Journal of Applied Mathematics & Bioinformatics, vol.3, no.1, 2013, 99-121
ISSN: 1792-6602 (print), 1792-6939 (online)
Scienpress Ltd, 2013

# Stealth Aircraft Tactical Assessment using Stealth Entropy and Digital Steganography

**T.G. Kostis[1], A.K. Goudosis[2], G.I. Bezanov[3] and D.A. Sarkar[4]**

**Abstract**

A stealth aircraft is not invisible. Stealth is a passive low observability technique that alters an aircraft's composite electromagnetic and electrooptical identities in order to be classified by an adversary as a target of no interest by blending into the background.

In this paper we explain the reasons for this inability of invisibility of a modern jet fighter aircraft by employing the concepts of Stealth Entropy (SE) and Digital Steganography (DS).

Our methodology is a comparison between the concepts of stealth jet fighters, low observability motion entropy and digital steganography. This effort leads to a tactical assessment of stealth aircraft.

We ascertain that a stealth aircraft is very similar to a digital steganography object. Also we argue that a stealth aircraft has low stealth entropy levels. From these two points we conclude that a stealth aircraft is a radar target that is difficult to hide from air defences especially

[1] University of the Aegean, e-mail: tkostis@iee.org
[2] University of the Aegean, e-mail: agou@aegean.gr
[3] London South Bank University, e-mail: bezanog@lsbu.ac.uk
[4] Subject Matter Expert - Smart Weapons & UAVs, e-mail: debojitsarkar@gmail.com

Article Info: *Received* : November 1, 2012. *Revised* : January 30, 2013
*Published online* : March 30, 2013

when cruising at higher altitudes. And this is the stealth aircraft paradox.
Finally our work may be beneficial to air defence systems designers and their counterpart aircraft signature reduction specialists.

**Mathematics Subject Classification:** 00A69
**Keywords:** Surveillance Radar; Stealth Aviation; Air Defence; Steganography

# 1 Introduction

The Chain Home was the British early warning ground-based radar that gave time of roughly eighteen (18) minutes to RAF pilots to scramble against oncoming Luftwaffe aircrafts. This time was proven adequate for countering the oncoming threat and acted as a power multiplier for the RAF that eventually tilted victory to the Allied side at the Battle of Britain.

At that time the Horten Brothers of the Luftwaffe were working on an aircraft design that wanted to eliminate as much parasitic drag as possible in order to be able to carry 1,000 kilograms of ordnance at a distance of 1,000 kilometres with a speed of 1,000 kilometres per hour with a high operational ceiling of 15,000 metres [1]. The outcome was the Ho-229 which is now proven to be the first stealth aircraft design due to its flying wing geometry, as shown in Figure 1.

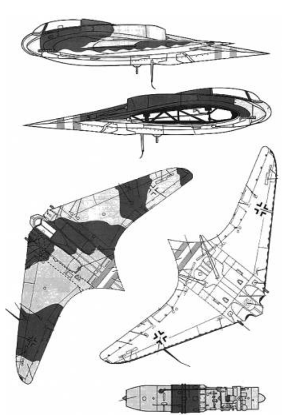

Figure 1: The first stealth aircraft was the Ho-229

Analytically the aircraft was basically made of wood with no protruding horizontal and vertical surfaces that would give a high backscattering factor to radar waves. And jet engine was the propulsion method thus no propeller modulations existed to accordingly would distort radar waves and give away the incoming aircraft. Moreover charcoal dust was mixed in the wood glue to absorb electromagnetic waves.

In 2008 Northrop-Grumman built a full-size exact reproduction of the Ho-229. This replica was tested at the company's classified radar cross-section (RCS) test range where it was illuminated by electromagnetic energy sources from various aspect angles using the same three frequencies in the 20 to 50 MHz range as was used by the Chain Home radars. This testing showed that an Ho-229 approaching the English coast from France flying at 885 kilometres per hour at twenty (20) metres above the sea surface would have been visible at a distance of 80 percent that of a Messerschmidt Bf-109. It is important that while the most visible parts of the aircraft were the jet inlets and the cockpit, still they caused no serious radar returns because they had smaller dimensions than the Chain Home's operational wavelengths [2]. Also it must be noted that this rcs reduction was largely based on the low flying altitude of the experimental parameters.

Moving on to the 1960s Pyotr Yakovlevich Ufimtsev began developing equations for predicting the reflection of electromagnetic waves from elementary two-dimensional shapes. Actually he created the mathematical theory and tools to simplify the description of the reflection of electromagnetic waves [3]. Ten years later in the 1970s Lockheed engineers in America began to expand upon some of his theories to create the concept of an aircraft with reduced radar signature. The result was the creation of the F-117 Nighthawk, the first operational stealth aircraft. It was nicknamed the Ghost of Baghdad for it conducted bombing missions despite the Iraqi air defence efforts. Still this success cannot be really credited solely on the F-117 due to the previous Apache helicopter attacks on Iraqi radar stations. For were these air defence installations operational then they would have been used to vector Iraqi interceptors (aircraft and missiles) onto the F-117s.

