A Space System to Nullify Nuclear Missiles for World Peace

Osamu Ichiyoshi
2018-2-11

Preface

Nuclear weapons will lose their military effects if the nuclear missiles systems are nullified.
It is proposed herein a system that can immediately detect the launches and track the orbits of the nuclear missiles, which will then be hunt, captured and returned to the launched sites. The launch of a nuclear missile can be immediately detected by at most two reconnaissance satellites. The position of the missile can be detected as the intersection of two straight lines given by the pictures taken by the satellites.
As the missiles exceed sufficiently high altitude, they can be monitored from afar by a long distance RADAR system that can observe objects of a few meters up to 3,000km away.
On detection of the targets being no normal aircrafts based on their altitude or speed, defense missiles will be launched. Unlike the conventional missiles defense systems, the defense missiles do not hit the targets, but run after, close in and catch them. The defense missiles then alter the orbits so they can carry the "stray" nuclear missiles back to their homes.
The proposed system will be able to capture the dreadful nuclear missiles with perfect certainty to destroy them in space or return them to their launchers.
The proposed system, if deployed widely can make the nuclear weapons meaningless and secure the peace of the world.

1. Immediate detection of missile launch by at most two reconnaissance satellites

Two pictures taken by two separate satellites are compared to detect the launch and position of the nuclear missile by the following methods.

Let the following parameters be;

Coordinate of the missile; $\mathbf{r} = (x, y, z)$

Coordinate of Satellite A ; $\mathbf{r}a = (xa, ya, za)$,

Position A' of the missile on the picture taken by satellite A; $\mathbf{R}a = (Xa, Ya, Za)$

Straight line vector connecting A' and A; $\mathbf{a} = \mathbf{r}a - \mathbf{R}a$

Similar vectors can be defined for satellite B as **rb, Rb** and **b.**

Then the position of the missile can be detected as the intersection of the following two vectors.

Straight line AA' ; $\mathbf{r}a + t \cdot \mathbf{a}$ $(0 < t < 1)$

Straight line BB' ; $\mathbf{r}b + u \cdot \mathbf{b}$ $(0 < u < 1)$

By setting

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

The solution is;

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

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

where $\mathbf{a} \cdot \mathbf{b}$, $\mathbf{b} \times \mathbf{a}$ are scalar and vector products of vectors **a, b.**

The position of the missile is then given by

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

2. Tracking orbits of nuclear missiles by long range RADAR

As the altitudes of the offense missiles get sufficiently high, it becomes possible to be monitored by the long ranges RADAR system. A design of such a system is given in the following section.

[1] Target capability

— Velocity in view of the missile ; 2,000 (m/s)

— Range of measurement ; Up to 3,000km

[2] Type of RADAR

PN code modulated signal is transmitted for 10ms and the reflected waves from any objects received and monitored for 20ms. With different PN codes it is possible for multiple RADAR stations to share the same frequency. Three separate RADAR stations are needed to determine the position of the target missile.

For exact integration of the receive PN coded signal, the phase of the signal needs to remain constant during the integration. Therefore the frequency errors should be sufficiently smaller than the inverse of the signal duration (10ms), or 100Hz. The Doppler frequency shifts can be much greater than 100(Hz), hence the correlation integration of the PN code shall be made for signals frequency converted to baseband in 10Hz steps.

Comparing the PN correlation detected signals with the transmit signal, the time delays and frequency differences can tell the distance and speed in view of the target missile.

[2] Radio Frequency

The RADAR must have very small rain attenuation for its long ranges of observation. The size of the target nuclear head will be in a few meters. For those reasons a radio wave with 1 meter wave length is assumed in the design.

[3] Link Power Budget

Let transmit(TX) power be Pt, TX antenna gain; Gt, distance to the target; d, radar aperture of the target; σ、aperture of the receive(RX) antenna; Ar.

Then the signal power obtained at the output of the receive antenna is given by the equation;

$$Pr = Pt \cdot Gt / (4\pi \cdot d^2) \cdot \sigma / (4\pi \cdot d^2) \cdot Ar$$

The design figures are given in the following table.

