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(54) Title: COMBAT SIMULATION SYSTEM AND METHOD

(57) Abstract: The present invention relates to combat simulations and, in particular, the invention concerns a combat simulation system and method to be used with models of weapon platforms controlled and navigated by a remote control to simulate a pre firing signal and a firing signal created by releasing electromagnetic radiation towards a target, thereafter registering the "hits" and transmitting the designated signal to a second location. The present invention provides for an effective combat simulation system to be used on weapon platform models, which simulates firing, target "hits" and registering the firing and the hits and which simulates target illumination and facilitates and illuminated target to "fire" upon the illuminator, either with simulated fire or real fire with real weapon systems and which mimics a variety of weapon systems by emitting the same type of illumination with the same characteristics that the weapon system actually emits and that the system will be suitably mounted on a remote controlled platform whether air-born, sea-born or land. Thus, the target can detect and employ the target defense systems including employing counter measures, performing evasive maneuvers, creating smoke screens and real fire resulting in the incapacitation and destruction of the illuminating platform.

COMBAT SIMULATION SYSTEM AND METHOD

FIELD AND BACKGROUND OF THE INVENTION

The present invention relates to combat simulations and, in particular, the invention concerns a combat simulation system and method to be used with models of weapon platforms controlled and navigated by a remote control to simulate a pre firing signal and a firing signal created by releasing electromagnetic radiation towards a target, thereafter registering the "hits" and transmitting the designated signal to a second location.

Since the invention of weapons, a simple and efficient way to simulate combat was sought. For many years individuals used models of weapon systems to simulate various combat scenarios. The various models and devices included, among others, scaled model tanks and scaled artillery models utilizing a single shot 0.22-inch gun to simulate tank and artillery fire. Alternatively, models equipped with a firearm have been used for simulating purposes both with and without shot. There is an obvious hazard in using such models as they may cause the injury or even the death of a user. Other combat simulation models include remote controlled model aircraft for performing aerobatic maneuvers or for using aircraft models to simulate air to air combat and for simulating attacking targets on the ground as well as pleasurable pastime activities according to the teachings of U.S. Patent Number 5,892,221

"Combat simulation method and system utilizing lasers with wireless activation" to Lev.

In the present and future battlefield, several different weapon systems are employed while using guidance and aiming accessories. Electro-optic systems emit electromagnetic radiation including, but not limited to, coherent electromagnetic radiation.

By way of example only, coherent electromagnetic radiation is used in range finders, which are used to measure distances between the laser source and a target with a high degree of accuracy. The principles and operation of a range finder are based on a short pulse being emitted, travels at the speed of light, in a narrow collimated beam until the target. The radiation returned from the target is scattered and the rangefinder detectors detect only part of the radiation. The time between radiation being emitted and detected enables an exact distance to be calculated.

Furthermore, designators are used to manually "mark" targets for accurate targeting. The principles and operation of designators are based on a laser source with of a narrowing column and a relatively high rate of pulsation. Thus, a typical radiation "signature" is produced on the target and is reflected in all directions. The radiation returned is then used for guiding bombs and missiles towards the target.

Another weapon system is a Laser guided missile. In the missile a laser source illuminates a target and the missile is guided by the laser radiation reflected from the target until impacting the target.

For the purpose of clarity, listed hereinbelow are sample characteristics of each radiation source commonly found in modern battlefields.

Type of Source	Wavelength (Microns)	Pulse (nSec)	Frequency Hz
Range Finder	1.06	5-30	1/1.5
Range Finder	0.69	30-40	1/1.5
Designator	1.06	15-40	2-20
Guided Missile	0.905	200	2,000

Each one of the weapon systems has many specific characteristics of the radiation source and the specific characteristics are often manifested in wavelength, pulse, energy and frequency.

Due to these characteristics being known, early warning systems can be created to warn as to the direction of the source and against risks related to any of the above systems. Furthermore, by knowing the type and location of weapon system, counter measures and electronic counter measures (ECM) can be employed against these systems.

In other weapon systems, radar is used for guidance to the target and delivery of the payload.

The radar systems can be identified by several characteristics including but not limited to frequency bands as listed hereinbelow:

Symbol	Frequency (GHz)	Wavelength (Cm)
L	1-2	30-15

S	2-4	15-7.5
C	4-8	7.5-3.75
X	8-12	3.75-2.5
Ku	12-18	2.5-1.6
K	18-27	1.6-1.1
Ka	27-40	1.1-0.75
MM (3)	40-100	0.75-0.3

Here as well, due to specific characteristics of each weapon being known, warning systems against each type of system can be created to warn as to the direction of the source and against risks related to any of the above systems. Furthermore, by knowing the type and location of weapon system, counter measures and electronic counter measures (ECM) can be employed against these systems.

Further combat simulations have been attempted by individuals, which recreate combined ground, air and naval forces simulating ground, air to ground, air to sea, or sea battles either separately or conjunctively, while using scaled models of the soldiers, weapons and platforms on which model weapon systems were used. Again, the attempts of recreating or simulating ground or sea battles also suffer from the deficiency of the attempts described.

Most methods for dealing with a laser threat include some active countermeasures, evasive maneuvers, or direct engagement. Generally, combat units will use laser threat-management methods in a variety of combinations. However, all of these alternatives presume that, in most situations, the hostile laser has been detected, identified, and exactly localized within the extremely short span of time available. Crews in fighting vehicles, tanks, armored trucks, infantry soldiers, and others can be instantaneously warned of specific laser

threats to maintain/enhance their survivability. However, simulating an attack by a plurality of weapon systems using illumination for target acquisition is not facilitated by existing systems. Moreover, all existing systems do not facilitate retaliatory measures including simulated fire and live fire upon the simulated illuminating weapon.

The military presently uses a laser detection system for battlefield simulation training. One such system is referred to as the Modular Integrated Laser Engagement System (MILES) developed by the Naval Training Equipment Center working in conjunction with military contractors. The MILES system equips soldiers with pulsed semiconductor lasers and sensors. The lasers may be attached to a variety of weapons, each firing a characteristic sequence of pulses. When the war games start, the soldiers fire laser pulses at each other, and the sensors keep score. However, such systems do not provide military personnel with advance warning of the laser threat and are not battlefield effective. Furthermore, systems for simulating live fire, such as the MILES system and other systems are incapable of simulating a wide range of weapon systems utilizing illumination, including weapons like Laser Guided Missiles and the like. Further still, systems like the MILES system do not facilitate live fire on an illuminator for obvious reasons.

Several US companies have developed the MILES system for the US Army. Among which, Lockheed® and Cubic® are the most dominant.

The principle used in the MILES and similar systems is to equip any weapon system with a encoded laser source whereby each weapon type is given

a special code to identify the type of weapon irrespectively of whether the weapon system has any illumination source whatsoever like for example rifles handguns and the like.

For he purpose of standardization of systems the Department of the Army simulation, training and instrumentation command issued a publication including the standard codes for each weapon system entitled "Standard for MILES Communication Code Structure". The latest edition for printed is entitled "MCC97 STANDARD".

All laser sources used in the MILES system use the same frequency and pulse on which the code is carried. A partial list of weapon systems and codes is listed hereinbelow.