Also during the Yugoslavian conflict an F-117 was shot down by an SA-2 Guideline missile which followed the same air defence dogma as the Iraqi configurations. Moreover F-117 flight paths were always carefully planned

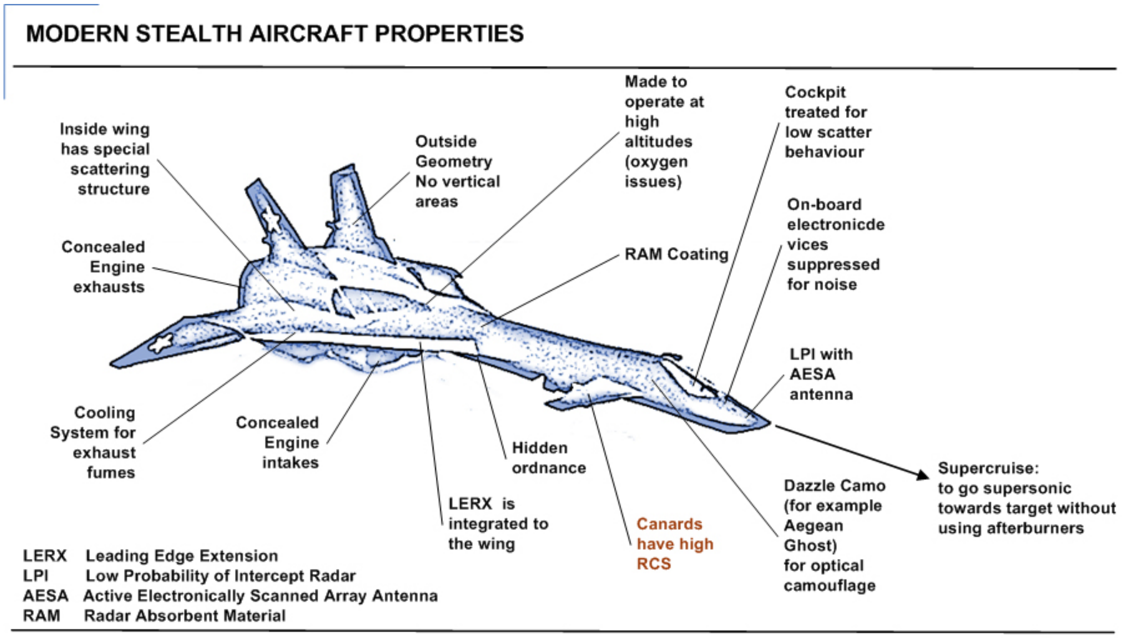


Figure 2: Stealth Aircraft Properties

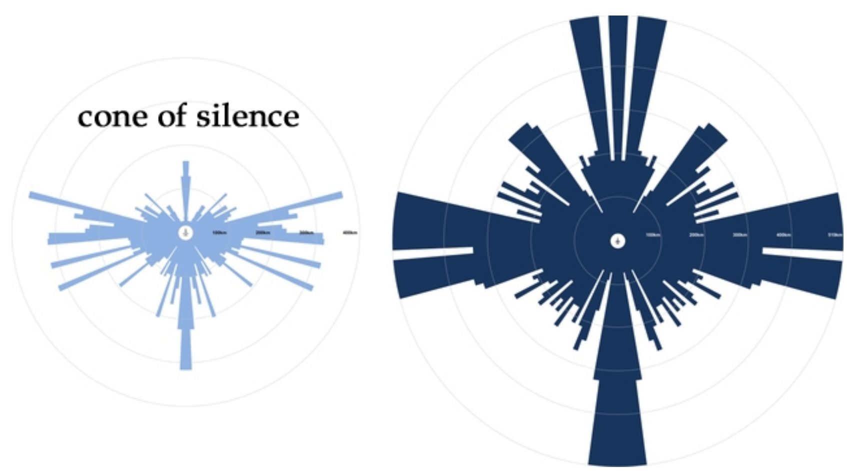


Figure 3: Cone of Silence for a Stealth Aircraft

to avoid any Yugoslavian radars that might spot them. Actually most of Yugoslavian SA-6 gainful batteries survived this conflict [14].

Nowadays modern stealth aircrafts are the epitome of technology [4]. Strong voices argue in their favour from scientifically respectable channels [11], [12],

