LASER HELICOPTER DOOR GUNNER TRAINER

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A Marine Corps Helicopter is on a medical evacuation mission in hostile territory. The door gunner continually scans the passing terrain. He watches roads, buildings, tree lines, stream beds and ridges. His job is purely defensive. He is watching for enemy fire and alert to take action.

Suddenly, he sees muzzle flashes from a river bank. He immediately tells the pilot and starts to fire. He drops a red smoke grenade to indicate he is being fired upon. He watches his tracers and ground effect and steers his fire into the target. He must continually correct his fire as the pilot takes evasive action.

These are the duties of the door gunner. He must observe, acquire targets, lay down suppressive fire and correct his fire.

These are the skills that must be taught to the door gunner. These are the objectives of the Laser Helicopter Door Gunner Trainer.

Current training consists of several hours of classroom instruction and three training flights. The training program was observed at the Marine Corps Air Station, New River, North Carolina. The classroom training consisted of familiarization with weapons and firing procedures. The training flights were over target hulks offshore in Pamlico Sound.

Due to the weather, or lack of available aircraft, or ammunition, the training flights were often cancelled. The use of a simulator as a supplement or replacement to some of these training flights should greatly improve training effectiveness.

The basic concept of the Laser Helicopter Door Gunner Trainer is to provide a realistic wide-angle display consisting of potential targets and background terrain which may be fired upon by the trainee from a simulated helicopter door.

Our approach to this problem was to apply the laser weapon firing simulation technology that we previously applied to other similar training problems such as tank gunner training, artillery gunner training, and infantry machine gunner training.

In the past, Helium Neon gas lasers, providing a narrow monochromatic beam of light, have been used to train in the firing of these direct fire weapons. Two disadvantages of these systems as applied to the helicopter gunner problem were (1) impact hit indication only, and (2) instantaneous time of flight. These characteristics, although not critical in their application, would have to be modified in the case of the helicopter door gunner. The door gunner should see his tracers, and time of flight must be simulated.

Figure 1 shows the general system configuration. The system can be divided into several subsystems. These are platform, display screen, projector (marked P), laser system (marked L), and electronic controls.

The desired characteristics for the various subsystems are:

PLATFORM

The platform is a simulated helicopter interior with an actual or mockup .50 caliber machine gun mounted in the door or window. This platform is spring mounted and motor vibrated to simulate helicopter vibrational motion.

DISPLAY SCREEN

The display screen is a ten-foot radius spherical segment screen providing 51° forward and 32° aft view of a total of 83° horizontal and 7° above horizon and 59° below horizon for a total of 66° vertical. The field of fire for the operational weapon is 82° horizontal and 49° vertical.

DISPLAY PROJECTION

The display projector is a standard 16 mm motion picture projector with either a 12 mm focal length or 6 mm focal length projection lens. As of this writing the projection lens has not been chosen. The tradeoffs involved are screen brightness, and display distortion as well as availability of standard or modified standard projector. The motion picture used in the display was made from a helicopter flying at various speeds and altitudes varying from 50-120 knots and 50-200 meters. The background scene consists principally of terrain with few roads or buildings. The attempt was primarily to avoid any objects in the field of view which could appear distorted or unrealistic. Targets were inserted by pricking in the emulsion simulating muzzle flashes. It is realized that this technique of filming and display is not optimum, but we were trying to demonstrate system feasibility and not optimum display.