BASIC MILES CODE STRUCTURE

D D D 0 1 2	DATA D D D D 3 4 5 6	BITS D D D D 7 8 9 10	BASIC MILES CODE NO.	WEAPON/FUNCTION
1 1 0	0 0 1 0	1 1 0 1	00	UNIV. KILL, CONTR, GUN, 100% KILL
1 1 0	1 0 0 1	0 0 1 1	01	MAVERICK HIT
1 1 0	0 0 1 1	0 1 0 1	02	HELLFIRE HIT
1 1 0	0 0 1 0	1 0 1 1	03	AT-3 SAGGER (NTC BMP) HIT
1 1 0	0 1 0 1	0 0 1 1	04	60MM, 81MM, 4.2 INCH HIT
1 1 0	1 0 1 0	1 0 0 1	05	M15 MINE (TRACK CUTTER) HIT
1 1 0	0 1 1 0	0 1 0 1	06	WEAPON "X" HIT
1 1 0	1 1 0 1	1 0 0 0	07	TOW, SHILLELACH, AT-6 (NTC HIND-D HIT
1 1 0	1 0 1 1	0 1 0 0	08	DRAGON, SPANDREL (NTC BRDM-2) HIT
1 1 0	1 1 0 0	1 0 0 1	09	FIRE & FORGET MISSILES (JAVELIN)
1 1 0	0 1 1 0	1 0 0 1	10	M21 ANTITANK, 125MM (NTC T72) HIT
1 1 0	0 1 0 0	1 0 1 1	11	CLAYMORE M81A1 AND M16 HIT

Alternatively the target can retaliate by firing upon the source of illumination by way of a laser simulating live fire.

Using cheap air-born platforms saves maintenance times and costs

which would have been needed for the simulation. Furthermore, real fire exercises cannot be performed against manned weapon systems.

Several additional combat systems have been developed to address laser illumination related threats. Namely, detecting an illumination by laser and detecting the direction the illumination came from, for the purpose of firing upon the laser illuminator.

All such combat systems are devoid of a simulation capability facilitating a simulated attacker to illuminate a target in a manner similar to existing combat weapon systems and such that a target illuminated will be able to "fire" upon the illuminator, either with simulated fire or live fire with the combat weapon systems firing live ammunition. Namely, all such systems cannot facilitate simulated attacks, which simulate a wide variety of illuminating weapon systems while incorporating live fire on the illuminator.

There is therefore a need for an effective combat simulation system to be used on weapon platform models, which simulates firing, target "hits" and registering the firing and the hits.

There is a further need for an effective combat simulation system, which simulates target illumination and facilitates an illuminated target to "fire" upon the illuminator, either with simulated fire or real fire with real weapon systems.

There is yet a further need to create a system which mimics a variety of weapon systems by emitting the same type of illumination with the same characteristics that the weapon system actually emits and that the system will be suitably mounted on a remote controlled platform whether air-born, sea-born

or land. Thus, the target can detect and employ the target defense systems including employing counter measures, performing evasive maneuvers, creating smoke screens and real fire resulting in the incapacitation and destruction of the illuminating platform.

SUMMARY OF THE INVENTION

The present invention is a combat simulation system and method, which can be used with a model of a weapon platform for simulating firing upon real targets as well as target "hits", and for registering the firing and the hits.

Hereinafter the term "UAV" refers to any unmanned aerial vehicle including, but not limited to: UAV's, VTOL's and drones.

In the case of remote controlled models used in such simulations, the users control the models from the remote location and are usually limited to the range of the transmitters in the remote controls.

A typical combat simulation of models will take place in the air space immediately above the heads of the users and may include several models attempting to maneuver to a firing position in relation to the other models.

A ship combat simulation will typically take place in the sea, a pool or a pond, using manned and unmanned remote controlled sea vessels.

The simulation will often be a re-creation of a famous battle or a conventional combat simulation.

The users will often attempt to maneuver their ships to a firing position

permitting broadside hits.

Hereinafter, the term "wireless device" refers to any device, which is capable of transmitting a signal to a receiver, which is not in direct physical proximity to the wireless device as well as any device, which is not attached to a controlling apparatus with an electrically conductive wire.

Hereinafter, the term "illumination" refers to any radiation originating from a predator platform, which simulates any "active" weapon or guidance system including, but not limited to: firing a weapon upon a target, releasing coherent electromagnetic radiation and microwave energy used to guide weapon systems to a target and radar radiation used by aircraft and missiles for "locking on" and guiding weapon systems to a target.

Hereinafter, the term "real target" refers to any target including a laser detection system or "illumination" detection system, which provides detection coverage capabilities to identify the region of origination of the laser or illumination or, identification of potential direct or indirect laser or illumination energy and automatically alerts the target or the target occupiers to the detected laser or illumination and the direction of laser or illumination origination. Furthermore, the detection and relevant parameters can be relayed to a remote station for analysis and battlefield assessment.

According to the teachings of the present invention there is provided, a combat simulation system including: (a) a predator including: (i) an illumination source; and (ii) a receiver electronically attached to the illumination source and responsive to signals transmitted from a remote

control; and (b) a target including: (i) a target illumination detector responsive to illumination from the illumination source; and (ii) a weapon system responsive attached to the target illumination detector and capable of neutralizing any threat from the predator.

According to further embodiments of the system according to the present invention the predator can simulate any illumination of any weapon system.

According to still further embodiments of the system according to the present invention the target weapon system can simulate any simulated defensive measures against the predator.

According to yet further embodiments of the system according to the present invention the illumination source includes a radar source.

According to further embodiments of the system according to the present invention the illumination source further includes a laser.

According to still further embodiments of the system according to the present invention the laser source includes a laser modulator.

According to yet further embodiments of the system according to the present invention the target includes a warning system for warning on any illumination detected by the target detector.

According to further embodiments of the system according to the present invention the illumination source includes a radar source and a laser.

According to still further embodiments of the system according to the present invention the target includes a warning system for warning on any

threats posed by any system detected.

According to the teachings of further embodiments of the present invention there is provided a combat simulation system including: (a) a predator capable of simulating any illumination of any weapon system including: (i) an illumination source mounted on a modular platform and including a radar source and a laser source; and (ii) a receiver electronically attached to the illumination source and responsive to signals transmitted from a wireless remote control device; and (b) a target including: (i) a target illumination detector responsive to illumination from the illumination source; (ii) a warning system for warning on any illumination detected by the target detector; and (ii) a weapon system responsive to the target illumination detector.

According to further embodiments of the system according to the present invention the modular platform is readily transferable from the predator to any other predator platform.

According to still further embodiments of the system according to the present invention the illumination source is independently alignable towards the target, irrespective of the alignment of the target in relation to the predator.

According to yet further embodiments of the system according to the present invention the illumination source includes a tunable laser.

According to the teachings of further embodiments of the present invention there is provided a combat simulation system including: (a) a predator capable of simulating any illumination of any weapon system

including: (i) an illumination source; (ii) a processor for controlling the predator according to simulation framework or the predetermined flight envelope or mission priorities in which combat takes place; and (b) a target including: (i) a target illumination detector responsive to illumination from the illumination source; and (ii) a weapon system responsive to the target illumination detector and capable of neutralizing any threat from the predator or performing any real or simulated defensive measures against the predator.

According to further embodiments of the system according to the present invention the predator and the illumination are autonomously controlled and operated.