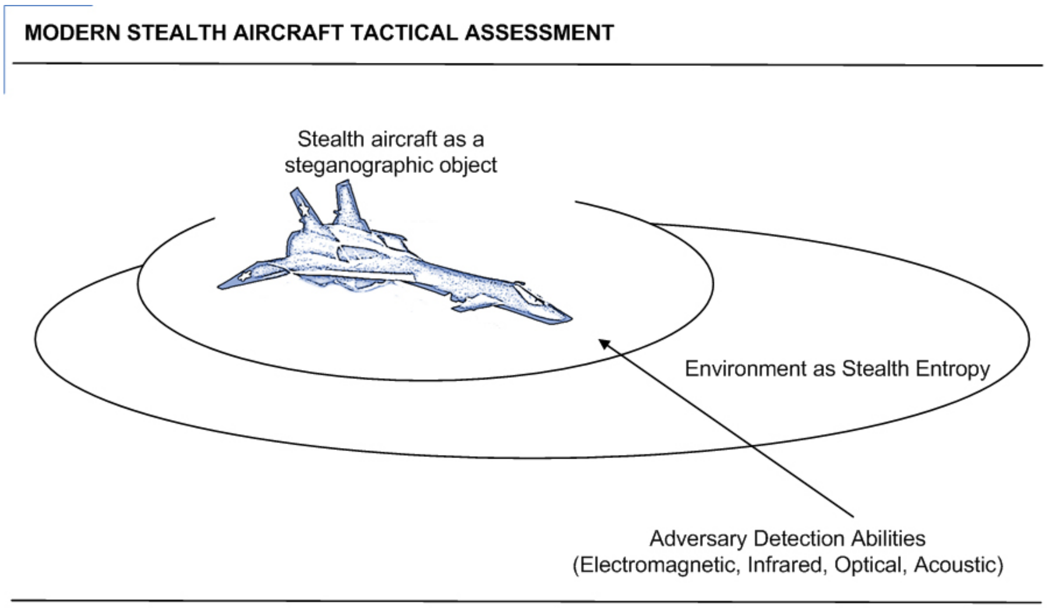


Figure 4: Stealth Aircraft Tactical Assessment

[14]. The most characteristic properties of a modern stealth aircraft are shown in Figure 2. And the effect of this design in the electromagnetic scattering map is shown in Figure 3 where a cone of silence is created in the frontal aspect of the aircraft. This decreases the rcs of the stealth aircraft and cuts off response time at adversary air defences.

So how really effective is a modern stealth aircraft? What are the latest low observability innovations and do they really produce a force multiplier for battlespace dominance?

In order to address these questions we must conduct a tactical assessment of the aircraft stealth potential, its operational environment and the methods of its detection, as shown in Figure 4.

First we lay the foundations for the explanation of the stealth entropy concept. We find that stealth entropy can be divided into three different levels and that a stealth aircraft is operating in a low stealth entropy level. Then we state briefly the concepts of digital steganography and compare the properties of a stealth aircraft. We find that a stealth aircraft is very similar to a stegoobject. From the previous two foundations stones we proceed to conduct a stealth aircraft tactical assessment. We ascertain that a stealth aircraft is very difficult to delay for a substantial amount of time its detection when in high altitude because it is not helped by the prevalent low stealth entropy levels. Since a stealth aircraft was made to conduct its operations from a high altitude this constitutes the stealth aircraft paradox.

Finally in this paper we follow the standard electronic warfare terminology. In this manner friendly forces are referred to as the blue force and adversary forces are termed as the red force.

# 2 Stealth Entropy Concept

The stealth entropy concept states that the convolution of the nature of the environment and the properties of the blue force object define the amount of distance that can be travelled without being understood as a true threat by the detection sensors of the red force [7].

Analytically the environment can be dense and abstract like a jungle or a forest area, can be built like a city or can be open like the sky. Moreover the properties of the blue object are its outer form and geometry and its original colourings.

We divide the stealth entropy into three levels which are high, medium and low. Then we use Table 1 to examine the blue force object relevant adaptations to each respective stealth entropy category.

The classification of the environment is based on the criteria of radar and optical viewing abilities.

We proceed by analyzing the different concepts of stealth entropy and present representative examples of each case.

## 2.1 High Stealth Entropy

In the case of high stealth entropy the environment is dense and its shapes are of irregular and unpredictable forms and colourings. Characteristic examples are a forest or a jungle.

Therefore the shapes and outer colourings of the blue force asset are changed to resemble in the highest degree the elements of this highly abstract environment.

Table 1: Stealth Entropy Levels

| stealth entropy | environment | blue force object changes in: outer form | outer colouring |
|---|---|---|---|
| high | irregular<br>dense<br>abstract | many<br>different<br>abstract | abstract |
| example | jungle, forest | | |
| medium | semi-open<br>regular<br>built | none | full adaptation |
| example | city, sea surface | | |
| low | open | change to another specific object of minimal threat value | change to adapt to specific new object colouring |
| example | open skies | | |

Figure 5: Snipers wearing ghillie suits move in a forest

A poignant example of this case is shown in Figure 5 where sniper troops wearing ghillie suits move through a forest area with low probability of intercept by adversaries.

This type of stealth movement may be combated by infrared sensors able to detect clandestine moving troops from their heat emissions.

## 2.2 Medium Stealth Entropy

In the medium stealth entropy case the environment is less abstract, semi-open, built while its colourings observe a certain pattern. Characteristic examples are a city or a desert.

The outer form of the blue force platform stays the same and only the outside colouring changes in a way to adapt to the environmental pattern.

A poignant example of this case is shown in Figure 6 where a Deutsche Afrika Korps (DAK) Messerschmidt Me-109 is flying over the Libyan desert in 1942.