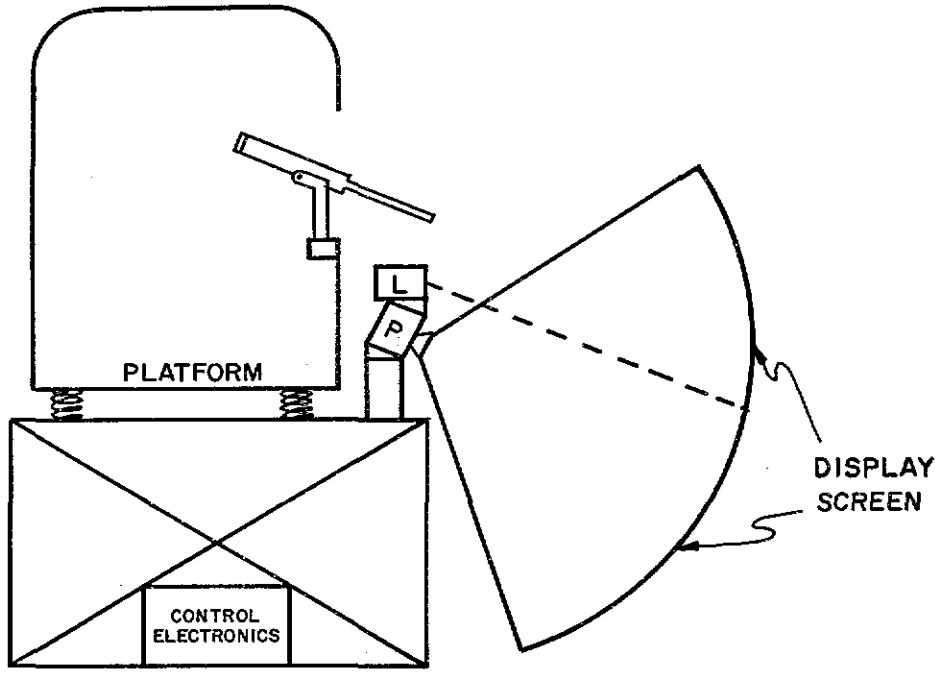

Figure 1. Laser Helicopter Gunner Trainer

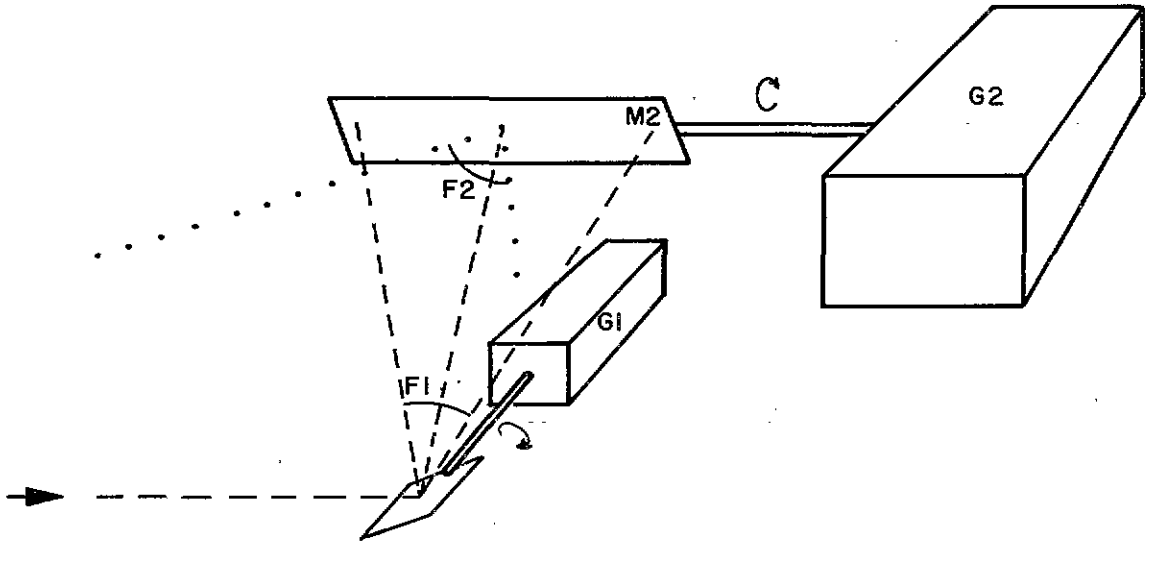

Figure 2. Laser Deflection System

LASER SYSTEM

Most of the development of this prototype trainer involved the laser system and electronics. The laser system consists of a laser, two shutter systems, and a two-axis beam deflection system.

The two-axis laser deflection system consists of two galvanometers, one of which rotates 30° producing a 60° scan and the other which rotates 45° producing a 90° scan.

In figure 2, G1 is the horizontal scanning galvanometer and G2 is the vertical scanning galvanometer - the laser beam enters from the left and reflects from the mirror M1. The beam is then directed to any angle within the fan F1 and headed up. The beam then strikes mirror M2 and is redirected out. The vertical galvanometer scans the beam to any angle within Fan F2 in the vertical plane. The scan angle errors introduced by this scanning method are fairly small.

The use of galvanometer-type scanners was dictated by their low cost and the slow scan rates involved.

The laser system also includes two shutters. The first shutter is simply a solenoid-operated flag which blocks the beam completely until it is activated. The second shutter is a motor-driven slotted disc which continually blips the laser beam eight times a second when the system is in the hit indication mode. The second shutter is also mechanically detented to stop on an open slot so that it will not interfere with tracer operation.

