**WEIGHTED, MULTI-DIMENTIONAL PROCESSING OF VARIABLE ELLIPTICAL POLARIZATION RADAR SIGNAL ALGORITHM**

**FOR HIGHEST DETECTION PROBABILITY**

**It is the NON TRADITIONAL RADAR SIGNAL PROCESSING METHOD**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | C:\Users\HP\Desktop\WIIPA-1.PNG |  |  |

|  |  |
| --- | --- |
| **Block schema** | D:\ẢNH KIDE-VN DEFENCE EXPO 2022\VN INTERNATIONAL DEFENCE EXPO 2022-2.jpg  **THE FIRST PRODUCT**  **Radar transmits circular polarization**  **exhibited at the Vietnam International Defence Expo 2022 on Dec. 8-10, 2022** |

***Summary***

**The radar transmits a variable elliptical polarization signals e i  i= [1…N], N in [1 ÷ +∞ ), the reflected signals from the targets are received and processed in 2 receiver channels, the output signal from the 2 receiver channels is processed by weighted, multi-dimensions special algorithms - formulas for getting the highest detection probability.**

***Describe***

**Radar transmits an elliptical polarized signal of the form i : e i T, ( i is positive integers in the range [1 ÷ I ], I is any positive integer that takes value in the range [1 ÷ +∞ ) (1) ), the elliptic signal i reflected from the target e i R can be decomposed on the union of 2 circularly polarized signals: right circular polarization and left circular polarization having different amplitudes which are received and processed in 2 receiver channels; the output signals from receiver channels 1, receiver channel 2 are E i1 , E i2 ; E i1 , E i2  are sent to the Signal Processing System and then sent to the Digital Signal Processing System to compute:**

* **Iiαβ = (2) is the Weighted Ratio (WR) of E i1 , E i2 ; α, β are positive integers in the range [1 ÷ M], M is any positive integer that takes value in the range [1 ÷ +∞ ) (3).**
* **Weighted Radar Cross Section (WRCS) of the target is computed:**

**Ϭiαβ = Ϭiαβ ( α, β, ) (4)**

* **Jiαβ = Jiαβ ( Iiαβ ) (5)**

**Jiαβ is the coefficient reflecting the Weighted Eigenfeatures (WE) of the target.**

**Jiαβ will be in the range [-a, +a] (6), a is a definite** **positive integer, range [ -a, +a ] is divided into N segments, N is a positive integer in the range [1 ÷ 100 ) (7), each segment is assigned a color so in the range [ -a, +a ] there are N segments corresponding to N colors, each color corresponds to a target class with the same Jiαβ value. Jiαβ , Ϭiαβ will be taken to a 2-dimensional display: color type, color brightness; Jiαβ determines the color type, which is the color of the target marker; Ϭiαβ determines color brightness, which is the brightness of the target marker (8).**

**The number of color types N is enough to be easily distinguishable by the eye, in the case of auto-detection using Artificial Intelligence (AI) technology, the number of color types that can be selected is large enough to satisfy the target marker resolution.**

**For each set of values α , β we have a pair of values Jiαβ , Ϭiαβ , for each pair of Jiαβ , Ϭiαβ we have a value of PDiαβ ( Target Detection Probability ); then we will have the value PDimax = Max { P Diαβ }; α, β = [ 1,...,M] (9), so we have a pair of α , β for the PDimax for each signal type elliptic polarization ei - PD is a most important parameter of radar.**

**The transmitted signal is parameterized to have ellipses of the form i (i = [1…I], then we have PDmax max = Max {PDimax } (10) i= [1…I], which is the highest Detection Probability P Dhighest = P Dmax max (11).**

**Set of Algorithms - Formulas (1), (2), (3), (4), (5), (6), (7), (8), (9), (10), (11) have implemented a weighted processing variable elliptical polarization radar signal in 5-dimensional space: α , β , Jαβ , Ϭ αβ , and time t give the highest Detection Probability. It is called “Weighted, multi-dimentional processing of variable eliptical polarization radar signal for highest Detection Probability”.**

**With this set of Algorithms – Formulas, we will not only choose the set of parameters α , β for the highest Detection Probability, but also base on Jαβ we can establish a library of Parameters Jαβ – Type targets to be able to identify and categorize targets. Furthemore It is very good interference of background supression by controlling Ϭαβ. These are very important issue in radar engineering.**

**In fact, we can have a very simple way of implementing the above Algorithms-Formulas: With the parameters I, M, N, α, β selected defined, the 2 important parameters Jαβ, Ϭαβ are computed while the radar continuously transmits e i T and brought them ( Jαβ, Ϭαβ ) to the display.**

***ADVANTAGE***

1. **With this technology radar can detect very small targets with the RCS small to 0.01 m2 , and the potencial even smaller than 0.01 m2;**
2. **Displaying only 1 color will choose a variant to get better ability to detect the target class of that color;**
3. **Change color type assignment to Jiαβ value will select the color assignment plan for better target detection and classification;**
4. **Very good interference of background elimination;**
5. **Capable of detecting targets in the woods (forest) because the Jαβ of the target is different from Jαβ of the woods;**
6. **Base on Jαβ we can classify and identify targets by creating a library of Target Types of Parameters Jαβ to defind target identification and classification, this is a very important issue in radar engineering.**

**Applicability**

**This Algorithms – Formulas can be applied for every radar type, specially for small target detection radar: Portable Coastal, Ground, Forest… surveillance radar; UAV, drone, rocket bullets,…detection radar.**

**This Algorithm is  "The top of experimental spirit award" from WIIPA at KIDE 2022 Kaohsiung International Invention& design EXPO 1-3 December, 2022 Kaohsiung, Taiwan and the " Special award " from CROATIA INMOVA international invention show on the same day.**

**The first product (radar) made base on this algorithm exhibited on VIETNAM INTERNATIONAL DEFENCE EXPO 2022, December, 8-10.**

**Copyright belongs to Dr.Sc. Dao Chi Thanh**

**Adress: Apartment 0310, Park2, Times City, Hanoi, VietNam**

**Mobile phone +84-979263611**

**Email:** [**dcthanh27@gmail.com**](mailto:dcthanh27@gmail.com)

**Việt Nam, Ha Noi August 12, 2023**

**Looking for Buyer / Investment**