COMPUTER VISION

VII. Log-Polar Plot for Size and Orientation Independence

- Using images that I have been rotated or translated, determining their log-polar plots
- Determining what happens to the log-polar plots under these transformations
- Quantifying what happened in the log-polar plots to express the degree of rotation and the extent of translation.

INTRODUCTION:

A log-polar plot of an image is a representation of an image in which the pixel intensities are transformed from Cartesian coordinates (x,y) to polar coordinates (r,θ), where r represents the distance from the origin and θ represents the angle from the horizontal axis. In addition, the logarithmic scale is used for the r-axis, which allows for more uniform sampling of the image features in both the radial and angular directions.

Log-polar plots are particularly useful in image processing and computer vision because they provide a way to represent images in a way that is invariant to scaling, rotation, and translation. This means that even if the image is resized, rotated, or shifted, its log-polar plot representation will remain the same.

One of the main applications of log-polar plots is in image registration, which involves aligning two images that may have undergone different transformations. By representing the images as log-polar plots, it is possible to compare them in a way that is invariant to these transformations, allowing for more accurate registration.

FORMULAS & PROCEDURE:

The formula for the log polar plot transformation can be expressed as follows:

For a given point (x,y) in the original image, the corresponding point (r,θ) in the log-polar plot is given by:

r = log(sqrt(x^2 + y^2))

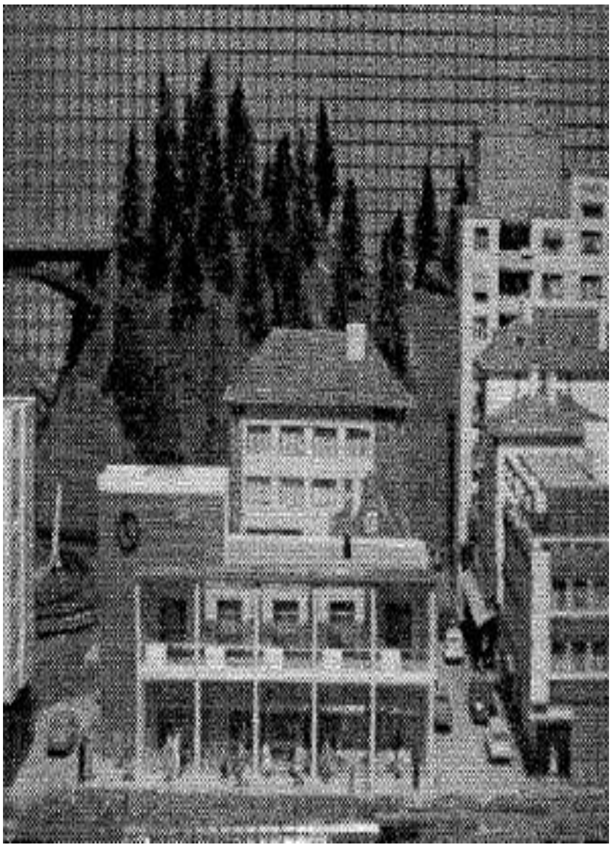
θ = arctan2(y,x)

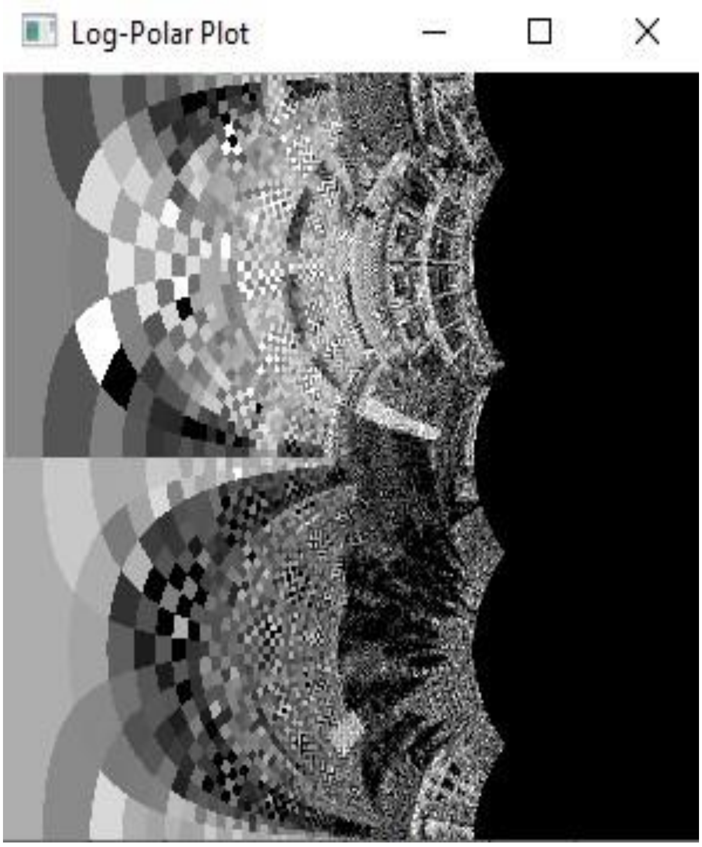
where log represents the natural logarithm and arctan2 is the two-argument arctangent function that returns the angle between the positive x-axis and the point (x,y) in radians.