According to still further embodiments of the system according to the present invention the predator further includes a predator illumination detector and predator processor for detecting and processing reflected illumination from the target or illumination by the weapon system.

According to yet further embodiments of the system according to the present invention the predator is capable of performing any defensive or offensive procedures according to survivability and tactical priorities determined by the predator processor.

According to further embodiments of the system according to the present invention the target retaliates automatically to any illumination detected by the target detector.

According to further embodiments of the system according to the present invention the target includes a database of all illuminations detected by

the target detector and all defensive or retaliatory measures taken against the illumination source.

According to still further embodiments of the system according to the present invention the illumination source includes a radar source.

According to yet further embodiments of the system according to the present invention the radar source includes a variable frequency generator.

According to further embodiments of the system according to the present invention the illumination source further includes a laser.

According to still further embodiments of the system according to the present invention the laser source includes a laser modulator.

According to yet further embodiments of the system according to the present invention the illumination source is a pulsed semiconductor laser.

According to yet further embodiments of the system according to the present invention the pulsed semiconductor laser is operated according to the Standard for MILES Communication Code Structure

According to further embodiments of the system according to the present invention the pulsed semiconductor laser is operated according to any weapon simulation system coding structure.

According to further embodiments of the system according to the present invention the pulsed semiconductor laser is operated according to any integrated multiple weapon simulation system.

According to the teachings of still further embodiments of the present invention there is provided a combat simulation system including any of the

features or components depicted in the specification of the application or in Figures 1-3.

According to the teachings of the present invention there is provided a combat simulation method including any system with any features or components depicted in the specification of the application or in Figures 1-3.

According to the teachings of the present invention there is provided a method for depleting target counter measures including: (a) a combat simulation system including: (i) a predator capable of simulating any illumination of any weapon system including: (1) an illumination source mounted on a modular platform and including a radar source and a laser source; and (2) a receiver electronically attached to the illumination source and responsive to signals transmitted from a remote control; and (ii) a target including: (1) a target illumination detector responsive to illumination from the illumination source; (2) a warning system for warning on any illumination detected by the target detector; and (3) a weapon system responsive to the target illumination detector and capable of neutralizing any threat from the predator or performing any real or simulated defensive measures against the predator; and (b) illuminating the target with an illumination of a weapon system originating from the illumination source, such that the target will exploit target defensive counter-measures.

According to further embodiments of the method for depleting target counter measures according to the present invention the illumination source includes a tunable laser.

According to further embodiments of the method for depleting target counter measures according to the present invention the radar source includes a variable frequency generator.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention is herein described, by way of example only, with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic view of the components making up the system according to the present invention and mounted on a model aircraft and a target tank;

FIG. 2 is a schematic view of the system mounted on model aircraft and for simulating an attack against a tank; and

FIG. 3 is a schematic diagram of preferred components of the system of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is a combat simulation system and method, which can be used with a model of a weapon platform for simulating firing upon real targets as well as target "hits", and for registering the firing and the hits.

The principles and operation of a combat simulation system according to the present invention may be better understood with reference to the drawings and the accompanying description.

Typically, aircraft combat simulations are held between two or more

aircraft in a pre-defined air envelope, which defines minimum and maximum altitudes as well as areas and altitudes where engagement is permitted.

Every user or pilot then maneuvers their aircraft to a starting point where the combat commences and each user or pilot starts maneuvering their aircraft until another aircraft is within the line of sight where the user or pilot will activate their weapon system, scoring a "kill".

Typically, most users or pilots will try to execute sharp angles of attack, which make it harder for a prospective target to successfully perform evasive maneuvers and tactics.

Obviously, with real aircraft, live fire is not an option available due to risk of injury or death to the participants.

Live fire simulations can only be performed with the real aircraft performing offensive maneuvers as a predator and against an unmanned aerial vehicles (UAV's), vertical takeoff and landing vehicles (VTOL's) and drones.

Hereinafter the term "UAV" refers to any unmanned aerial vehicle including, but not limited to: UAV's, VTOL's and drones.

In the case of remote controlled models used in such simulations, the users control the models from the remote location and are usually limited to the range of the transmitters in the remote controls.

A typical combat simulation of models will take place in the air space immediately above the heads of the users and may include several models attempting to maneuver to a firing position in relation to the other models.

A ship combat simulation will typically take place in the sea, a pool or a

pond, using manned and unmanned remote controlled sea vessels.

The simulation will often be a re-creation of a famous battle or a conventional combat simulation.

The users will often attempt to maneuver their ships to a firing position permitting broadside hits.

Hits between the bow and the beam are especially favored, as they probably would have resulted in the target ship sinking if real shells had been fired.

Hereinafter, the term "wireless device" refers to any device, which is capable of transmitting a signal to a receiver, which is not in direct physical proximity to the wireless device as well as any device, which is not attached to a controlling apparatus with an electrically conductive wire.

Hereinafter, the term "illumination" refers to any radiation originating from a predator platform, which simulates any "active" weapon or guidance system including, but not limited to: firing a weapon upon a target, releasing coherent electromagnetic radiation and microwave energy used to guide weapon systems to a target and radar radiation used by aircraft and missiles for "locking on" and guiding weapon systems to a target.

Hereinafter, the term "real target" refers to any target including a laser detection system or "illumination" detection system, which provides detection coverage capabilities to identify the region of origination of the laser or illumination or, identification of potential direct or indirect laser or illumination energy and automatically alerts the target or the target occupiers to the detected

laser or illumination and the direction of laser or illumination origination. Furthermore, the detection and relevant parameters can be relayed to a remote station for analysis and battlefield assessment.

Referring now to the drawings, Figure 1 illustrates the basic components of a system according to the present invention, wherein a first remote control **10**, operated by a user, activates a first illumination source **12**. After the user has maneuvered a modular platform **13**, on which first illumination source **12** is mounted, into a firing position.

As shown, first remote control **10** sends a signal along a path, generally indicated as "χ", to first illumination source **12**. The illuminating radiation, emitted by first illumination source **12**, travels along a path generally indicated as "α", and contacts a target **14**, which can be substantially illuminated by first illumination source **12**. A target illumination detector **16**, situated on target **14** and responsive to illumination from first illumination source **12**, picks up illumination radiation illuminating target **14**.

Preferably, first radiation source **12** is suitably mounted on a predator platform **18**. Preferably, illumination source **12** includes a laser **20**. Laser sources sufficiently small and lightweight to be mounted on small model aircraft are well known in the art. Laser sources of such dimensions have been disclosed in U.S. Pat. Nos. 5,179,235 and 5,435,091 granted to Tolle and U.S. Pat. No. 5,509,226 granted to Houde-Walter, to name but a few.

Preferably, laser **20** is a pulsed semiconductor laser **20**.

More preferably, pulsed semiconductor laser **20** is operated according to

the Standard for MILES Communication Code Structure.

Preferably, modular platform **13** can be transferred *in situ* from one predator **18** to another predator **18** for ready replacement, maintenance and the like.

Preferably, predator platform **18** includes a source of radar radiation **22** for creating radar radiation and simulating radars of aircraft, weapon systems and missiles.

More preferably, radar radiation source **22** is within the L (Lima), C (Charlie), X and Ku frequencies commonly used in military radars.

More preferably, radar radiation source **22** further simulates other characteristics of common radars like type of scan and Pulse Repetition Frequency (PRF).

