

The background is a grayscale aerial map with various radar and sensor overlays. There are several concentric circular arcs, some with tick marks, and several straight lines intersecting the map. Overlaid on these are several white, semi-transparent geometric shapes: rectangles, circles, and lines. Some of these shapes have a slight 3D effect with shadows. The overall aesthetic is technical and futuristic.

EV-SAR

**Portraitist.
Deep Learning
Technologies for Target
Decomposition**

Evolution of SAR made by EVOSAR: see your target better

EVOSAR has developed a **software solution** based on **Deep Machine Learning** specifically for SAR imagery analysis. It's called **Portraitist**, featuring a new method of Radar Target Signature Patterns. As a good artists sees all peculiarities and conveys them with high accuracy. Similarly, Portraitist captures all existing targets on the surface and provides their description unaffected by noise and interferometry patterns.

Current Challenges

Even though, SAR imagery has proven its effectiveness, still sometimes users are faced with challenges which are beyond human capabilities i.e., processing large SAR data in a short period of time or inaccurate targets description due to the low quality of processed raw data caused by unpredictable interferometry patterns on a complicated surface which may result in inaccurate classification of all targets. Such inaccuracies can even result in somebody losing their life.

Portraitists as a solution

Portraitist can efficiently process ultra-high resolution SAR imagery for deep target analysis in a wide range of industries such as defense & intelligence, planning and control of search & rescue operations and so on.

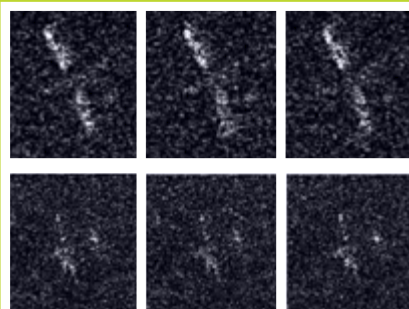
As the system uses an innovative operation mode i.e., VideoSAR, it can capture target images from various angles from one flight and can help operators investigate small areas within a huge picture. Users are provided with a set of characteristics in three dimensional space that defines each target uniquely with no noise component. The intelligent software also benefits from an incredibly high precision (97.5%) which has been achieved with Neural Network developed on an incomplete database (10% of the M-Star database was used). It can be integrated into any graphical interface to enable interactive data processing while recognizing any target on a database or can give access to the EVOSAR's database with more than 10 Tb data of different targets obtained through flight missions from all across the world.

RADAR IMAGE vs. RADAR TARGET SIGNATURE

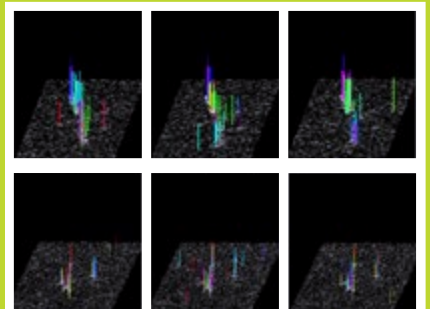
The Radar Signature is...

- > describing a set of points in space and featured by:
 - size
 - electron spin resonance
 - position (~ 5 cm)
 - target phase delay
 - the target phase
 - the type of target (sphere/dipole)
- > taking into account signal interference
- > analyzing the surface type
- > invariant to turn
- > more detailed than RI
- > no noise
- > not affected by neighbouring targets

RADAR IMAGE	RADAR TARGET SIGNATURE
Requires several flights to make a target's picture from different angles	Contains target data only and requires fewer data for classification
Provides only a 2D target picture	Contains 3D picture that allows you to restore portrait from any angle
The image is limited by spatial resolution	Limited by computing power and running time
It is processed like an image with fixed-step-size	Better suited for Neural Network processing because it contains a precise list of features without excessive information



Radar image with noise affected



Radar Target Signature

PORTRAITIST AT WORK



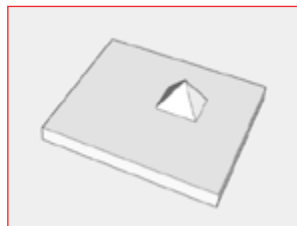
We are sure – nothing is unpredictable if you know from which angle to look.

Our patented algorithm estimates specific surface characteristics of a target from just a few SAR pictures extracted from different angles helps in creating a unique footprint for any surface. The combination of surfaces (and therefore footprints) is used to recreate the mathematical model of an object and predict the exact interferometry pattern. With such data, we can analyze geometric shapes on surfaces, and see the target's orientation and position on the ground from any angle. After the footprints of surfaces are estimated, the target recognition problem becomes an easier task for developed Neural Network-based classification.

