TRAINING THROUGH SIMULATION IN THE AIR DEFENCE ARTILLERY. FIRE CONTROL SYSTEM GUN*STAR NIGHT SIMULATOR

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***Abstract**: In the last decade technology has seen an unprecedented development. Engineering, served by the human factor is becoming more complex, increasingly automated, with an extremely high factor of reliability and accuracy. The operator must be well prepared in terms of theoretical and practical, to serve its maximum possibilities. Good preparation is achieved through training, service improvement and automation technology and skills through many hours of theoretical, but practical, and in some areas by practicing specific simulator. As in most areas, military simulators began to occupy a leading place in preparation of serving a particular type of technique. Practical training is based, in large measure, on the training on simulator and in final stage is passed to operation on fighting technique. In the Air Defence field there are little simulation programs, few programs of military training, and the existing ones require a relatively high cost for implementation, maintenance and use. In the present project we established a program simulation for the fire control system Gun*Star Night, a modern air defence complex caliber 35 mm.*

***Keywords**: simulator, simulation program, air defence, fire control system.*

1. INTRODUCTION

The model is a physical representation, mathematical or logical of a system, entity, phenomenon or process.

NATO classified simulations into three categories:

a) the actual simulation: a simulation in which real people are operating real systems;

b) virtual simulation: a simulation in which real people operate simulated systems. Simulations play a central role in exercising motor skills and control, decision-making skills and communication skills;

c) constructive simulation: simulation in which people simulate operating simulated systems. Real people providing input for these simulations, but are not involved in the simulation output.

The scope of modeling and simulation [1] levels: strategic, operational, tactical and individual, is shown simultaneously in the matrix below (Table 1).

Table 1 Scope of modeling and simulation

Rescue factor	**25:1**	**10:1**	**Leader-ship**
	Acquisition Development	***Exercise Education Practice***	***Planing Analisys***
Strategic	Acquisions simulations	Related and combined operations	Decision making support
Opera-tional	Operational research studies	Tactical simulation	
Tactical	Development of operational research	Simulators	
Indivi-dual		Simulatos equipments	

Currently, given the short time that troops should be out training, it is necessary to show more responsiveness to all means to reduce training time, in order make this one accurate, allowing the training tasks maximal parameters, but with minimal expenditure and

consumption. By using simulators, fighters are put in complex situations and realistic training [2].

Particularly in the NATO armies in certain specialties, there aldready exist simulators for military training under conditions similar to the theaters of operations. With the american pilots known position before the actual performance of a combat mission, pilot that made hundreds of hours of training on the simulator, the mission itself will not be anything other than a training „somewhat serious". The pilot knows to perfection every step mission. This explains the success of NATO fighter-bomber aviation plays out the tasks and missions unfulfilled very low rate.

Simulation training as a modern and efficient methods of training, is already a reality in our army [3]. This method provides an efficient and inexpensive tool that allows training to meet specific missions.

2. SPECIFIC REQUIREMENTS

Oerlikon Contraves air defence complex caliber 35 mm is an automated system, and is meant for the Air Defense Forces troops, control points and the points required for passage.

From the action point of view it is intended to control air targets closely spaced, low and very low height and light armored ground targets.

Fig. 1 Fire control system

The complex has anti-aircraft automatic guns comprises two 35 mm caliber, and a fire control system (Fig. 1), for detection, identification and automatic target accompany. Also, this system is designed to combat air targets when working in a centralized manner.

Fire control system Gun*Star Night is a optronic system based on electro-optical tracking system and equipped with a computer to calculate ballistic trajectory and timing of fire release.

Fire control system Gun*Star Night provides the following main operations:

a) receiving data on air targets at Radar Research Station (CRS) or its digital optical viewfinder;

b) assess potential air attack in the area of responsibility (in decentralized mode);

c) seek, find and identify the target;

d) accompanying three-dimensional target (finders using laser and electron-optical system);

e) calculated angles of sight for guns;

f) forward angles in gun sights.