Preferably, predator platform **18** further includes a predator processor **23** to activate and deactivate first illumination source **12** according to the simulation framework and the predetermined flight envelope in which combat commences and takes place.

Preferably, predator **18** is capable of performing any defensive or offensive procedures according to survivability and tactical priorities determined by predator processor **23**.

Preferably, the system is mounted on weapon platforms as shown in Figure 1 and Figure 2. Typically, the system will be mounted on model aircraft. First radiation source **12** is mounted on predator model **18**. Predator model **18** is maneuvered by the user such that target **14** is within the line of sight of first

radiation source **12**. Target illumination detector **16** is suitably mounted on target **14** to illumination from predator **18**. Target detector **16** is also connected to a weapon system **24** mounted on target **14**.

Preferably, weapon system **24** is either the integral weapon system of target **14** or a dedicated weapon system capable of damaging and destroying predator **18**. Preferably, after target detector **16** detects illumination, target detector **16** transmits a signal to weapon system **24** where a firing solution upon predator **18** is processed on a weapon system processor **26**.

Thereafter and in accordance with the settings of weapon system **24**, simulated fire is performed on predator **18**, utilizing coherent electromagnetic radiation or other illumination apparatus. Alternatively, actual live fire commences against predator **18** until predator **18** is neutralized. Namely, predator **18** is incapacitated or cannot pose a real or simulated "threat" to target **14**.

Preferably, remote control **10** includes a remote control transceiver **28** for sending signals from remote control **10** by sending a signal along the path, generally indicated as "χ", from transceiver **28** to predator **18**.

Preferably, target **14** features a plurality of target illumination detectors **16**.

Typically, target **14** features a target indicator **30** indicating when target detectors **16** detect illumination.

Alternatively, target indicator **30** features a display **32** for displaying the number of times in which target detectors **16** detects an illumination.

Optionally, a predator illumination detector **34** is suitably mounted to receive reflected radiation from target **14** along path "ß". Predator illumination detector **34** is also connected to a transmitter **36** mounted on predator **18**. Predator transmitter **36** transmits a signal to remote control **10**, after illumination "fired" by illumination source **12** at target **14** is reflected from target **14** and returns to predator **18**, where predator detector **34** detects illumination.

Due to the fact that predator **18** is capable of illuminating target **14** with a wide variety of illumination types, which simulate a plurality of weapon systems and weapon guidance systems, and the fact that predator **18** is unmanned, live fire retaliatory procedures are facilitated against predator **18** without risking injury or death of the user controlling predator **18**.

Furthermore, the unique combination of illumination apparatus on a model predator **18** facilitates multiple dry fire runs culminating with a live fire run in a single session.

Further still, the unique combination of illumination apparatus on a model predator **18** facilitates damaging or destroying predator **18** while incurring significantly reduced costs by using a model predator UAV **18**.

Preferably, first illumination source **12** is mounted on predator model **18** such that target **14** is within the line of sight of predator **18** and first illumination source **12**. Radiation detector **34** is suitably mounted to receive reflected illumination from target **14** along path "ß". Predator transmitter **36** transmits a signal to remote control transceiver **28**, after illumination radiation

is "fired" by illumination source **12** at target **14**, contacting target **14** and returned to predator detector **34**, where it is duly detected by predator detector **34**.

Preferably, target **14** also features target detectors **16** connected to a detection processor **38**, which processes the signal from detectors **16** and converts them to an amplified digital signal for identification of weapon system and threat.

Preferably, processor **38** determines which sensor **16** detects the strongest illumination level and generates a directional vector to illumination source **12** for displaying on display **32**, such that in accordance with the settings of weapon system **24**, target **14** can commence simulated fire on predator **18**, utilizing coherent electromagnetic radiation or other illumination apparatus.

Alternatively, actual live fire commences against predator **18** until predator **18** is neutralized. Namely, predator **18** is incapacitated or cannot pose a real or simulated "threat" to target **14**.

Preferably, display **32** provides real-time display for positioning laser **20** and radar source **22**, thereby warning the operators of weapon system **24** of the existence, the type, the characteristics and the direction of the detected laser **20** and radar source **22**. Locating of laser **20** is performed according to which detector **16** detects the strongest illumination level and the variance between illumination levels detected by detectors **16**, as well as the margin between illumination detection by detectors **16**.

Furthermore, the wavelength, coding and modulation of the illumination detected by detectors **16** are displayed on display **32**.

Alternatively, display **32** displays the predetermined coding of the simulated weapon system and the type of weapon system.

Preferably, display **32** displays the type of laser **20** and radar source **22**. By way of example only, a short-pulse laser having a frequency of substantially less than 2.0 Hz, will be displayed on display **32** as a range finder used by the armed forces for measuring distances and providing positioning readings for long-range weapons. By way of example only, conical X-band scanning pattern radars detected by detectors **16** will be displayed either as fire control radars or as a missile, depending on the frequency, wavelength and PRF detected. A pulse laser having a frequency between 2-20 Hz, will be displayed on display **32** as a laser target designator.

Alternatively, indicator **30** includes a score board **40** for scoring the number of times target detectors **16** detected illumination as well as the history of illumination types, characteristics, the method in which the "threat" was addressed and the success rates of the tactics used against laser **20** and radar source **22**.

Although the present invention has been described in terms of ship, tank and aircraft platforms, it will be appreciated that the present invention may be used with any combination or plurality of tanks, submarines or any platform capable of using a weapon system as well as any weapon system.

Figure 2 illustrates a preferred embodiment of the system according to

the present invention, wherein a first remote control **10**, operated by a user, activates a first illumination source **12**.

After the user has maneuvered a modular platform **13**, on which first illumination source **12** is mounted, into a firing position. First remote control **10** sends a signal along a path, generally indicated as "χ", to first illumination source **12**. The illuminating radiation, emitted by first illumination source **12**, travels along a path generally indicated as "α", and contacts a target **14**, which can be substantially illuminated by first illumination source **12**.

Like above, a target illumination detector **16**, situated on target **14** and responsive to illumination from first illumination source **12**, picks up illumination radiation illuminating target **14**.

Here as well, first radiation source **12** is preferably mounted on a modular platform **13**. Preferably, illumination source **12** includes a laser **20**.

Preferably, laser **20** is a pulsed semiconductor laser **20**.

More preferably, pulsed semiconductor laser **20** is operated according to the Standard for MILES Communication Code Structure or similar weapon simulation systems.

Preferably, first illumination source **12** includes a source of radar radiation source **22** for creating radar radiation and simulating radars of aircraft, weapon systems and missiles.

Preferably, illumination source **12** includes a predator processor **23** to activate and deactivate first illumination source **12** according to the simulation framework and the predetermined flight envelope in which combat commences

and takes place. Furthermore, illumination source **12** preferably also includes radar radiation source **22**, laser **20** and predator processor **23** as well as modular platform **13** being readily transferable from one predator **18** to any other predator **18**.

Preferably, predator **18** is capable of performing any defensive or offensive procedures according to survivability and tactical priorities determined by predator processor **23**.

Preferably, illumination source **12** can be independently aligned towards target **14**, irrespective of the alignment of target **14** in relation to predator **18**.

More preferably, radar radiation **22** is within the L (Lima), C (Charlie), X and Ku frequencies commonly used in military radars.