Here the aircraft shape cannot change but the selected camouflage pattern blends nicely with the desert surface when in very low flight attitudes. Such aircraft were very difficult to be spotted during WWII because appropriate radar systems were not available. Much later during the era of the Vietnam War and the invention of the look-down shoot-down radar mode this stealthy type of threat was able to be seen through with radar type AN/APG-59 on board Phanotm IIs. Even then some Vietnamese Mig-21s were painted in jungle camouflage resulting in serious spotting difficulties by their American opposition.

A modern example is the Aegean Ghost camouflage on the Hellenic Air Force's conventional fighter jets, as shown in Figure 7.

Of course nawadays optical camouflage on high altitude flying aircrafts is not so effective due to advanced radar and optical targeting systems. Still this optical signature suppression has its effectiveness for very low altitude flying aircraft over the sea surface.

## 2.3 Low Stealth Entropy

In the case of low stealth entropy the environment is open and scarcely contains any visibility hindrances. Characteristic examples are the sky or the

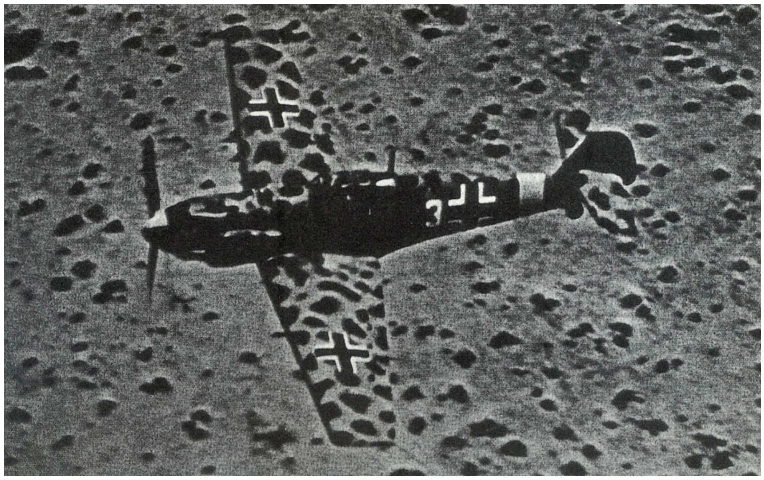

Figure 6: DAK Me-109 flying low over the Libyan desert

Figure 7: Hellenic Air Force Aegean Ghost camouflage

undersea environments.

Therefore the outer form of the blue force platform and its outside colouring must change in a specific way in order to mimic another object of no value to

Figure 8: Kallima Inachis is the leaf butterfly

the red force for conducting a successful stealthy passage.

A poignant example of this case is shown in Figure 8 where a butterfly has been altered to look like a leaf. While in motion it looks like a leaf in the wind but seen from above its blue and yellow characteristic properties are visible to a predator.

Another characteristic example is the movement of a zebra herd, as shown in Figure 9. The white and black stripes of each animal are interwoven while in motion creating a form which a predator like a lion perceives as crops moving in the wind.

From this analysis we see that in this level deception is better than a stealth only movement strategy. Examples were taken from the natural environment which is an optical monochrome world, much like an infrared sensor.

# 3 Digital Steganography Concepts

A steganographic communication does not arouse an observer's suspicion of its very existence [5], [6]. Particularly in digital steganography the infor-

Figure 9: Zebras on the move can confuse a predator

mation hiding process uses the redundant bits of the cover image, which is usually of JPG type. Because these bits can be modified without destroying the cover object's integrity. We now state the fundamental definitions of digital steganography.

**Definition 3.1.** *Hidden Object.*
*The blue force object that needs to travel undetected by the red force sensors.*

$$hiddenobject = secretmessage \tag{1}$$

**Definition 3.2.** *Cover Object.*
*The cover object is the outside shell that hosts that hidden object.*

$$coverobject = jpgimage \tag{2}$$

**Definition 3.3.** *Stego-Object.*
*The convolution of the hidden object with the cover object.*

$$stegoobject = coverobject(hiddenobject) \tag{3}$$

**Definition 3.4.** *Digital Steganography Capacity.*

*The amount of emdebbed data that can be hidden in a cover object.*

$$hiddenobject < coverobject \tag{4}$$

**Definition 3.5.** *Digital Steganography Security.*

*An adversary's ability to be able to detect the emdedded data.*

$$t_{detected} = f(steganographic\ methodology) \tag{5}$$

**Definition 3.6.** *Digital Steganography Robustness.*

*The level of modification the stego-object can withstand before an adversary can destroy the embedded data.*

$$modification(X) = Y, \ \ \rho_{XY} \to 1 \tag{6}$$

It can be seen as when the correlation of the stegoobject $X$ with its modified self is very close or equal to 1 after any modification implying that the hidden object has remained intact from the modification.

# 4 Stealth Aircraft Tactical Assessment

We conduct a tactical assessment of a stealth aircraft object using the concepts of digital steganography and stealth entropy. The results of this effort will address the effectiveness of a modern stealth jet fighter. First we make a direct comparison with the six (6) digital steganography definitions of the previous section which were hidden-object, cover-object, stego-object, capacity, security and robustness.