Table 1　RADAR system parameters

Target	Distance of the target　d (km)	1500
	Speed in view of the target (km/s)	2000
Transmitter	TX Power Pt　(dBW)	40
	TX antenna gain Gt (dBi)	20
Forward path	Distance d (km)	1500
	Path loss ; 1/(4 π .d^2)　(dB/m^2)	-134.5
Target object	Radar aperture　σ　(m^2)	10
Return path	Distance d (km)	1500
	Path loss; 1/(4 π .d^2)　(dB/m^2)	-134.5
RX antenna	Antenna effective aperture Ar　(dBm^2)	20
	RX power at antenna output Pr　(dBW)	-179
Thermal noise	Rx system temperature (dBK)	20
	Boltzman constant (k=1.33x10^-23)　(dB)	-228.6
	Noise power spectrum density No　(dBW/Hz)	-208.6
Communication capacity	C/No (dB/Hz)	29.6

[5]　TX antenna

The effective aperture Ae of the antenna with antenna gain 20 dBi is;

$$Ae = (\lambda^2 / 4\pi) \cdot G = 7.96\ (m^2)$$

[6] RX antenna

The antenna with effective aperture of 100m^2 (20dBm^2) is difficult to realize in one antenna. Even if possible it raises another problem of narrow coverage.

The antenna gain with the specified effective antenna aperture is;

$$G = (4\pi / \lambda^2) \cdot Ar = 400\pi = 31.0\ (dBi)$$

The directivity;

$$\Omega = 4\pi / G = 0.01,$$

which gives the view angle

$$\theta = 2\sqrt{(\Omega / \pi)} = 0.113\ (rad)$$

That covers about 170km with distance 1500km.

The coverage is too narrow and requires multiple antennae of the type to cover the target areas.

[7] Receiver

The receive antenna poses the following problem.

Problem;　How can one realize a receiver with high gain and wide area coverage?

Solution;　Use multiple receivers with lower gain antennae and combine the outputs.

We will use the antennae with the same parameters as the TX antenna. Let the effective antennae apertures of the TX, and RX antennae by Ae and Ar, then the required number of the receivers is

Ａｒ／Ａｅ　＝　１００／７．９６＝１２．６

Namely 13 receivers are required to meet the specification.

The outputs of the receiver antennae are respectively demodulated, sampled by system clocks and A/D converted. The A/D converted samples are combined with proper coefficients for different directions.

[8] Pulse compression system

<> Pulse width　　　　　　$\Delta t = 1.2\mu s$

<> Spectrum spreading code　　PN code

<> PN code

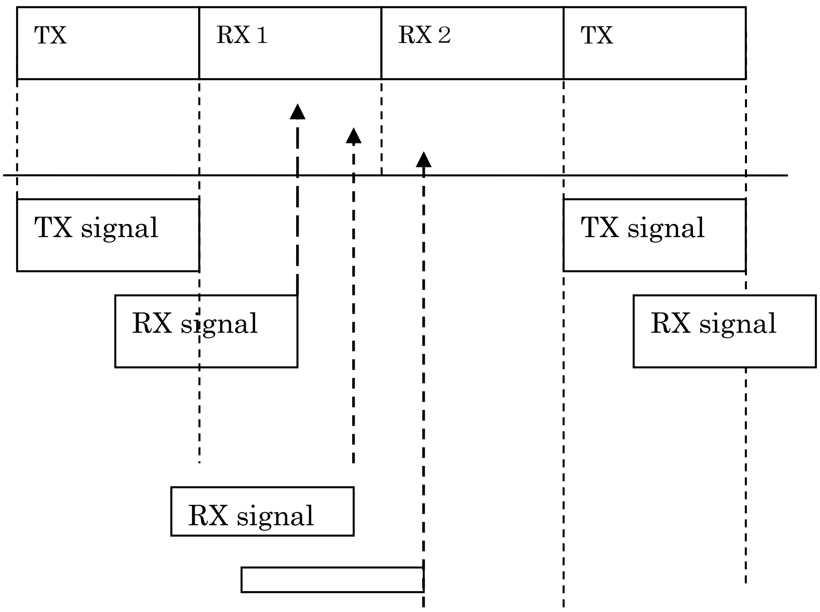
- Code length　　　2^{13}
- time period　　　10ms
- Chip rate　　　819.2kc/s
- Modulation　　　Direct spreading (BPSK)

<> PN code correlation detector

- Impulse recovery method　　PN correlation detection
- Frequency spectrum analysis　　in 10Hz steps

♦ RADAR system time frame

The RDAR time frame consists of 10ms TX, 10ms RX1 and 10ms RX2. RX1, 2 receive the radio waves reflected from the targets up to 1500 and 3000km away.