More preferably, radar radiation **22** further simulates other characteristics of common radars like type of scan, PRF and any other characteristics.

Typically, the system of the present invention will be mounted on a model aircraft. First illumination source **12** is mounted on modular platform **13**. Modular platform **13** is maneuvered and displaced by the user such that target **14** is within the line of sight of first illumination source **12**, irrespective of the alignment between predator **18** and target **14**. Target illumination detector **16** is suitably mounted on target **14** to illumination from predator **18**. Target detector **16** is also connected to a weapon system **24** mounted on target **14**.

Preferably, weapon system **24** is either the integral weapon system of target **14** or a dedicated weapon system capable of damaging and destroying

predator **18**. Preferably, after target detector **16** detects illumination, target detector **16** transmits a signal to weapon system **24** where a firing solution upon predator **18** is processed on a weapon system processor **26**.

Thereafter and in accordance with the settings of weapon system **24**, simulated fire is performed on predator **18**, utilizing coherent electromagnetic radiation or other illumination apparatus. Alternatively, actual live fire commences against predator **18** until predator **18** is neutralized. Namely, predator **18** is incapacitated or cannot pose a real or simulated "threat" to target **14**.

Preferably, remote control **10** includes a remote control transceiver **28** for sending signals to first illumination source **12** by sending a signal along the path, generally indicated as "χ", to first illumination source **12**.

More preferably, remote control **10** includes a first laser-activating switch **42** for predator **18** to illuminate target **14** with radiation of a first type of laser system. Furthermore, remote control **10** preferably includes a second laser-activating switch **44** for predator **18** to illuminate target **14** with radiation of a second type of laser system. Thus, the user, which controls predator **18** with remote control **10**, can readily select the type of illumination desired for any simulation.

Preferably, remote control **10** also includes a first radar radiation-activating switch **46** for predator **18** to illuminate target **14** with a radiation of a first type of radar system. Furthermore, remote control **10** also includes a second radar radiation-activating switch **48** for predator **18** to illuminate target

14 with a radiation of a second type of radar system.

Preferably, target **14** features a plurality of target illumination detectors **16**.

Preferably target **14** is in communication with a remote station **50**, for reporting and analyzing any illumination detected by detectors **16**. Typically, remote station **50** features a receiver **52** and a target indicator **54** indicating when target detectors **16** detect illumination.

Alternatively, target indicator **54** features a display **56** for displaying the number of times in which target detectors **16** detects an illumination and type and characteristics of the illumination detected by detectors **16**.

Due to the fact that predator **18** has the capability of illuminating target **14** with a wide variety of illumination types, which simulate a plurality of weapon systems and weapon guidance systems, and the fact that predator **18** is an unmanned, live fire retaliatory procedures are facilitated against predator **18** without risking injury or death of the user controlling predator **18**.

Furthermore, the unique combination of illumination apparatus on a model predator **18** facilitates multiple dry fire runs culminating with a live fire run in a single session.

Further still, the unique combination of illumination apparatus on a model predator **18** facilitates damaging or destroying predator **18** while significantly reducing costs by using a model predator UAV **18**.

Preferably, first illumination source **12** is mounted on predator model **18** such that target **14** is within the line of sight of modular platform **13** and first

illumination source **12**. Radiation detector **34** is suitably mounted on predator **18** for receiving reflected illumination from target **14** along path "ß". Predator transmitter **36** transmits a signal to remote control **10**, after illumination radiation is "fired" by illumination source **12** at target **14**, contacting target **14** and returned to predator detector **34**, where it is duly detected by predator detector **34**.

Like above, target **14** also features target detectors **16** connected to a detection processor **38** which processes signals from detectors **16** and converts them to amplified digital signals for identification of weapon systems and threats.

Processor **38** determines which sensor **16** detects the strongest illumination level and generates a directional vector to illumination source **12** for displaying on display **56**, such that in accordance with the settings of weapon system **24**, target **14** can commence simulated fire on predator **18**, utilizing coherent electromagnetic radiation or other illumination apparatus.

Alternatively, actual live fire commences against predator **18** until predator **18** is neutralized. Namely, predator **18** is incapacitated or cannot pose a real or simulated "threat" to target **14**.

Preferably, display **56** provides real-time display for positioning illumination source **12** and warning the operators of weapon system **24** of the existence, the type and the direction of the detected illumination source **12** based upon which detector **16** detects the strongest illumination level an the variance between illumination levels detected by detectors **16**, as well as the

margin between illumination detection by detectors **16** and the wave length of the illumination detected.

Preferably, display **56** displays the type of illumination source **12**. By way of example only, a short-pulse laser having a frequency of substantially less than 2.0 Hz, will be displayed on display **56** as a range finder used by the armed forces for measuring distances and providing positioning readings for long-range weapons. By way of example only, conical X-band scanning pattern radars detected by detectors **16** will be displayed either as fire control radars or as a missile, depending on the frequency and PRF detected. A pulse laser having a frequency of at least than 2.0 Hz, fired will be displayed on display **56** as a laser range finder.

Alternatively, target **14** includes a score board **40** for scoring the number of times target detectors **16** detected illumination as well as the history of illumination types, the method in which the "threat" was addressed and the success rates of the tactics used against illumination source **12**.

Although the present invention has been described in terms of ship, tank and aircraft platforms, it will be appreciated that the present invention may be used with any combination or plurality of tanks, submarines or any platform capable of using a weapon system as well as any weapon system.

Figure 3 is a schematic diagram of preferred components of the system of the present invention illustrating a preferred basic embodiment of the system.

A first remote control **10**, operated by a user, activates a first

illumination source **12**. A target **14** including an illumination detector **16**, responsive to illumination from first illumination source **12**, picks up illumination radiation illuminating target **14**.

Preferably, predator **18** includes a receiver **58** including an amplifier **60** for amplifying signals from remote control transceiver **28** and a processor **62** for processing signals from remote control **10**.

Preferably, illumination source **12** includes a first laser modulator **64** for producing laser radiation of a first laser system. Preferably, first illumination source **12** includes a second laser modulator **66** for producing laser radiation of a second laser system. More preferably, first laser modulator **64** is a variable laser modulator for producing laser radiation of a plurality of laser systems.

Preferably, illumination source **12** includes a first frequency generator **68** for producing radar radiation of a first radar system. Preferably, first illumination source **12** includes a second frequency generator **70** for producing radar radiation of a second radar system. More preferably, first frequency generator **68** is a variable frequency generator for producing radar radiation of a plurality of radar systems.

An antenna **72** for illuminating target **14** with radar radiation is electronically attached and responsive to first frequency generator **68** and second frequency generator **70**.

A laser source **74** for illuminating target **14** with laser radiation is electronically attached and responsive to first laser modulator **64** and second laser modulator **66**. Additionally, a tunable laser **75** is electronically attached to

laser modulator **64** for illuminating target **14** with illumination having a variety of wavelengths.

Target **14** includes a first optical illumination detector **76** suitably mounted on target **14** to detect illumination. Preferably target **14** also includes a radar radiation detector **78** for detecting radar radiation.

A laser radiation amplifier **80** is electronically connected to a threat processor **82** for analysis of the type and degree of threat of the laser system detected.

Preferably, illumination detector **76** also transmits any illumination detected to remote station **50** for threat analysis. Also preferably, radar radiation detector **78** also transmits any radar radiation detected to remote station **50**.