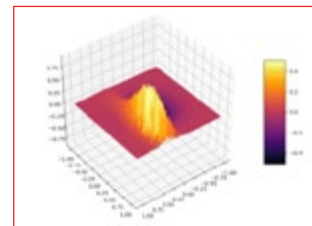
AN ALGORITHM CLASSIFIES OBJECTS BY THREE STEPS:

STEP 1

Compare raw signals and analyse what combination of simple shapes it could be produced of. Linear combination of such forms is chosen for every angle. However, only one combination can generate all signals at the same time. So it is an algebraic problem with one solution – complicated but not unsolvable.



Simplified math model of a single bump (aberration) on a surface

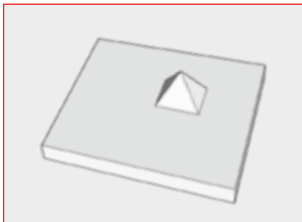


Real radio signal registered from such a surface

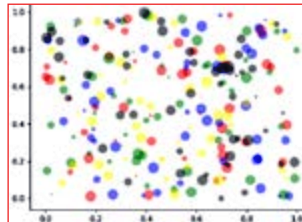
STEP 2

The second step is to repeat the process for all small echo-signals from a target creating a 2D field of simple shapes which generates a complete footprint .

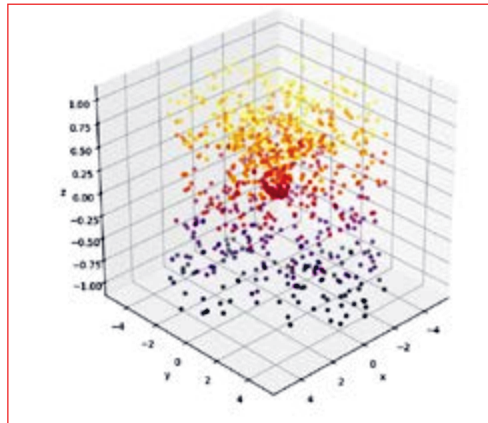
Usually, targets like cars have few bright segments; footprints can be obtained for each one.



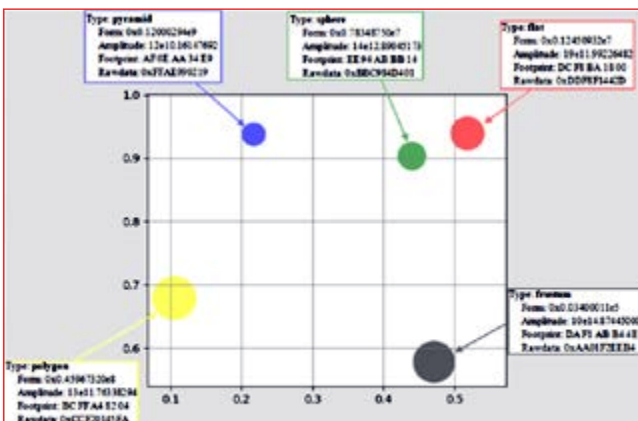
Real surface can be seen as a series of elements bumps on a flat plane



Every bump can be described as deformed 'Ideal' model



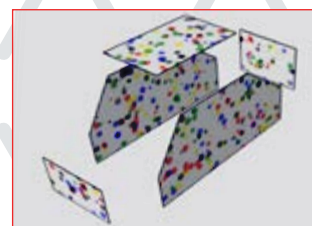
All signature points of a simple object can be seen as an array of features that identifies the target



Series and types of deformations create a unique footprint of an elemental surface («Signature Point»)



Features of a single target can be split into groups describing an object from different points of view. All together such groups create target's footprint



STEP 3

The footprint objects are classified by Neural Network into groups. High accuracy is guaranteed by the Neural Network, processes giving both the primary and secondary features of the object. For example, not only wings of an aircraft but also the presence of the fuselage.



VIDEOSAR MODE

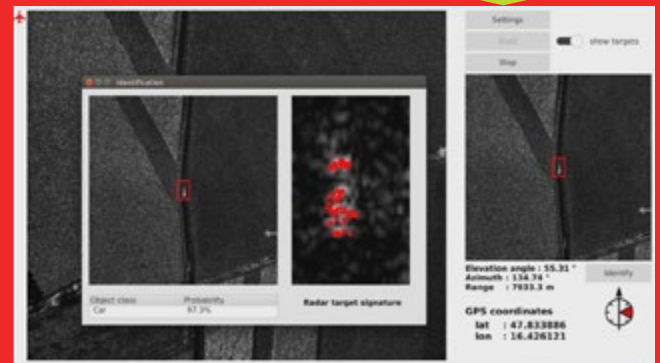


Key features

- VideoSAR is our patented algorithm of raw SAR data processing is compatible with INSYN
- It allows to collect and process data quickly and continuously
- Provides target image at different angles unaffected by noise and interferometry patterns in just one flight regardless of environmental conditions
- Determines the trajectory and speed of moving targets

Minimal hardware & software requirements

- 16 Gb of RAM
- INSYN radar data processing software
- Python 2.7.13
- QT version 5.7.1
- CUDA Toolkit Library 8.0.61



Object classification

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