ELECTRONICS

There are two semi-independent systems for the two fire modes. The first system we will describe is that for the hit indication mode. A block diagram of the hit indication mode is pictured in figure 3. In this system, by manipulating his weapon, the trainee provides three inputs: (1) the angle of elevation of the weapon, (2) the azimuth angle of the weapon and (3) activating the trigger.

The elevation angle of the gun provides two parameters: (1) the time of flight and (2) the elevation deflection angle. The time of flight directly gives the delay time between the time the gun points to a certain position and the time that the deflection system aims the laser beam toward that same position. The delay time also controls the time displacement of a trigger burst. The shutter opens a delay time after the trigger is pulled and closes a delay time after the trigger is released. Ballistics and parallax corrections are assumed to be constant for a given target and are added to the delayed azimuth and elevation signals. Shutter 2 operates continuously in this mode.

The tracer mode of operation is pictured in figure 4. The elevation and azimuth inputs are decoupled from the stores when the trigger is pulled. Ballistics are then slowly added simulating gravity drop and wind resistance. Upon trigger pull, shutter 1 opens immediately and then shuts off after a delay time. The system resets itself one second after initial trigger pull, one second being the maximum tracer lifetime simulated, and also the simulated frequency of tracer occurrence. Shutter 2 is locked in open slot.

The laser helicopter door gunner trainer may be summarized by describing how it may be used.

The trainee is briefed on his mission and told to watch for muzzle flashes and lay down covering fire when he sees them. The trainee then takes up his position by the door with his weapon ready to fire.

The flight starts -

The platform begins to oscillate - until it is vibrating rapidly.

The background scene starts passing the window; the trainee starts watching for potential targets. He is passing over rocky terrain.

Suddenly, there are a series of muzzle flashes from an outcrop about 400 meters away. The trainee starts firing. A half-second later, he sees his burst of incendiaries hit to the right of the target. He corrects his aim and fires another burst; a few seconds later the helicopter starts to slew away from the enemy fire. He continues to fire until the target is out of his field.

The helicopter is now flying over a densely foliated area. He again sees muzzle flashes, only this time he must use tracers to steer his fire into the target.

We believe that this system will provide cost-effective training for helicopter door gunners. The system will be ready for operational testing at the Marine Corps Air Station (Helicopter) at New River, Jacksonville, North Carolina, in approximately eight months. There will be a report published at that time describing in detail all of the technical aspects which were only mentioned today.