**Definition 4.1.** *Hidden Object of a Stealth Aircraft.*

*The backscattering elements and active emissions of an aircraft that the stealth aircraft designer wishes to hide from adversary sensors.*

The passive backscattering elements are in the electromagnetic (radar), electrooptical (infrared), optical and acoustic bands. And the active emissions are the on-board radar and electronic telecommunications and countermeasure emissions made by the aircraft antennas.

**Definition 4.2.** *Cover Object of a Stealth Aircraft.*

*The backscattering shapes, aerodynamic abilities and coating of the aircraft's elements as modified by the incorporation of the hidden object.*

The aircraft's backscattering shapes do not include vertical surfaces in order to avoid dihedral backscattering which is strong for radar systems. the aerodynamic ability has certain drawbacks like reduced manoeuvrability due to the exclusion of surface configurations that present higher rcs to radar systems. The coating of the aircraft must be able to adsorb the adversary radar's electromagnetic waves and also must have no imperfections. otherwise travelling waves will be generated from the imperfections that will present a high rcs to the adversary radar system. the engine exhaust must be muffled for heat using embedded ducts and special ffule additives that lower the exhaust temperature. The on-board radome must be of high quality otherwise it will easily give away the aircraft. The cockpit must be treated for low rcs performance. Last but not least optical and acoustic camouflage must be applied.

**Definition 4.3.** *Stego-Object of a Stealth Aircraft.*

*The convolution of the hidden object with the cover object.*

The end-product stealth aircraft.

**Definition 4.4.** *Stealth Aircraft Capacity.*

An airborne platform has the most limited capacity carrying potential. Nevertheless the capacity of the airframe must be adequate for the hosting of all required internal components, like the pilot area, oxygen supply, electronics (radar, telecommunications, electronic warfare), ordnance and fuel. For example the dimensions of the F-22 aircraft show that the airframe is big enough to host all required components. Moreover special modifications have to be made in areas not needed for a conventional aircraft. A characteristic example

Figure 10: Ordance for stealth aircraft has to fit in internal bays

is the custom AIM-120[5] missile for the F-22 with reduced control surfaces in order to fit in the weapons bay, as shown in Figure 10.

Another example is that the fuel must be stored internally therefore all available volumes inside the airframe must be utilised for this purpose.

**Definition 4.5.** *Stealth Aircraft Security. The amount of time required for an adversary sensor to detect the stealth aircraft.*

The stealth aircraft security property depends on the passive and active signature management of the stealth aircraft. Signature management is the effort to control the passive backscattering and active emissions of the aircraft so the probability of their detection at a tactically useful time for the adversary is minimised [13].

## 4.1 Passive Backcsattering Issues

We first analyse the passive backcsattering issues. The signal from the aircraft backscattering is $S$. And the collection of noise and other interference

[5] http://www.f-22raptor.com/lm_weapons_aim120c.htm

factors is termed as $N$. Then it is useful to define the signal to noise ratio $SNR$ which shows how stronger is the signal from the target to the noise levels that exist at the output of the radar's receiver. Therefore a radar receiver detects signals of interest coming from targets and from other noise factors which are unwanted signals and should be suppressed. Now the detection of a target is defined by probability theory and is termed as $P_d$. It is the probability that the target energy plus the noise energy received by the adversary radar exceeds a selected detection threshold $T_h$. This threshold is a function of $P_d$ and $P_{fa}$ which is the probability of false alarm (the returned energy that crosses the threshold is only dependent on noise and interference and no target is present), as shown is Figure 11 [17].