符号処理

- TX PN signal

  The PN signal triggered at time t= 0 is;

  P(t) = P(0).g(t) + P(1).g(t+T) + P(2).g(t+2t) +;;;;; P(M-1).g(t+(M-1)T)

  = [m=0,M-1] Σ P(m) ・ g(t+ m ・ T)

  where

  {P (m)=1, or -1 ; m= 0,1,2,,,,M-1} are PN codes and the pulse shape g(t)is,

  g(t) = 1 (-T/2 < t < T/2) (T; time of pulse duration)

  = 0 (otherwise)

- RX PN signal

  The receive signal reflected from an object at a distance d is given by,

  Q(t) = e^(j ω d.t).P(t - 2d/c)

  where ω d is the Doppler shifted angular frequency.

- PN correlation detection of receive signal

  The receive signal Q(t) is PN correlation integrated to give the pulse compressed output Q'(t);

  Q'(t) = P(0).Q(t) + P(1)Q(t-T) + P(2)Q(t-2T)+,,,,P(M-1)Q(t-(M-1)T)

  = ml'=0,M-1] Σ P(m') ・ Q(t- m' ・ T)

  = [m,m' =0,M-1] Σ Σ P(m) ・ P(m') ・ e^(j ω d.(t- m' ・ T)) ・ g(t+ (m-m') ・ T- 2d/c)

  = e^(j ω d.t) [m,m' =0,L-1] Σ Σ P(m) ・ P(m') ・ e^(-j ω d. m' ・ T)) g(t+ (m-m') ・ T- 2d/c)

  The maximum correlation is achieved for m= m' ,、

  Q'(t) = e^(j ω d.t). g(t - 2d/c) ・ [m=0,M-1] Σ e^(-j ω d. m ・ T)

$= e\hat{}(j\omega d.(t-(M-1)T/2)) \cdot \sin(\omega d.T.M/2) / \sin(\omega d.T/2) \cdot g(t - 2d/c)$

By comparison with the transmit timing, the waveform g(t - 2d/c) gives the distance d to the object.

- Doppler frequency shifts

  For RF frequency fr = 300MHz, the speed in view of the objects 2000km/s, the Doppler frequency caused is 2,000Hz.

On the other hand the PN detection function is in the following form;

$$\sin(\omega d.T.M / 2) / \sin(\omega d.T / 2) = \sin(\pi fd.T.M) / \sin(\pi fd.T)$$

It tells that it must meet $|\pi fd.T.M| << 1$ to give good response.

With T.M =100(ms), it must meet /fd/<< 100/ π (=) 30(Hz).

- Frequency analyzer type PN detector

In order to meet the above conditions, we conduct frequency analyzing and PN correlation detection for frequency steps Δf = 10Hz.