Thus, training simulations of a wide variety are facilitated including, but not limited to, regular training, two sided training and MILES and weapon simulation system simulations of any type.

A radar radiation amplifier **84** is also electronically connected to threat processor **82** for analysis of the type and degree of threat of the radar system detected.

Preferably, threat processor **82** is also electronically connected to a warning system **86** for warning on any threats by any system detected. Preferably, warning system **86** includes an alarm and warning display **88** for alerting occupants of target **14** to the threats.

Upon a threat being detected by optical detector **76** and radar detector **78**

a weapon system **24** mounted on target **14** is used to neutralize any threats posed by illumination source **12**. Preferably, weapon system **24** is either the integral weapon system of target **14** or a dedicated weapon system capable of damaging and destroying any illumination system. Preferably, after target detector **16** detects illumination, target detector **16** transmits a signal to weapon system **24** where a firing solution upon illumination source **12** is processed on threat processor **82**.

Thereafter and in accordance with the settings of weapon system **24**, simulated fire is performed on illumination source **12**, utilizing coherent electromagnetic radiation or other illumination apparatus. Alternatively, actual live fire commences against illumination source **12** until illumination source **12** is neutralized. Namely, illumination source **12** is incapacitated or cannot pose a real or simulated "threat" to target **14**.

Preferably, remote control **10** includes a remote control transceiver **28** for sending signals to first illumination source **12** by sending a signal along the path, generally indicated as "χ", to first illumination source **12**.

More preferably, remote control **10** includes a first laser-activating switch **42** for illumination source **12** to illuminate target **14** with radiation of a first type of laser system. Furthermore, remote control **10** preferably includes a second laser-activating switch **44** for illumination source **12** to illuminate target **14** with radiation of a second type of laser system.

Preferably, remote control **10** also includes a first radar radiation-activating switch **46** for illumination source **12** to illuminate target **14** with a

radiation of a first type of radar system. Furthermore, remote control **10** also includes a second radar radiation-activating switch **48** for illumination source **12** to illuminate target **14** with a radiation of a second type of radar system.

Preferably, target **14** features a plurality of target illumination detectors **16**.

Preferably for the purpose of for reporting and analyzing any illumination detected by detectors **16**, a target transmitter **90** is situated on target **14** and is in communication with a remote station **50**. Typically, remote station **50** features a receiver **52** and a target indicator **54** indicating when target detectors **16** detect illumination.

Alternatively, target indicator **54** features a display **56** for displaying the number of times in which target detectors **16** detects an illumination.

Due to the fact that illumination source **12** is capable of illuminating target **14** with a wide variety of illumination types, which simulate a plurality of weapon systems, MILES and other simulation systems and weapon guidance systems, and the fact that illumination source **12** is mounted, by way of example only, on an Unmanned Aerial Vehicle (UAV), live fire retaliatory procedures are facilitated against illumination source **12** without risking injury or death of the user controlling illumination source **12**.

Furthermore, the unique combination of illumination apparatus on a model facilitates multiple dry fire runs culminating with a live fire run in a single session.

Preferably, display **56** provides real-time display for positioning

illumination source **12** and warning the operators of weapon system **24** of the existence, the type and the direction of the detected illumination source **12** based upon which detector **16** detects the strongest illumination level an the variance between illumination levels detected by detectors **16**, as well as the margin between illumination detection by detectors **16**. Furthermore, the wavelength, coding and modulation of the illumination detected by detectors **16** are displayed on display **56**.

Preferably, display **56** displays the type of illumination source **12**. By way of example only, a short-pulse laser having a frequency of substantially less than 2.0 Hz, will be displayed on display **56** as a range finder used by the armed forces for measuring distances and providing positioning readings for long-range weapons. By way of example only, conical X-band scanning pattern radars detected by detectors **16** will be displayed either as fire control radars or as a missile, depending on the frequency and PRF detected. A pulse laser having a frequency of between 2-20 Hz, will be displayed on display **56** as a laser target designator.

Alternatively, display **56** includes a target score board **92** for scoring the number of times target detectors **16** detected illumination as well as the history of illumination types, the method in which the "threat" was addressed and the success rates of the tactics used against illumination source **12**.

Thus, predator **18** can be used as a decoy in actual battles due to predator **18** being capable of illuminating a plurality of targets **14** with illumination of a plurality of weapon systems. Thus, defensive counter-

measures will be exploited against predator **18**, thereby creating a valuable offensive tool for any armed force.

Although the present invention has been described in terms of ship, tank and aircraft platforms, it will be appreciated that the present invention may be used with any combination or plurality of tanks, submarines or any platform capable of using a weapon system or any weapon system.

It will be appreciated that the above descriptions are intended only to serve as examples, and that many other embodiments are possible within the spirit and the scope of the present invention.

WHAT IS CLAIMED IS:

1. A combat simulation system including:

(a) a predator including:

(i) an illumination source; and

(ii) a receiver electronically attached to said illumination source and responsive to signals transmitted from a remote control; and

(b) a target including:

(i) a target illumination detector responsive to illumination from said illumination source; and

(ii) a weapon system responsive attached to said target illumination detector and capable of neutralizing any threat from said predator.

2. The combat simulation system of claim 1, wherein said predator can simulate any illumination of any weapon system.

3. The combat simulation system of claim 2, wherein said target weapon system can simulate any simulated defensive measures against said predator.

4. The combat simulation system of claim 1, wherein said illumination

source includes a radar source.

5. The combat simulation system of claim 1, wherein said illumination source further includes a laser.

6. The combat simulation system of claim 5, wherein said laser source includes a laser modulator.

7. The combat simulation system of claim 1, wherein said target includes a warning system for warning on any illumination detected by said target detector.

8. The combat simulation system of claim 1, wherein said illumination source includes a radar source and a laser.

9. The combat simulation system of claim 1, wherein said target includes a warning system for warning on any threats posed by any system detected.

10. A combat simulation system including:

(a) a predator capable of simulating any illumination of any weapon system including:

(i) an illumination source mounted on a modular platform and

including a radar source and a laser source; and

(ii) a receiver electronically attached to said illumination source and responsive to signals transmitted from a wireless remote control device; and

(b) a target including:

(i) a target illumination detector responsive to illumination from said illumination source;

(ii) a warning system for warning on any illumination detected by said target detector; and

(ii) a weapon system responsive to said target illumination detector.

11. The combat system of claim 10, wherein said modular platform is readily transferable from said predator to any other predator platform.

12. The combat system of claim 10, wherein said illumination source is independently alignable towards said target, irrespective of the alignment of said target in relation to said predator.

13. The combat system of claim 10, wherein said illumination source includes a tunable laser.

14. A combat simulation system including:

(a) a predator capable of simulating any illumination of any weapon system including:

(i) an illumination source;

(ii) a processor for controlling said predator according to simulation framework or the predetermined flight envelope or mission priorities in which combat takes place; and

(b) a target including:

(i) a target illumination detector responsive to illumination from said illumination source; and

(ii) a weapon system responsive to said target illumination detector and capable of neutralizing any threat from said predator or performing any real or simulated defensive measures against said predator.

15. The combat simulation system of claim 14, wherein said predator and said illumination are autonomously controlled and operated.

16. The combat simulation system of claim 14, wherein said predator further includes a predator illumination detector and predator processor for detecting and processing reflected illumination from said target or illumination by said weapon system.