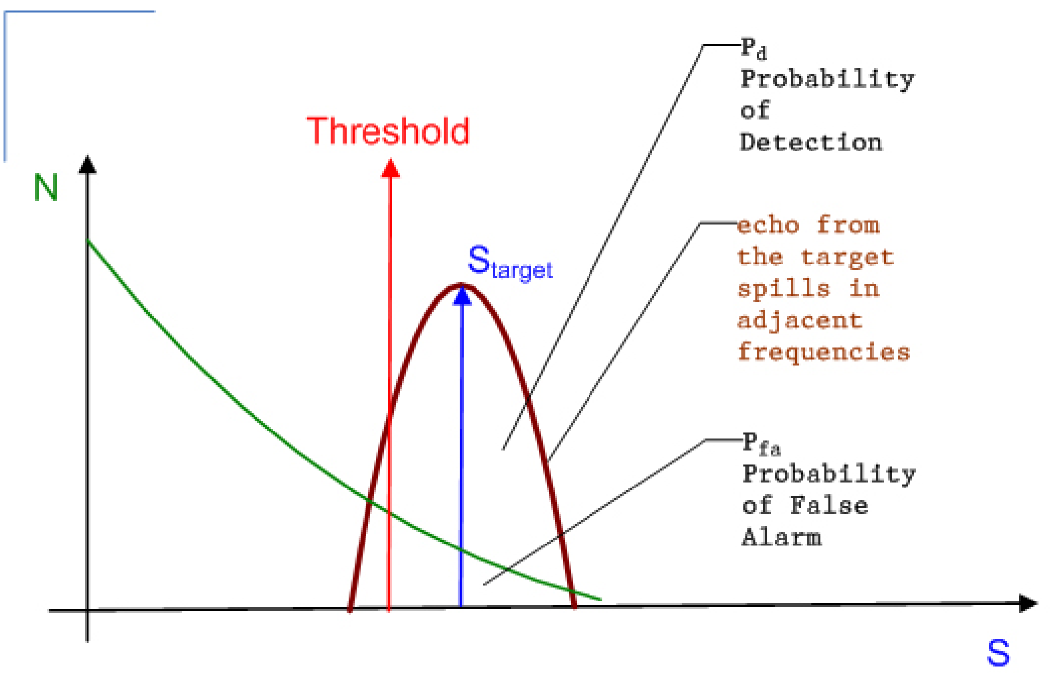


Figure 11: Relationship between $P_d$,$P_{fa}$ and Radar Threshold $T_h$

There is a relationship between $SNR$, $P_d$ and $P_{fa}$ as shown in Equation (7).

$$P_d = \frac{1}{2} erfc(\sqrt{-lnP_{fa}} - \sqrt{SNR + \frac{1}{2}}) \tag{7}$$

where $erfc$ is the error function.

A simple explanation the above equation is when a radar operator wishes to increase the probability of detection $P_d$ while the values of $P_{fa}$ remain constant then a substantial increase of $SNR$ is required. And an increase of $SNR$ means a refinement of the radar receiver's sensitivity which is not a very straightforward task. For it involves technological receiver innovations and advanced digital signal processing methodologies. From the receiver sensitivity relationship the value of $SNR$ is connected to the maximum range $R_{max}$ of a radar's ability to detect a target, as indicated by Equation 8.

$$R_{max} = \sqrt[4]{\frac{P_{TX} G_{TX} A_{eff} \sigma t_{ot}}{(4\pi)^2 k T_0 B_N F SNR_{OUT}}} \tag{8}$$

where,
$P_{TX}$ is the transmitted power by the radar
$G_{TX}$ is the gain of the transmitter antenna
$A_{eff}$ is the receiving antenna efficiency
$\sigma$ is the radar cross section of the target
$t_{ot}$ is the time the radar beam dwells on the target
$k$ is the Boltzmann's constant
$T_0$ is the ambient temperature of the receiver
$B_N$ is the noise bandwidth of the receiver
$F$ is the noise figure which is the figure of merit of the receiver
$SNR_{OUT}$ is the signal-to-noise ration at the radar receiver's output

From Equation (8) we see that the radar antenna is very important because it affects two terms in the numerator, namely $G_{TX}$ and $A_{eff}$. Peculiarly the transmitted power by the radar $P_{TX}$ does not contribute much to the detection enhancement effort because of the nature of the fourth root. For example doubling the transmitted power will result in only a 30 percent increase in detection range. The term $kT_0B_NF$ is the receiver thermal noise power which we consider here as the only interference source for simplicity. Better radio designs which avoid receiver saturation by automatic gain control stages, which minimize transmitter, noise figure and quantization noise have an impact on this term by increasing the detection sensitivity through conventional refinements [16].

Now the reduction of the radar cross section $\sigma$ factor is the major effort of a stealth aircraft design. The ideal case would be a complete aspect angle reduction of the aircraft's passive rcs. Unfortunately as the aircraft needs to manoeuvre, this value presents higher backscattering back at the radar receiver. The passive signature management effort is simplified in Figure 12 where the normal aircraft target echo is higher than the corresponding stealth aircraft echo at a given distance $R$. In other words the stealth aircraft backscatters less energy at the same distance and less ambient noise is required in order to mask the stealthy airborne target.

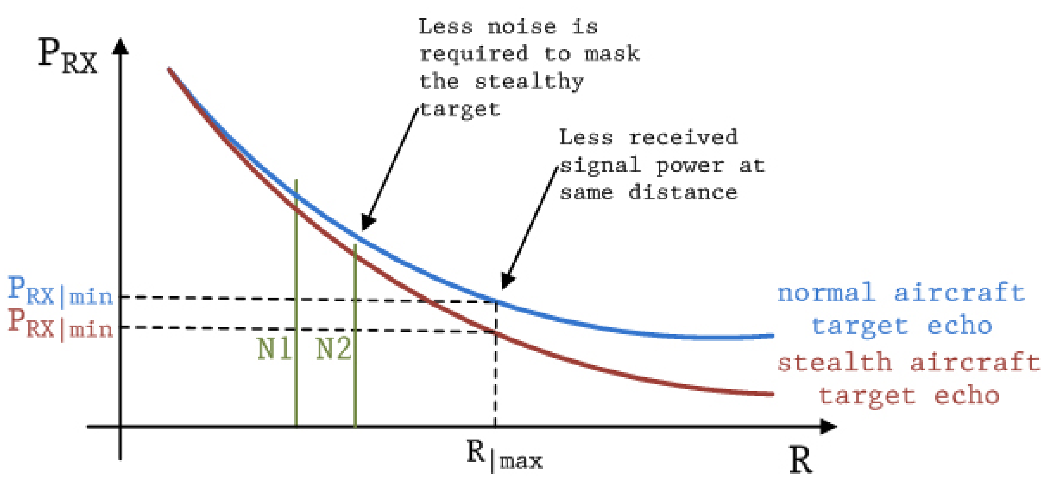


Figure 12: Threshold Levels and Detectability

The last important factor is the time on target $t_{ot}$. This dwelling time of the radar's beam on the target can add the reflections that are received over time in order to increase the SNR.