Note that the logarithmic transformation of r helps to compress the large range of distances in the original image into a smaller range, making it easier to sample the image features evenly across the polar coordinates. The use of arctan2 ensures that the angle θ is calculated in the correct quadrant and is invariant to changes in the sign of x and y.

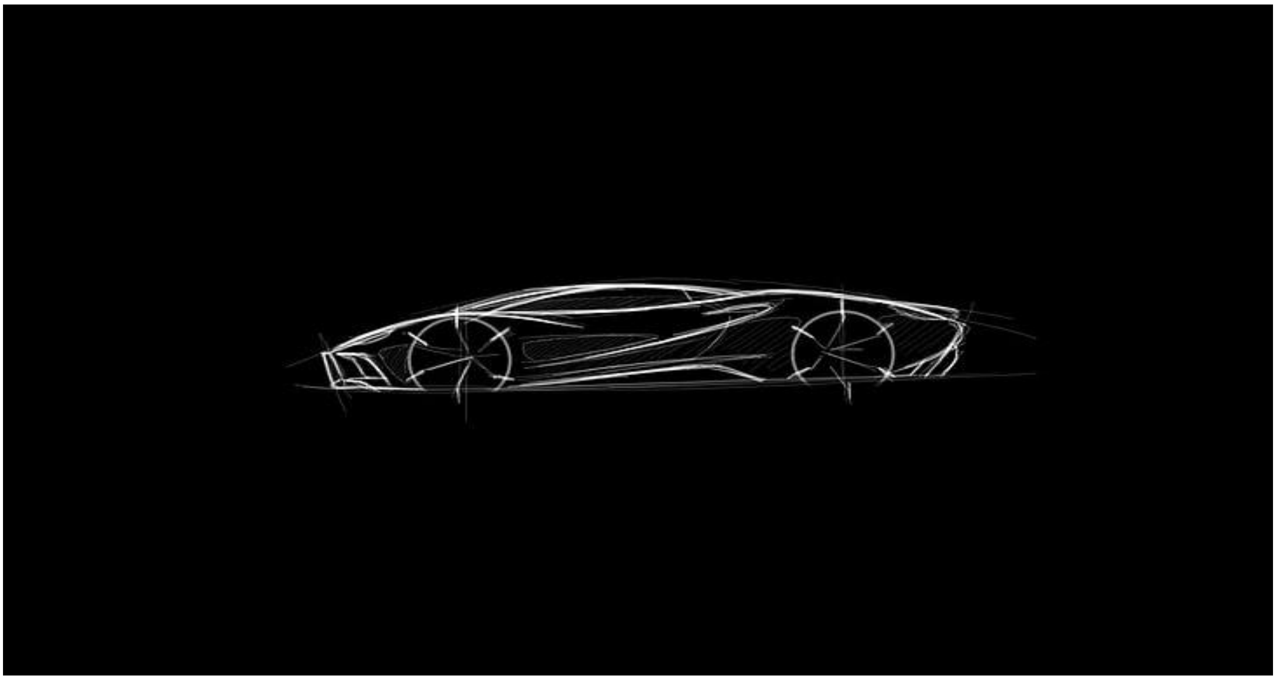
RESULTS :