17. The combat simulation system of claim 14, wherein said predator is capable of performing any defensive or offensive procedures according to survivability and tactical priorities determined by said predator processor.

18. The combat simulation system of claim 14, wherein said target retaliates automatically to any illumination detected by said target detector.

19. The combat simulation system of claim 18, wherein said target includes a database of all illuminations detected by said target detector and all defensive or retaliatory measures taken against said illumination source.

20. The combat simulation system of claim 14, wherein said illumination source includes a radar source.

21. The combat simulation system of claim 20, wherein said radar source includes a variable frequency generator.

22. The combat simulation system of claim 14, wherein said illumination source further includes a laser.

23. The combat simulation system of claim 22, wherein said laser source includes a laser modulator.

24. The combat simulation system of claim 14, wherein said illumination source is a pulsed semiconductor laser.

25. The combat simulation system of claim 24, wherein said pulsed semiconductor laser is operated according to the Standard for MILES Communication Code Structure

26. The combat simulation system of claim 24, wherein said pulsed semiconductor laser is operated according to any weapon simulation system coding structure.

27. The combat simulation system of claim 24, wherein said pulsed semiconductor laser is operated according to any integrated multiple weapon simulation system.

28. A combat simulation system including any of the features or components depicted in the specification of the application or in Figures 1-3.

29. A combat simulation method including any system with any features or components depicted in the specification of the application or in Figures 1-3.

30. A method for depleting target counter measures including:

(a) a combat simulation system including:

(i) a predator capable of simulating any illumination of any weapon system including:

(1) an illumination source mounted on a modular platform and including a radar source and a laser source; and

(2) a receiver electronically attached to said illumination source and responsive to signals transmitted from a remote control; and

(ii) a target including:

(1) a target illumination detector responsive to illumination from said illumination source;

(2) a warning system for warning on any illumination detected by said target detector; and

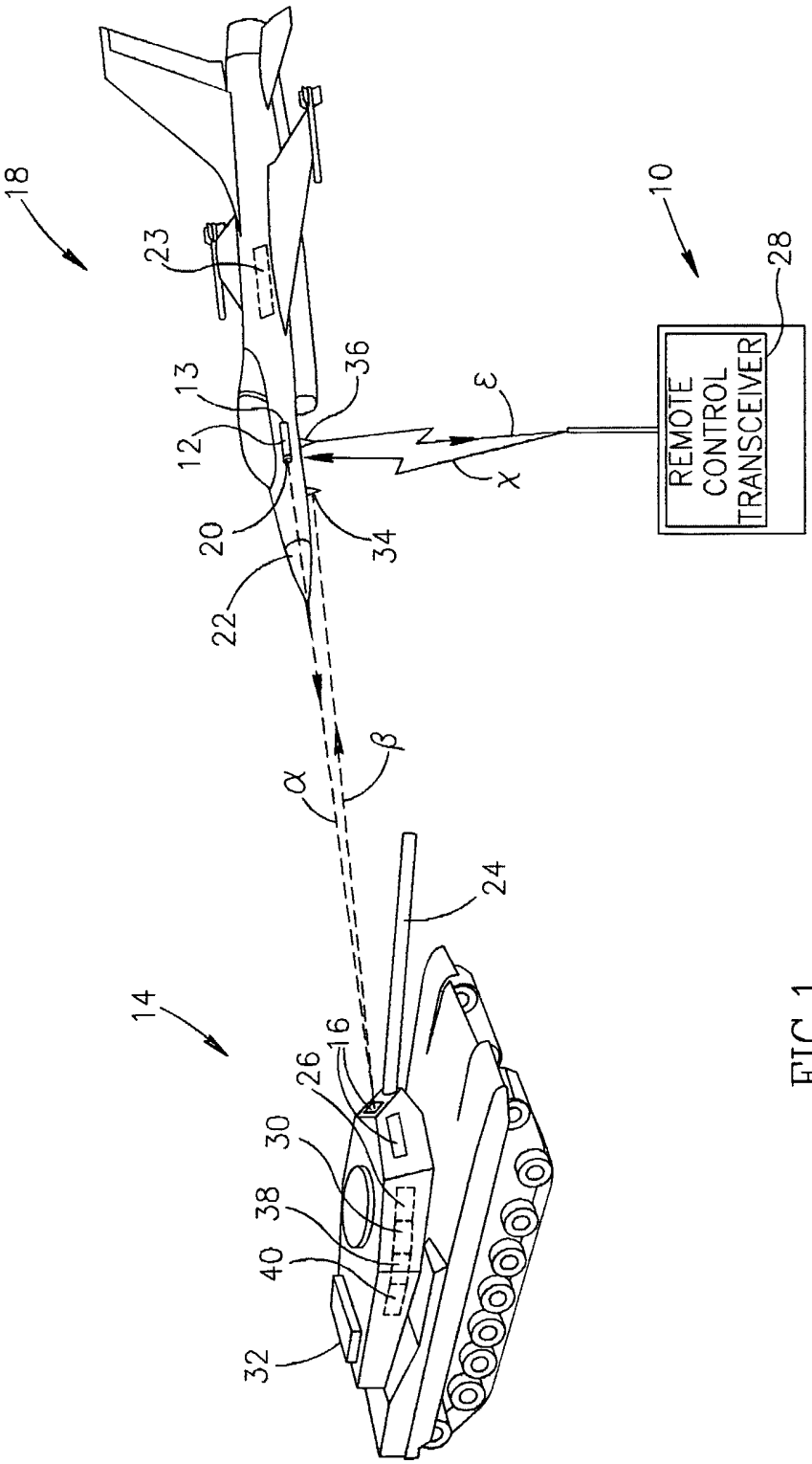
(3) a weapon system responsive to said target illumination detector and capable of neutralizing any threat from said predator or performing any real or simulated defensive measures against said predator;

and

(b) illuminating said target with an illumination of a weapon system originating from said illumination source, such that said target will exploit target defensive counter-measures.

31. The method for depleting target counter measures of claim 30, wherein said illumination source includes a tunable laser.

32. The method for depleting target counter measures of claim 30, wherein said radar source includes a variable frequency generator.


18
23
13
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22
36
34
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28
REMOTE CONTROL TRANSCEIVER
α
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24
14
16
26
30
38
40
32