Moreover $P_{fa}$ can be reduced by advanced signal processing techniques [9]. For example a detection is not declared until it has been detected many times, as in the track-before-detect method. Or a lower threshold is initially applied and when a detection occurs the radar beam revisits the same spot with a higher threshold as in the alert-confirm method. Simply this means that the probability of detection can be increased by signal processing methods. Furthermore an important emerging field is the software-defined radar. In this configuration, the hardware of the radar remains the same, for example an active or passive electronically steered antenna. But the reception data from this radar hardware is processed by a software controlled stage where the acting algorithm can be easily changed to adapt to the prevalent conditions. Finally the most important security risk which is helped by software defined radar is the employment of frequency diversity. Here the usage of multiple frequencies in all bands carefully crafted to be at least one bandwidth apart from known target sizes can make the hiding of an aircraft very difficult. And the stealth aircraft designer must be fully aware of these signal processing capabilities.

## 4.2 Active Emissions Issues

The active signature management is the utilization of Low Probability of Intercept radar systems which try to mask the emissions by coded waveforms and spread spectrum techniques. In detail the main radar system is an electronically scanned array multi-function radar with synthetic aperture and moving target indicator abilities. Targeting information is provided by a medium range electro-optical system which uses thermal imaging, laser tracking and an all aspect (360 degree) infrared system. Therefore the aircraft?s systems must also provide navigation, missile warning and infrared search and track capabilities. And all this tactical ISTAR (Intelligence, Surveillence, Target Aquisition and Reconnaisance) assets must be secure from adversaries for a tactical useful time [15].

**Definition 4.6.** *Stealth Aircraft Robustness. The measure of how impervious is the stealth ability of an aircraft to the different types and versions of threats (radar, infrared, acoustic and visual).*

The problem is that even a rough measurement of stealth aircraft robustness under actual operational conditions is at least very difficult. The stealth behaviour of an aircraft is an uncertain outcome.

Uncertainty Quantification (UQ) is the science of quantitative classification of uncertainty in a system's output. With this classification process the reduction of uncertainty in the system is attempted. The effort is to determine how likely are certain outcomes when the ideal behaviour of a system differs from its actual on the field behaviour by an unknown factor which can only be interpreted in a statistical approach. The ideal behaviour is usually stated through computer modelling and simulations of the system in its operational environment.

The unknown aspects in this case is the backscattering behaviour and active emissions signatures of the stealth aircraft. The outcome of interest is whether the aircraft has been detected at a tactically useful time for the opponent. Moreover the prevalent environmental conditions are important, which are the atmospheric attenuation, clutter, terrain masking and electronic order of battle [10]. Moreover the selection of appropriate stealth waveforms by the stealth aircraft does not guarantee a late detection by the adversary air defences. Furthermore any flight manoeuvre backscatters a different and unknown amount of energy away from the aircraft.

The uncertainty in stealth aircraft is mostly epistemic. It arises from imperfect knowledge or inability to determine the actual operating behaviour of a system's output as compared to its computer model. Although the epistemic uncertainty can be reduced by funding and time in this casde the group of input variables is very diverse and unpredictable. And the effort is to move from the epistemic state to the aleatory uncetainty state, as shown in Figure 13.

For instance let us consider the F-35 JSF in the 2 metre band favoured by Russian VHF radar designers. From a platform shaping perspective, it is immediately apparent that the nose, inlets, nozzle and junctions between fuselage, wing and stabs will present Rayleigh regime scattering centres, since the shaping features are smaller than the radar's wavelength. Most of the straight edges are 1.5 to two wavelengths in size, putting them firmly in the resonance regime of scattering.

VHF radars can detect stealth planes by virtue of operating at wavelength between 1 and 3 meters within Rayleigh scattering region thus creating resonance along the aircraft's dimensions. Due to their poor resolutions VHF radars are not used as engagement radars but they can be used to direct guided heat seeking missiles close enough to very low observable (VLO) targets. Then according to the seeker technology of the missile (television, infrared, radar active mode) the signatures of stealth plane can be acquired and tracked [8].