The whole system (two sets cannons and fire control system) is powered by electricity, with voltages of 220V AC and 110V DC.

In order to work independently of the national electricity network in any place and time conditions, voltages are provided by two sets, running on leaded petrol, with a consumption of 24 l\h, and a generating set of low power, functional unleaded petrol, with a consumption of 1.5 l\h Thus we can realize the costs involved in preparing a one man operator, since the basic and advanced skills needed at least three training phases, each phase is taking place over a period of 1-3 weeks [4].

This project has at least two reasons:

a) the operator during the preparation of a fire control system greatly shortens the stages of initiation, training and perfecting their skills being done with the simulation program, thus changing the actual fighting technique will be very easy, the operator benefiting from experience gained on the simulator;

b) it costs a lot less to train an operator, as the first two stages of training can be conducted using the simulation program and only the third stage fighting technique to use. Thus, instead of preparing a single operator there can be trained three operators in three stages.

3. FIRE CONTROL SYSTEM GUN*STAR NIGHT SIMULATOR

Simulation program for fire control system Gun*Star Night is destined for learning and involvement of operators, training and improving their skills in order to shorten the preparation time and training costs.

Simulation software can be a way to train even when for some reason, the technique is unable to efficiency. It also represents a necessary learning tool for the main menus and submenus and the presentation of the art verification algorithms.

In current conditions, modern combat no longer leads through direct contact with the enemy, but it is based on information received from higher echelons or the discovery and tracking its equipment.

Respecting the laws of modern conflict, fire control system Gun*Star Night flies over the target information from the research station (radar) to senior and displays them on the video display. Data on target are displayed while the operator has selected the option of designating the target by radar and has been aligning with the radar. If operations were not performed, the display will show data on the flight parameters of the target. Besides fire control interface device, the frame main menu we created a help menu designed to facilitate understanding the operation of the simulator, everything here may be introduced by the instructor or operator of the target flight parameters to evolve.

In what follows I will present two options menu target data and target route.

- *Target Date*: This opens a dialog where you will enter flight parameters of the target to move (the designated target number - this number is given, usually by radar direct distance to the target speed target, azimuth and elevation angle below which sees the target, etc.).

Flight of the target parameters are also valid when running the application and fixed, usually before the simulation. When the operator began checks and alignments, it is desirable flight parameters to be introduced so that the evaluator should not influence the operator [5].

- *Route target*: at home option is the development target. From this time the target can be intercepted by the operator and is taken to cover the camera automatically fire control system.

Target will appear on the video display and will be accompanied by camera stable only if the operator has set the target designation radar DOS and has been aligning with the two subsystems. Otherwise, the target will not come into sight of the camera, so video will not show the target.

Flight parameters of the target (set before running the application) will be displayed on fire control system only if the alignment was made with radar. If this alignment was not done, then do not submit data to the radar system.

If during development target alignments or operator fails to select target designation by one of the two elements, then it will come in sight of the camera (the target was automatically taken to cover) and therefore the signal will be displayed and on the video display.

Frames were created about the size of the actual opening to the center of the screen, with the possibility of moving them on screen. Closing is the upper right corner. Since the application is intended as an educational program in the upper left we have listed and open submenu name, although not firing system displays the names of submenus.

Frame home is Gun*StarNight.frm and is the main menu on your panel TACH firing system (Fig. 1). Each opens a submenu to access different frames, frame parent Hide worth taking.

The main frame contains four main submenus (Status, Settings, Alignment and Check), show only the value of having access submenu. Each of the submenu command opens another frame other than the principal, the latter taking the value of Hide. Back in frame main frame where he worked Hide value.

On the main frame were created other shortcuts on the panel TACH namely:

- Designation - target designation, which has values: Both, Optical Sight, Search Radar, None;

- Elevation Scan - searching in elevation, which has values: Manual, Automatic, Constant Height;

- Gate – "gate" to accompany the target, which has values: Armed, Disarmed;

- Field of View - view the plan target, with two values: Narrow, Wide;

- Tracking - how to cover the target, with two values: On, Off;

- Ranging - how to select the amount of distance to target, with the following: Near, Mid, Far, Straight, Lasers (which gives exact distance to target), Radar, Auto Select;

- Gun Mode - how to work with fire control system, with two levels: On Line, Zero Test;

- Gun Alarm - the alarm guns, with two values: Auto, Manual.