Input Image **Output Image**

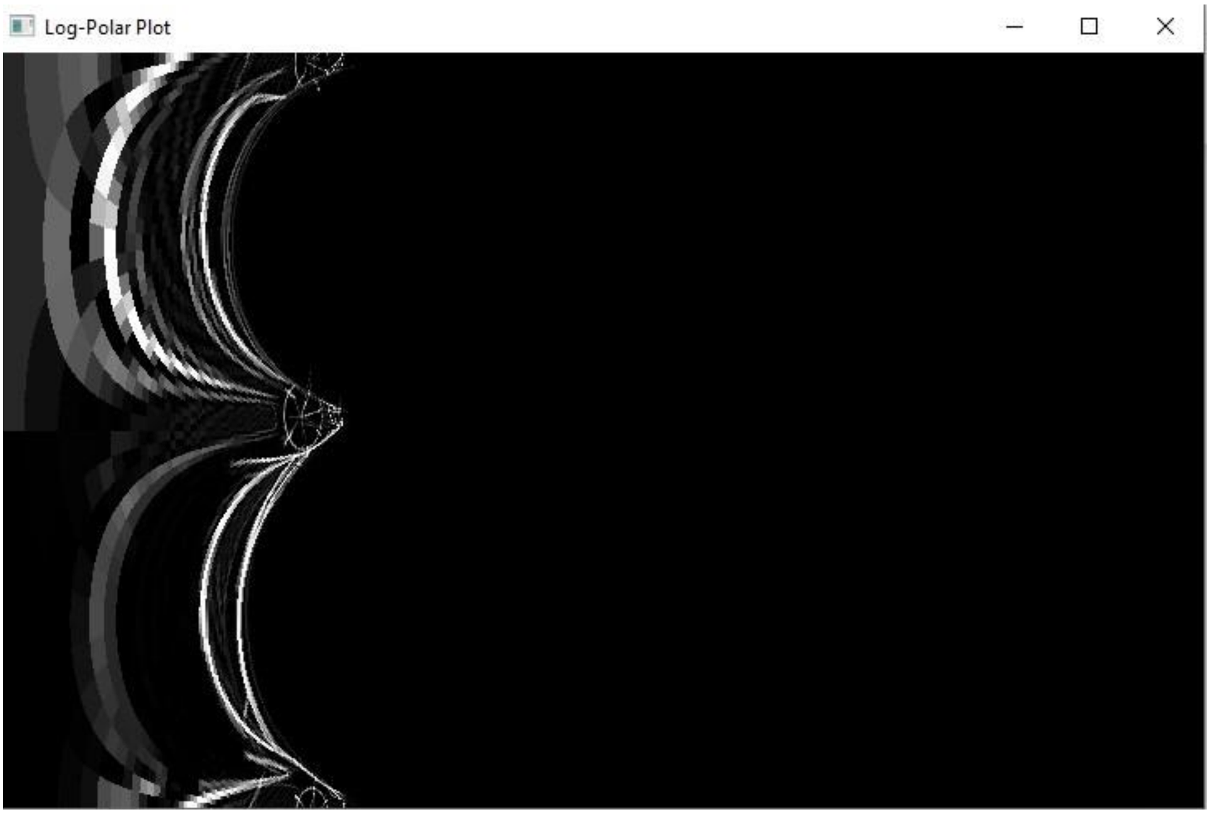




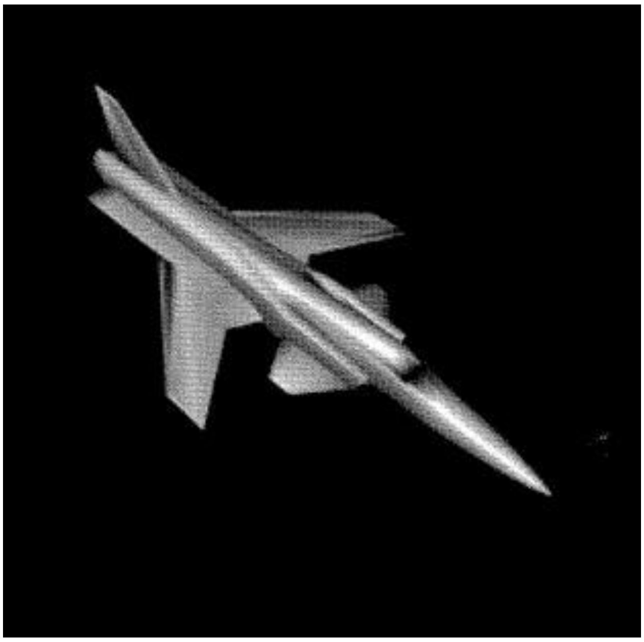
Input Image of Car



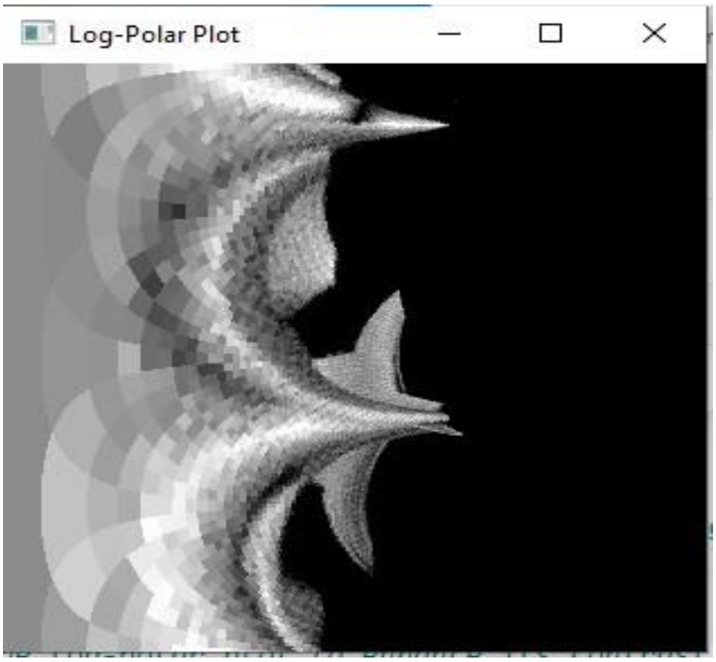