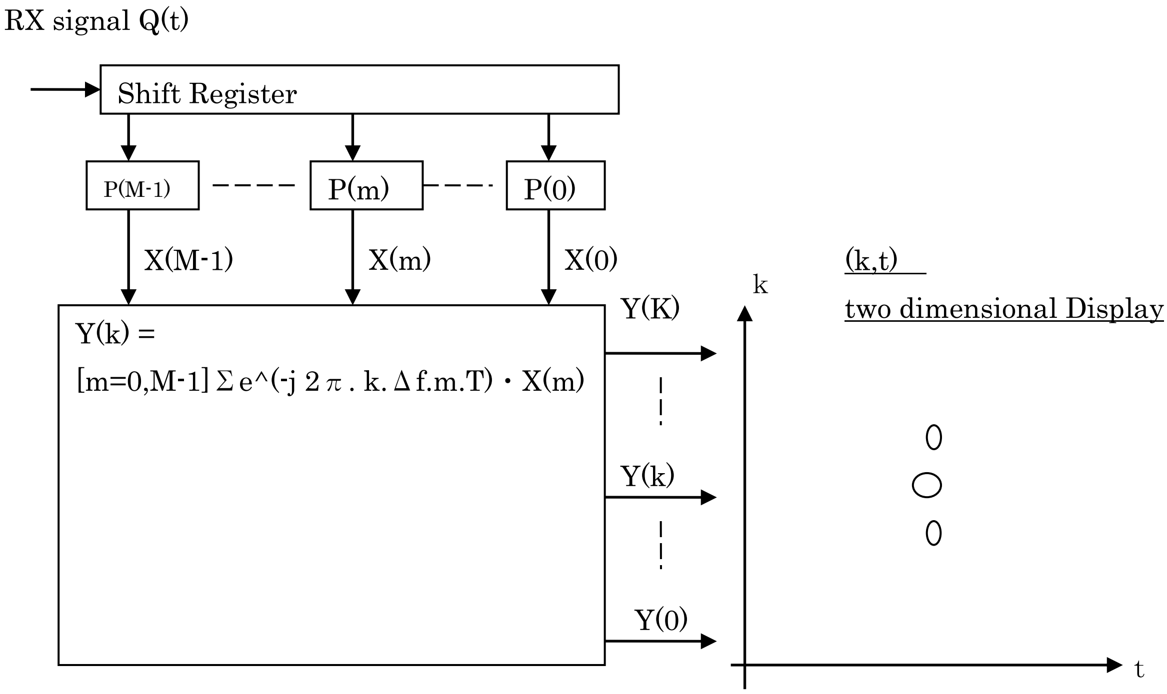
The receive signal is frequency shifted k.Δf→ 0(Hz) for K=0,1,-1,2,-2,,,. to get the output R[k](t);

$$R[k](t) = [m'=0,M-1] \Sigma P(m') \cdot e\hat{}(-j 2\pi . k. \Delta f.m'.T) \cdot Q(t-m' \cdot T) \qquad (k= +,-1,2,3,,,)$$

With the 10(Hz) step the speed of the object is measured with the precision;

$$V= c \cdot fd / fr = 3x1o\hat{}8 \text{ x } 10 / 300(MHz) = 10 \text{ (m/s)}$$

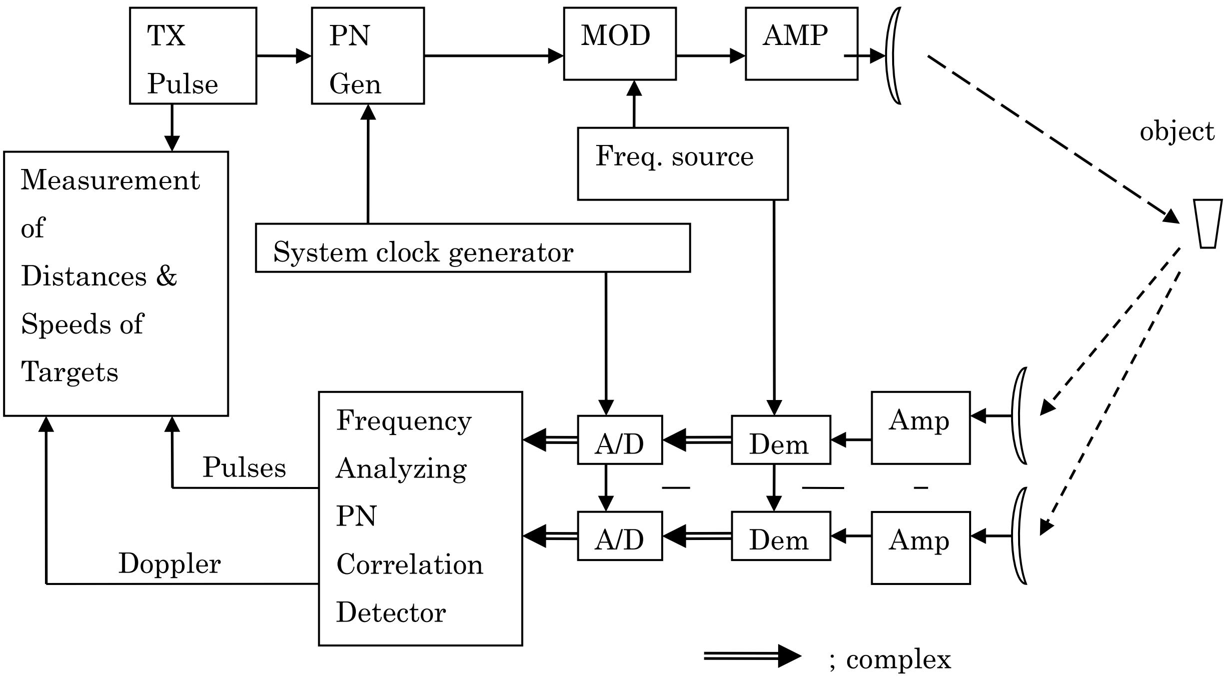
A block diagram of the frequency analyzer-PN detector is given in the following figure.