Any option selected on the main frame will be displayed on the video display of other frames.

On the video display device of fire control system Gun*Star Night are displayed information about the target. This information is vital in engaging the fight, so the operator needs to know and know how to interpret them very well. Next we will present information and their interpretation.

Information designated by the senior research station, Shorar-TCP, which appear on the video display:

- TR / Track Number: number of targets designated by unit fire

- AR / Radar Azimuth: angular position value Shorar-TCP research station to the fire control system;

- RD / Radar Distance: parallax offset distance in feet from the research station;

- TH / Target Height: once target height in meters;

- TV / Target Velocity: speed in m / s target.

Information designated by the discovery and identification of its equipment:

- HD / HIT Distance: distance measured to the point of impact between the target and the projectile beam, calculated in meters;

- EL / Line of Sight Elevation: elevation angle of the target to fire control system;

- AZ / Line of Azimuth: azimuth angle of the target to fire control system;

- DI / Target Distance: distance inclined to direct fire control system to the target;

- T / Distance Tracing Mode: how to determine the distance to the target.

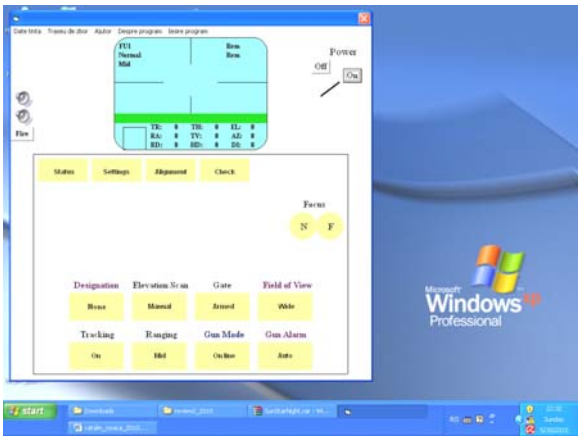

Fig. 2 Running program

Information on identifying fire control device:

- UNIT - how to work independently;

- FU1 - FU4 - centralized mode.

Information on how to determine the distance of the accompanying target:

- Radar - distance is determined by the research station;

- Laser - distance is determined by laser telemetry;

- Near - near distance fixed plan;

- Mid - Fixed remote environmental plan;

- Far - Plan fixed distance away;

- Straight - fixed remote tracking function.

For fire control system operator to carry out its mission, the algorithm must meet strict training and technique to go through each stage separately. Every step of preparation is well esta blished and not taking each step leads to errors and failure to tackle the target.

With the simulator developed algorithm we take into account the preparation technique. Thus, if the operator does not align with the north and DOS, then it will not receive information on target position will not be able to identify its signal will not appear on the video display.

If the operator does not align with the radar, then you will receive information on flight parameters of the target and the operator is unable to open fire, not knowing if entered into the possibilities of control.

Fire control system alignment with guns is another vital part of the preparation for war, since, if not running at this stage, fire channels will not be synchronized with the fire control system and therefore the volley of fire shooting will not be directed on target, but will take any direction.

If during the development of the target the operator will fix any error in the preparation technique to combat, the simulator will take into account and correct in real time, shooting fire on air targets.

It must be noted in anti-aircraft defense, because the fight is going to target aircraft (airplanes and helicopters, high speed and high precision), it can not take more than a few tens of seconds, ie the time required for an airplane or helicopter carrying out a mission (launch a rocket or a bomb self-directed). Therefore the fight goes “with the seconds”.

Time evolution of the target zone of fire is random, the maximum being about 50 seconds. During the time evolving target, the operator can open fire at any time. Length volley fire was set at 1.5-2 seconds, during actual firing.