Output Image of car



Input Image of plane

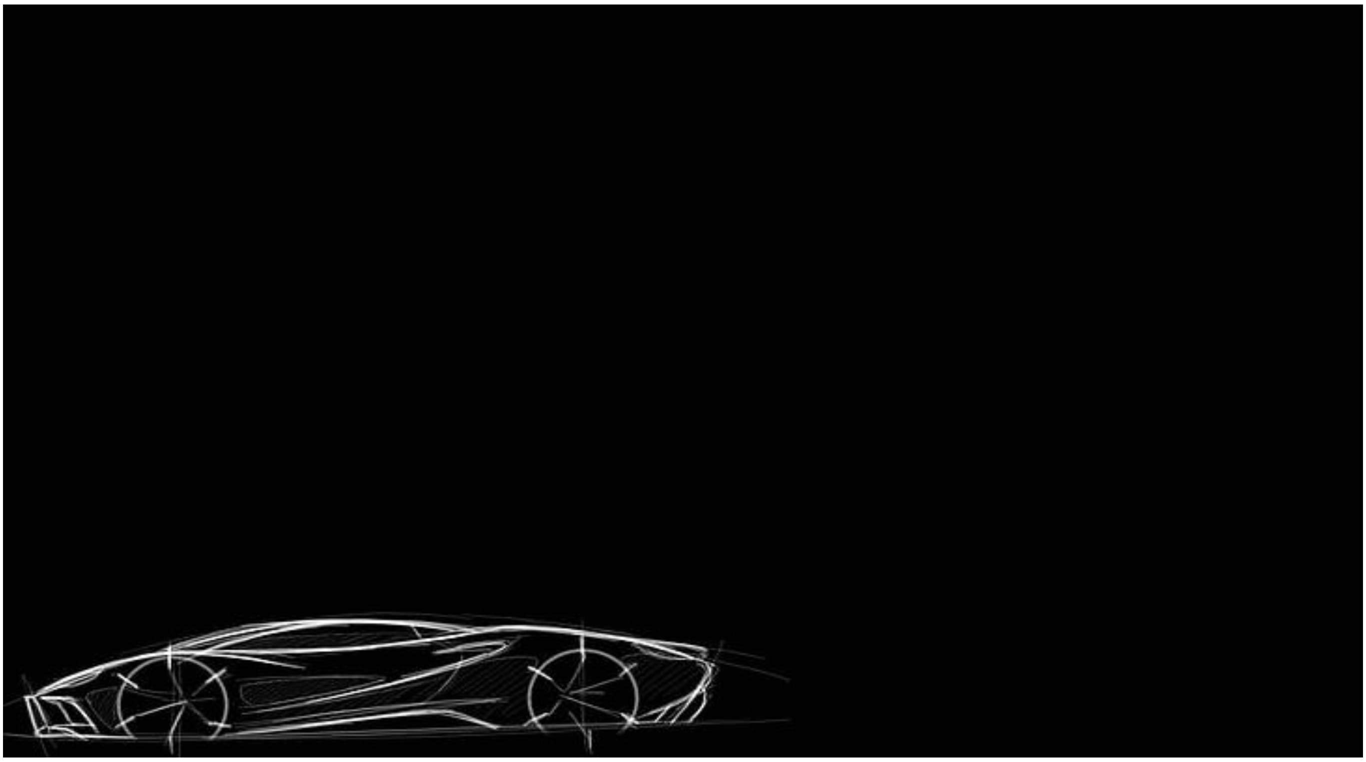


Output Image of plane



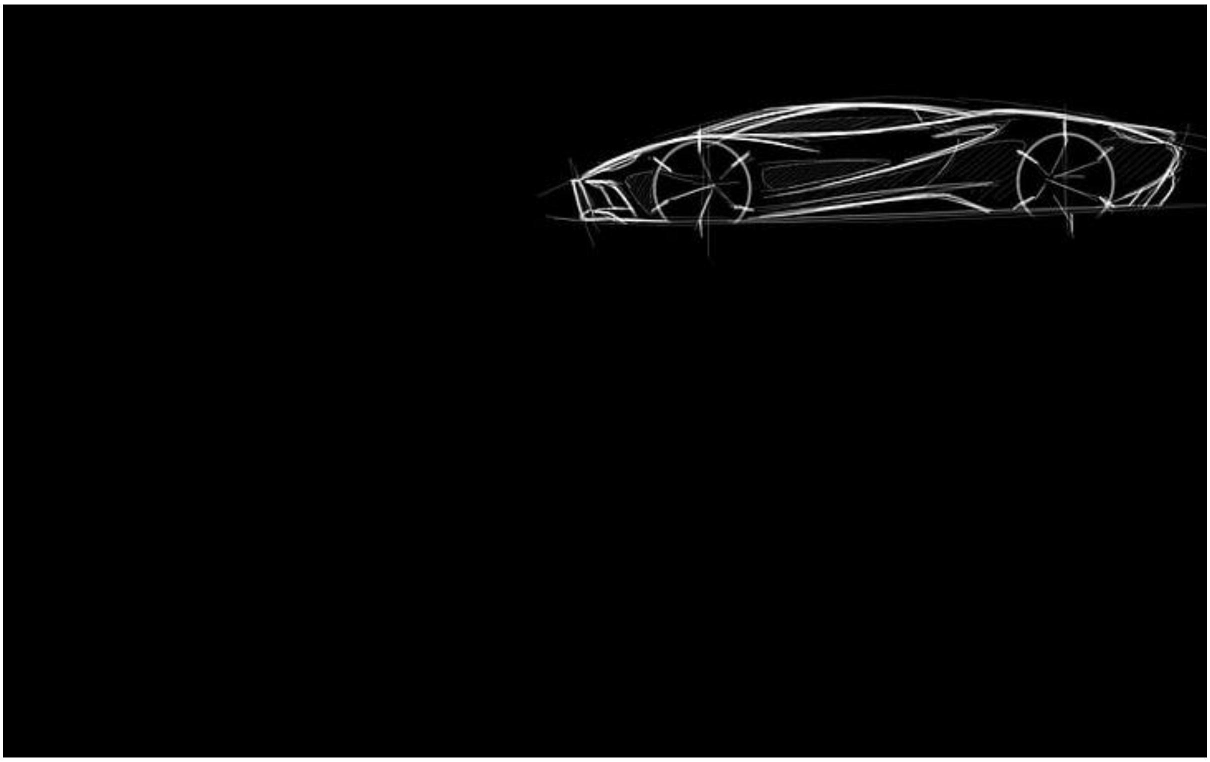
