View of ATGM crew within field of vision of tank T-72 TKN-3B commander’s observation device

Simulator's learning and teaching capabilities

Specialists' individual training	○ Individual training of tank drivers ○ Individual firing training of tank gunners ○ Tank commander's individual training ○ ATGM gunner's individual training ○ ATGM crew commanders individual training
Crew's collective training	○ combined firing and tactical training of tank crews (including fighting against simulated enemy) ○ combined ATGM crew training (including fighting against simulated enemy)
Team building (collective) training of crews during force-on-force tactical exercises	○ Tank crews team building training under conditions of force-on-force simulation training vs ATGM crew ○ ATGM crew team building training under conditions of force-on-force simulation training vs tank crew

Simulator's capability to develop training scenarios:

■3D terrain model dimensions - 5x5 km
■Terrain types - normal country, mountainous, deserted (3D terrain model of any area section can be developed, subject to customer request)
■Road types - unpaved, with hard paving, lack of roads
■The time of day - day, twilight, night
■Meteorological conditions - sunny, cloudy, rain, snow, wind of various speed and direction
■Time of year - summer, winter (any conditions of particular geographical area can be developed, subject to customer request)

Capabilities to supervise trainees

○ by current status of tank driver's, commander's and gunner's, ATGM gunner's controls and indicator means
○ by duplicate field of vision of tank optical observation and aiming devices
○ by duplicate field of vision of ATGM 9Ш119 sight-guidance unit
○ by current status of tank and ATGM weapon system from external controllable camera
○ by position of a tank at driving range route, firing range or tactical field
○ by position of ATGM at firing range and tactical field
○ by protocol of driving, firing and tactical exercise performance
○ by reports from trainees via communication means

Development of training scenarios capabilities

○ selection of meteorological conditions.
○ selection of standard (pre-set) or development of new firing or tactical exercise scenario
○ selection of terrain, tame of day and year
○ assigning of initial positions for opposition forces
○ reiteration (multiple, if required) of exercise or situation
○ injecting of faults and failures of tank and ATGM equipment

Results processing and storing capabilities

○ results e-documenting (printing)
○ results archiving for training session or period

Force-On-Force Simulator effectiveness

The main operating mode of simulator - force-on-force training, representing interactive opposing tank crew and ATGM crew actions within single (united) virtual battle space.

Opposition forces are acting under control of their commanders with the goal is to win by destroying enemy and suffer minimal damage from enemy fire.

All possible Tactics, Techniques, and Procedures should be used to achieve victory - camouflage and concealment, continuous surveillance, long range target engagement, repositioning, smoke-screen laying

There is no any specified scenario when fighting force-on-force. The constant factors are only initial positions of tank and ATGM and assigned ammunition load

Development of situation on the battlefield is depended exclusively on forces proficiency and cohesion of crews, adhering of commander's guidance, proper manoeuvring and precise firing.

The role of commanders from both sides - situation analysis, adequate decision making and continuous control over tank and ATGM weapon system crews via communication means.

Force-on-force training facilitate shaping effective cooperation within crews, development of current situation tracking skills, short term large volume data processing.

Introduction of Force-On-Force simulators into combat training allows:

- to solve at least 80% of tank and ATGM crews training objectives from Combat Training Program
- to reduce formality of training events and to bring training conditions most closely to combat one
- objectively evaluate individual and collective training level of crew members and crews
- to rise control over training and intensiveness of training events and exercises
- fully and timely consider trends in TTPs in combat training process

Simulator developer and manufacturer:
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The developer and manufacturer of the simulator provides:

- manufacturing of the simulator and its delivery to the place of use for the intended purpose
- assembly, adjustment (tuning) and acceptance tests of the simulator on the site of use
- training of technical personnel of the Customer
- warranty service
- post-warranty service, subject to a separate contract
- author's supervision and modernization of the simulator software package during whole exploitation period