FIG.1

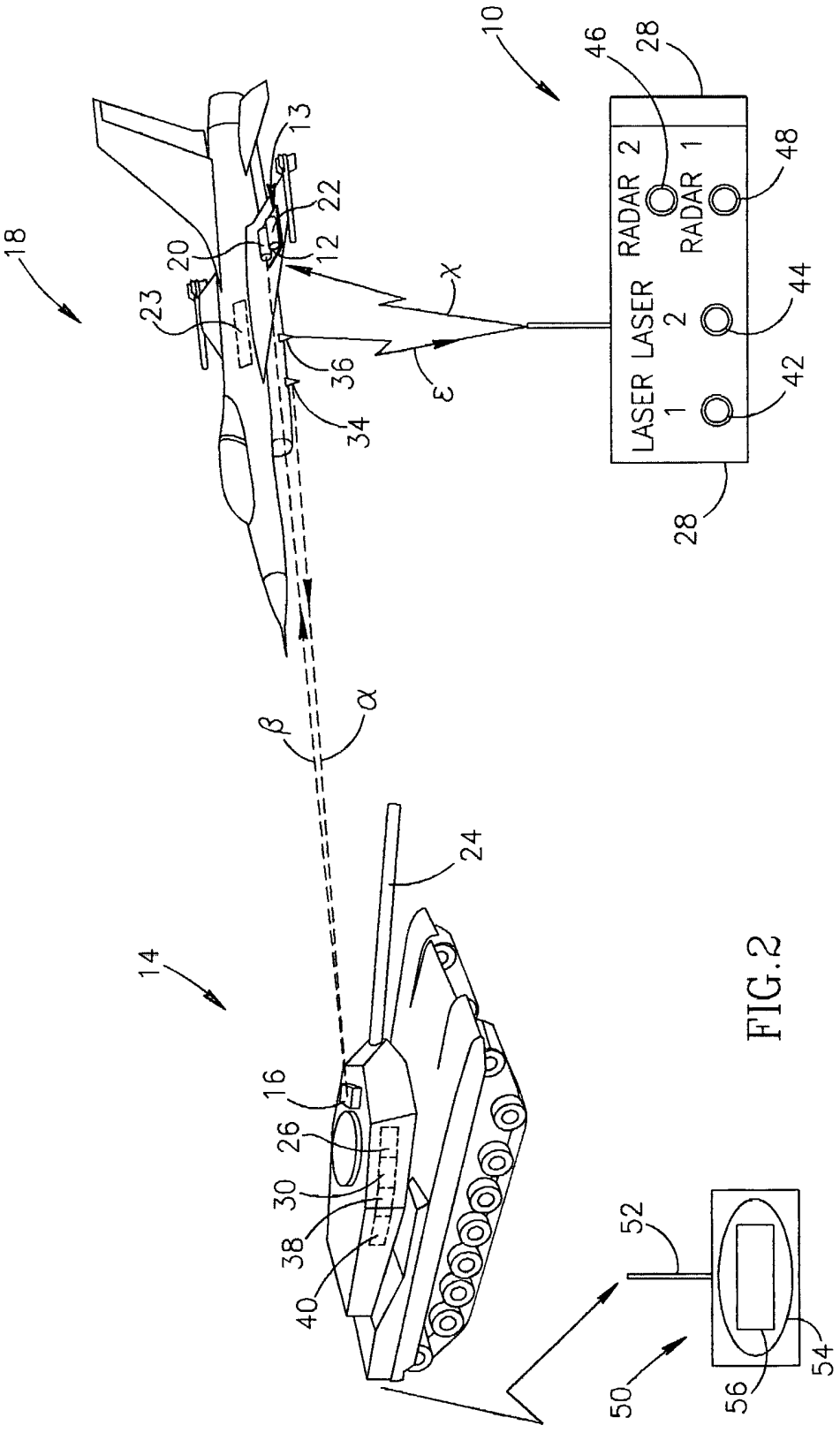
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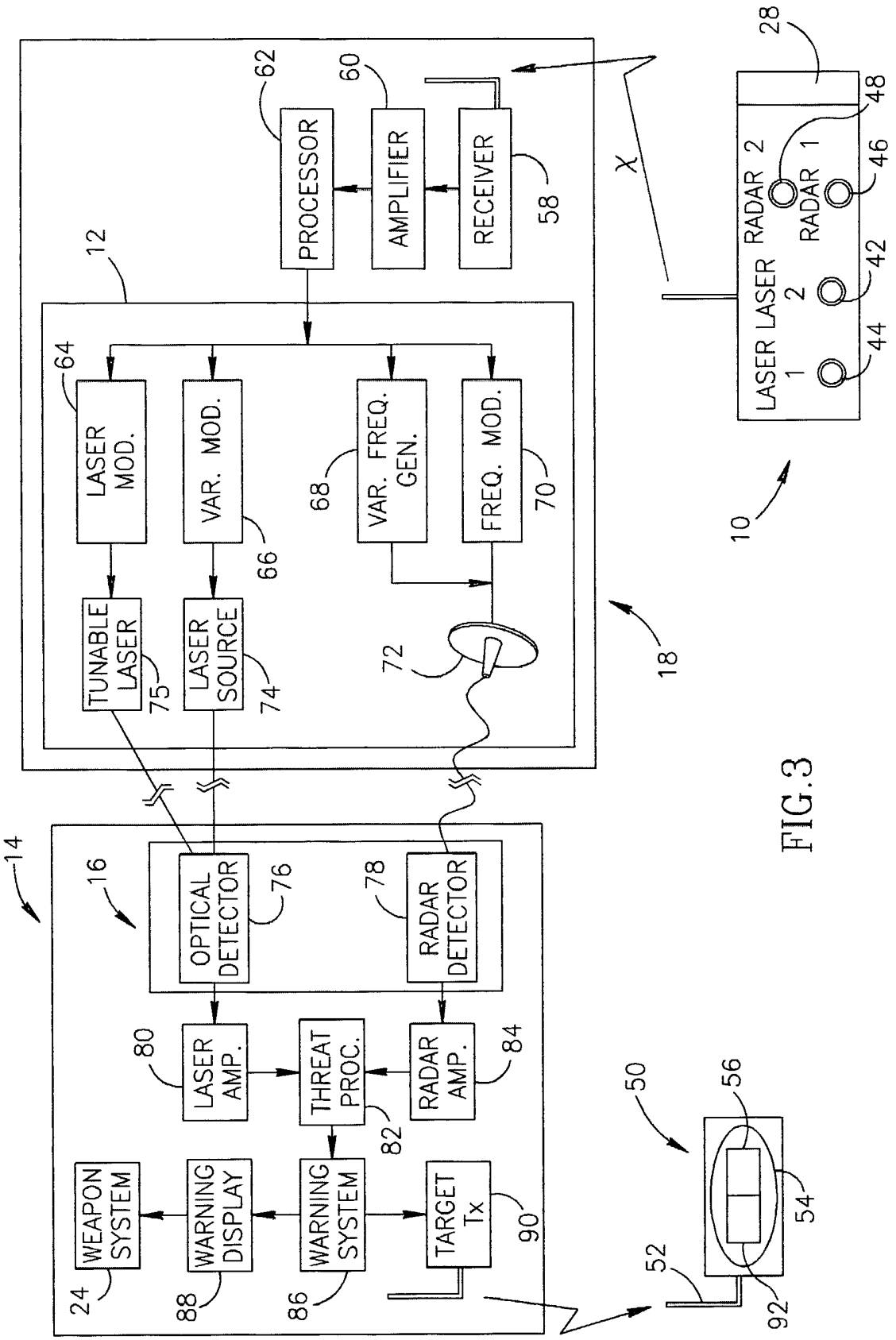
FIG.2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48
46
42
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10
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AMPLIFIER
RECEIVER
12
64
LASER MOD.
VAR. MOD.
66
68
VAR. FREQ. GEN.
FREQ. MOD.
70
TUNABLE LASER
75
LASER SOURCE
74
72
18
14
16
OPTICAL DETECTOR
76
78
RADAR DETECTOR
80
LASER AMP.
THREAT PROC.
82
RADAR AMP.
84
WEAPON SYSTEM
24
WARNING DISPLAY
88
WARNING SYSTEM
86
TARGET Tx
90
50
56
54
52
92

FIG.3