Depending on the number of volleys to open fire on target and taking into account the probability of destroying its target will be reduced.

If the operator, for various reasons, do not open fire on the target when given flight route (Route Target to hold option on the menu), then opened fire on the target fire control system.

Next I will present several lines of code used in the simulator [6].

```
Private Sub Timer1_Timer()
If traseuzbor = 1 Then
        Timer1.Interval = 2000
If gun1fire.Caption = "REM-Fire" Then
        nrfoc = nrfoc + 1
        gun1fire.Caption = "REM"
        gun2fire.Caption = "REM"
        Line15.Visible = False
        Line16.Visible = False
        Line17.Visible = False
        Line18.Visible = False
End If
End If
End Sub
```

Since air combat with the enemy takes more than a few tens of seconds (considering the speed of development targets hundreds of meters per second), in the home page we introduced two types timer components, components that are designed to limit while certain actions.

The first function, timer type is to display the video screen for two seconds; the message to open fire, Fire REM, the message means that the two channels of running fire on target (Fig. 2).

After two seconds the channels cease fire first volley of fire and prepare for the next opening volleys. Video screen, this message is reflected by the fact that REM-REM thread is replaced with the message. Here we introduced a variable fire number, variable that is to count the number shoot fired.

If the operator was able to open more than four volleys on target at the end of its evolution will show a message which will confirm its destruction: Mission Complete!, Otherwise, the message of failure of the mission, “You have been destroyed !”.

```
Private Sub Timer2_Timer()
If zbor.Playing = True Or traseuzbor = 1 Then
        Timer2.Interval = 49000
If nrfoc > 3 Then
        zbor.Playing = False
        zbor.Visible = False
        Text1.Visible = True
Text1.Text = "Mission complete!!!"
Else
Text1.Visible = True
        Text1.Text = "You have been
    destroyed!!!"
End If
End If
   gun1fire.Caption = "Rem"
   gun2fire.Caption = "Rem"
   zbor.Playing = False
   zbor.Visible = False
   Line15.Visible = False
   Line16.Visible = False
   Line17.Visible = False
   Line18.Visible = False
End Sub
```

All conditions outlined in the above procedures are intended to approximate actual conditions and simulator to demonstrate that

any operation should be performed with a sense of responsibility and must respect the art training algorithm, otherwise the effects could be devastating: combat mission will not be met, the target will reach its aim, fire unit will be removed from combat.

4. CONCLUSIONS

One of the roles that simulation can play is to save financial resources, materials, time and, not least, human. Also, the diversity decision algorithms can be tested using the simulator, just respecting the initial conditions. In this way you can find, without spending any additional resources or alternative optimal algorithm to obtain optimal peak performance.

Also, if the actual technique wears as a result of overloading it, there is no question in simulators. Regardless of the number of hours they spend in front of an operator simulator practicing, regardless of its level of preparation (simple or advanced student) technique will not suffer as a result of "experiments" that could be taxed.

When the operator is well prepared, when discovered, through experience, which is the best algorithm to follow, which is the best decision to be taken at a given time, then he can shift the actual equipment in the best conditions.

Military educational institutions in the field have not, at present, a simulation program of fire control system Gun*Star Night, so the present program could be a useful tool for training and improving students or trainee officers.

Currently, in the Romanian army anti-aircraft artillery gun there is a program for simulation equipment operators anti-aircraft artillery, the only occasions for training in real conditions as those of the polygon of drawdowns conducted missions in very good conditions, but as cost. Therefore, simulation software is intended as a first step in the field.

And in the future, a collaborative project with the Faculty of Informatics, when we are able to create a 3D simulation, with possible targets in real-time combat, we will be able to create a simulator which includes other subsystems that run on multiple workstations connected to network operators served by serving those subsystems, and we will be able to say that we -and also anti-aircraft artillery- did a first step towards the future.

And then, finally we can say that the passion for this weapon, for the air defence artillery has regained the place it deserves: a weapon of first-class falling in battle, umong weapons that can decide, in just the first two hours armed conflict, whether the fight is won or not.

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