A Missiles Defense System

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Introduction

Nuclear weapons, however powerful, turn meaningless if their transportation systems are nullified. A key method to detect a launch of ballistic missiles anytime anywhere is proposed in this memorandum. Two satellites observing the target area continuously take pictures of the area day and night. If a missile is launched, it can be detected by the images as bright spot from its hot propellant gas. The two images combined can detect the location of the missile.

On detection of the launched missile, it is also tracked by a radar system from the ground. Discriminating it from aircrafts by its altitude or speed, a missile defense system is triggered. The defending missile is launched and keeps guided by the tracking data on the target missile so it can close into the target accurately. The offense missile can then be carried back to its launcher or destroyed in the space.

1. Instantaneous Detection of the Target Missile

Let co-ordinate of the target missile be ; $\mathbf{r} = (x, y, z)$

Satellite A;

Location of Satellite A ; $\mathbf{ra} = (xa, ya, za)$,

Location A' of the missile projected on the ground ; $\mathbf{Ra} = (Xa, Ya, Za)$

Vector connecting A and A' ; $\mathbf{a} = \mathbf{ra} - \mathbf{Ra}$

Similar vectors for satellites B, ,,, ; **rb, Rb, b,**

Then the position of the missile can be calculated as the crossing of the following two lines;

AA' ; $\mathbf{ra} + t \cdot \mathbf{a} \quad (0 < t < 1)$

BB' ; $\mathbf{rb} + u \cdot \mathbf{b} \quad (0 < u < 1)$

Set

$$\mathbf{ra} + t \cdot \mathbf{a} = \mathbf{rb} + u \cdot \mathbf{b}$$

The solution;

$$ta = (\mathbf{rb} - \mathbf{ra}) \cdot \{ (\mathbf{a} \times \mathbf{b}) \times \mathbf{b} \} / \{ (\mathbf{a} \cdot \mathbf{b}) \cdot (\mathbf{a} \cdot \mathbf{b}) - (\mathbf{a} \cdot \mathbf{a}) \cdot (\mathbf{b} \cdot \mathbf{b}) \}$$

$$ub = (\mathbf{ra} - \mathbf{rb}) \cdot \{ (\mathbf{b} \times \mathbf{a}) \times \mathbf{a} \} / \{ (\mathbf{a} \cdot \mathbf{b}) \cdot (\mathbf{a} \cdot \mathbf{b}) - (\mathbf{a} \cdot \mathbf{a}) \cdot (\mathbf{b} \cdot \mathbf{b}) \}$$

where $\mathbf{a} \cdot \mathbf{b}$ is the inner product and $\mathbf{b} \times \mathbf{a}$ is the outer product of the vectors.

Then the position of the target missile is

$$\mathbf{r} = \mathbf{ra} + ta \cdot \mathbf{a} = \mathbf{rb} + ub \cdot \mathbf{b}$$

2. Missile Tracking System

The two satellites continuously take the images and send the data to the earth station. Based on the images the coordinate of the target missile is calculated. Thus the position of the target missile is continuously monitored by the satellites while the rocket engine emits the propellant gas.

Once the missile gets a sufficiently high altitude, it can be monitored by the terrestrial radar system. Three radar stations measure the distances and the Doppler frequency shifts of the target missile, which are collected and integrated at the missile tracking station to determine the position and velocity of the target missile.

We will design a radar system with the following features.

- Distances	up to 1,500 km
- Speed of target missile	3 times of sound velocity

Radar system

- Frame period (ms)	10
- Spectrum spreading by PN code	continuous
- Spread ratio	10^4

Link budget;

TX power (dBW)	40	
TX antenna gain (dBi)	20	
Forward link loss (1/(4 π .d^2) (dB/m^2)	-134.5	(d=1,500km)
Missile aperture (dBm^2)	10	
Return link loss (1/(4 π .d^2) (dB/m^2)	-134.5	(d=1,500km)
RX antenna aperture (dBm^2)	20	
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Power at RX antenna output (dBW)	-179	
Noise		
RX system temperature (dBK)	20	
Boltzman const k=1.33x10^-23	-228.6(dB)	
Noise power density (dBW/Hz)	-208.6	
Bandwidth (dB.Hz)	60 (PN Chip rate =1Mc/s)	
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Noise power (dBW)	-148.6	
RX C/N power ratio (dB)	-30.4	

Process gain (dB)	40.0	
Recovered pulse C/N power ratio(dB)	9.6	

Performances ;

Measurement frequency (times/sec)	100

Max missile movement per measurement (m)	10

Operation

The TX system transmits the PN code continuously. The RX system receives the radio wave reflected by the objects in the target directions. The PN processing system detects the timing of the receive pulse, which tells the radio wave propagation delay to/from the target missile. The timing is also used to operate a delay lock loop (DLL) circuit. The DLL gives the Doppler frequency shift that tells the velocity of the target missile toward the radar station.

The tracking station collects the delay and Doppler shifts data from more than two radar stations to determine the position and velocity of the target missile at the time.

The speed and the altitude of the target missile can be used to discriminate it from normal aircrafts. For example if the altitude of the target gets greater than 30 km, it is definitely not an aircraft and the missile destruction system is triggered.

3. Trigger of Missile Defense System

The missile defense missile is then launched as commanded by the missile tracking system. It is continuously guided by the positional data of the target missile. A great feature of the proposed method is not in hitting but in docking. The defense missile will track and dock with the offense missile..

4. Destruction of the target missile

If possible we want to return the offensive missile back to its launcher. Otherwise, destroy it in the space. It is required that the explosion be made at sufficiently high altitude in case a nuclear explosion should occur. At the altitude of 100km, the effect of a nuclear explosion on the ground will be small.

Conclusion

If the missile systems are nullified, the nuclear weapons will be meaningless. The proposed system can detect, track and destroy any missiles whenever and wherever. It can be readily implemented by application of the satellites, imagery, radar, signal processing, computing and military technologies today. It is purely defensive but more powerful than any powerful nuclear weapons system

The author sincerely wishes the proposed system will be implemented promptly to maintain the peace of the world.

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