Size simply precludes the possibility that this airframe can neatly reflect impinging 2 metre band radiation away in a well controlled fashion. The only viable mechanism for reducing the VHF band signature is therefore in mate-

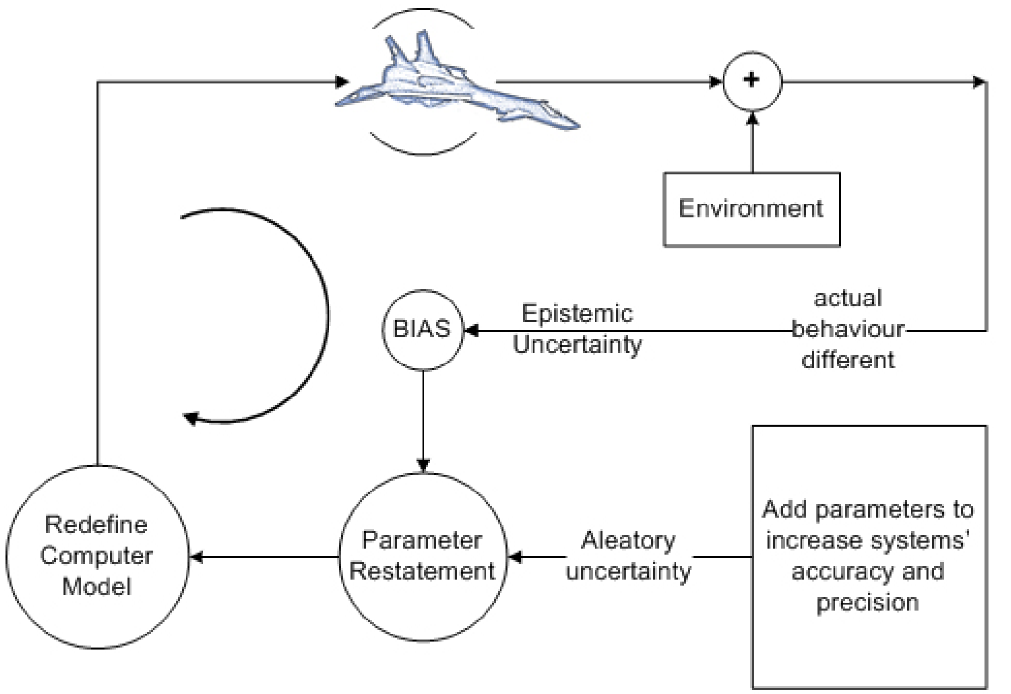


Figure 13: Stealth aircraft robustness in measured by the concept of uncertainty

rials, especially materials which can strongly attenuate the induced electrical currents in the skins and leading edges because of strong magnetic properties.

VHF frequencies are used in modern day OTH (Over the Horizon) radars which can bounce HF waves from the ionosphere to look over the horizon. Stealth aircrafts are not optimized for defeating HF radio waves coming from above and therefore OTH radars can easily detect them. Specifically the new generation of Russian fully mobile multispectral AESA radars are capable of tracking similar aerodynamic VLOs in the X band. An example is the the Russian army's Kolchuga-M [6] passive detecting system.

Therefore a stealth aircraft's robustness as depicted by its epistemic and aleatory uncertainties is very low.

[6]http://www.ukrspecexport.com/index/catalogue/t/airdefence/lang/eng/id/71

# 5 Results

The similarities between steganography and stealth aircraft technology have assisted us into understanding the stealth aircraft field. Moreover the concept of stealth entropy has assisted us into understanding the operational framework of a stealth aircraft. Specifically its environmental low entropy status is a disadvantage to its operation.

Thus a stealth aircraft's competitive advantage is overestimated as an all-round effective weapon because it cannot contribute to a guaranteed tactical advantage of adversary air defence suppression. Although a tactical edge exists which is distant operation with beyond visual range ordnance (see before being seen at a very long distance, fire and survuve by quickly leaving the combat scene) its evaluation is characterised mostly by epistemic uncertainty. Because both the aircraft will need to maneuver and present higher rcs backscattering and beyond visual range weapons are dubious to their effectiveness of securing a hit.

# 6 Discussion

The value of the results lie in the proof that a stealth aircraft cannot be made to be tactically invisible. A stealth aircraft's tactical operational condition is far distant targeting of adversary air defences and not low visibility at all distances and aspect angles.

The environment plays a great role in an aircraft's obscuration abilities and a stealth aircraft pilot will always seek to exploit situations that contribute to low visibility. On the other hand in higher altitudes there is nowhere to hide.

# 7 Conclusions

A stealth aircraft is not invisible for stealth is a passive low observability technique that alters an aircraft's composite electromagnetic and electrooptical identities in order to be classified by an adversary as a target of no interest at great distances and higher altitudes due to weak echo returns. Ideally in this situation the stealth aircraft is seeking to be buried in noise or atmospheric attenuation than rely solely on its stealth design abilities (geometry and coatings).

In this paper we explained the reasons for this inability of invisibility of a modern jet fighter aircraft by employing the concepts of Stealth Entropy (SE) and Digital Steganography (DS).

Our methodology was a comparison between the concepts of stealth jet fighters, low observability motion entropy and digital steganography. This effort led to a tactical assessment of stealth aircraft.

We ascertained that a stealth aircraft is very similar to a digital steganography object. Also we proved that a stealth aircraft has low stealth entropy levels. From these two points we concluded that a stealth aircraft is a radar target that is difficult to hide from new generation air defences especially when cruising at higher altitudes. And this is the stealth aircraft paradox.

Finally this offers the explanation of the reason electronic warfare deception abilities is an important and integral part of a modern stealth fighter aircraft.

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