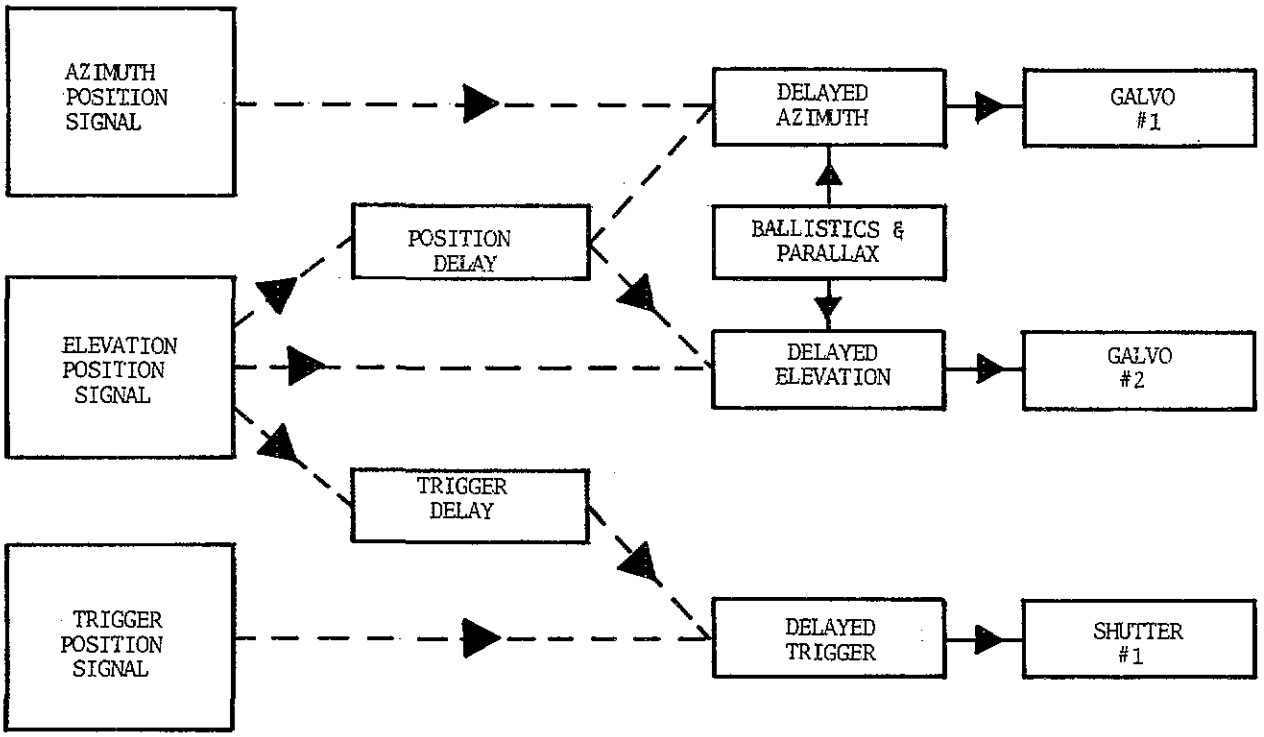

Figure 3. Hit Indication Mode

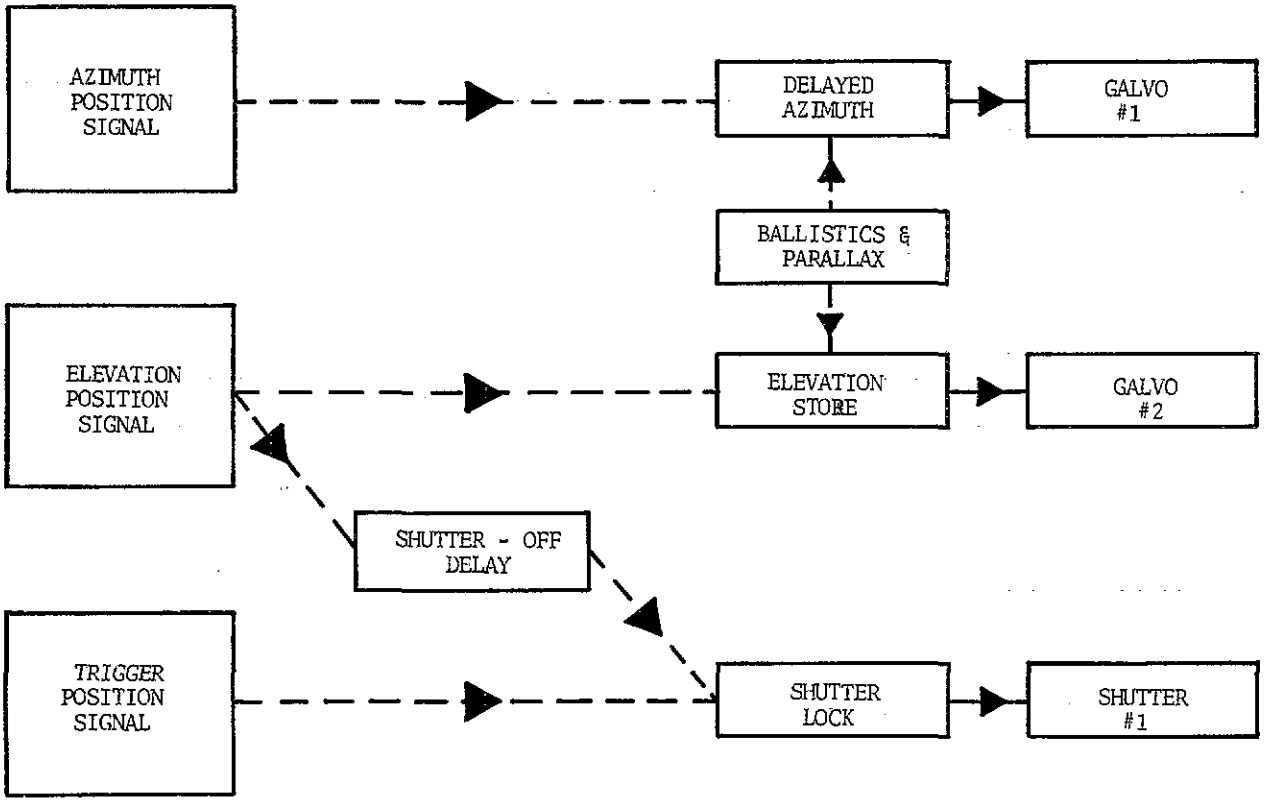

Figure 4. Tracer Mode

ABOUT THE AUTHORS

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