Frequency Analyzing PN Detector

♦ Block structure of RADAR station

The above design is summarized into the structure of the RADAR station as follows.



Configuration of RADAR station

3. Missiles Capturing System

[1] Conventional missiles defenses methods

The conventional defense missiles hit the offense missiles on orbits. Considering their immense speeds, it seems technically difficult to hit the targets with a perfect certainty.

[2] Missiles capturing methods

It is proposed herein not to hit but to run after, close in and capture the targets nuclear war heads in the space. This is technically established and daily used in space systems today.

[3] Changing directions of objects in space

We study two methods to reverse the direction of a flying object with mass m and velocity **v**.

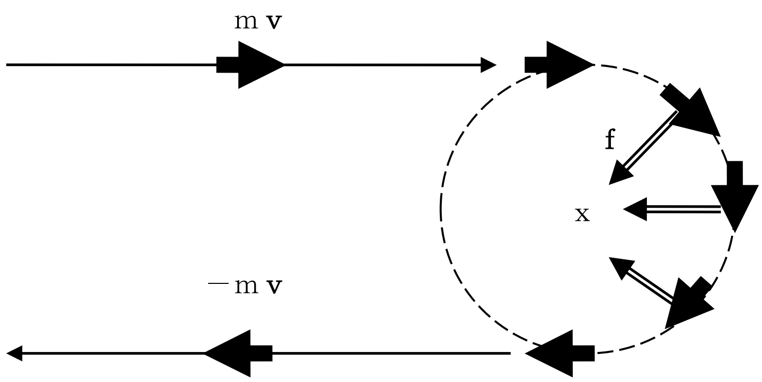
♦ Direct reversing

We can reverse the direction of the flying object by applying the momentum -2m**v**.

Suppose we apply a constant force f to the object which causes acceleration a = f/m, which then generates a velocity u = a.t = f/m.t. The direction of the object is reversed at time t = T when u = f/m.T = -2v or f.T = -2m.v.

♦ Half circular orbit reversing

We apply a constant force f toward a point which gives the center of the semi-circle until the direction of the object is reversed as shown in the following figure.



Half circular orbit reversing

Let the radius of the circle R, then the force to be applied is f = m.v^2 / R toward the center. Suppose the direction of the object is revered in time T which must meet T = π R / v. Multiplying the above two equations we get f.T = π mv.

Suppose we try to change the direction of an object with mass m= 10(ton) and speed v = 2,000 (m/s) in 100 seconds, then we need to apply the force f to the object;
in direct method; f = 2m.v / T = 200 (tonf)
in half circular method; f = π m.v / T = 314 (tonf)

[4] Return to the launcher

The captured nuclear war head can be reversed in the direction to be returned to the launcher. The defense missile carries the warheads toward the launcher, detach it on the way and return to its own home for future reuse.

[5] Destruction in space

The captured nuclear war head can be destroyed in space, sufficiently remote from the ground to avoid damage by a possible nuclear explosion.

4. Conclusion

The concept of the system described above is depicted in the following figure.

It has been shown in the paper that immediate detection of the launch and constant monitoring of a nuclear missile is possible by reconnaissance satellites and long ranges RADAR systems.

The defense missiles in the proposed system does not hit but fly side by side with the nuclear missile to catch it. The captured missile can be reversed its direction to return it to the launcher or destroy in space. Thus any nuclear missile will be captured with perfect certainty.

The author sincerely wishes that the proposed system will be developed and deployed widely to nullify the nuclear missile systems to certify the peace of the world.