Images with translation & Rotation:

Input Image of car1:



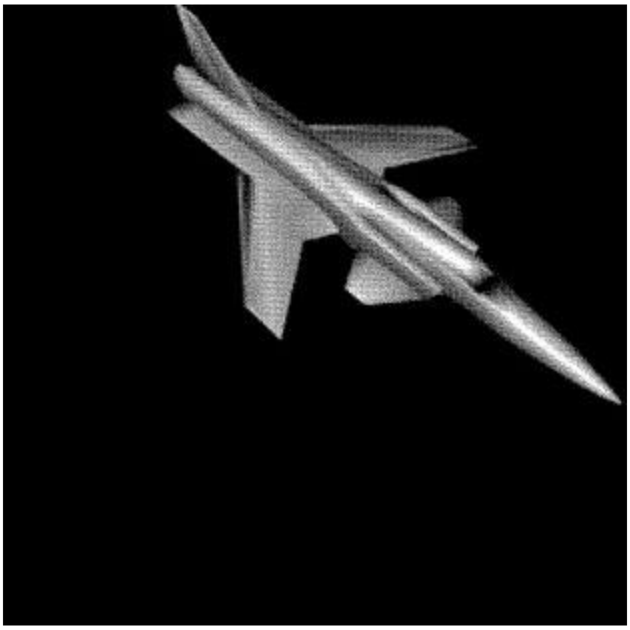
Output Image of car1:

Input Image of car2:

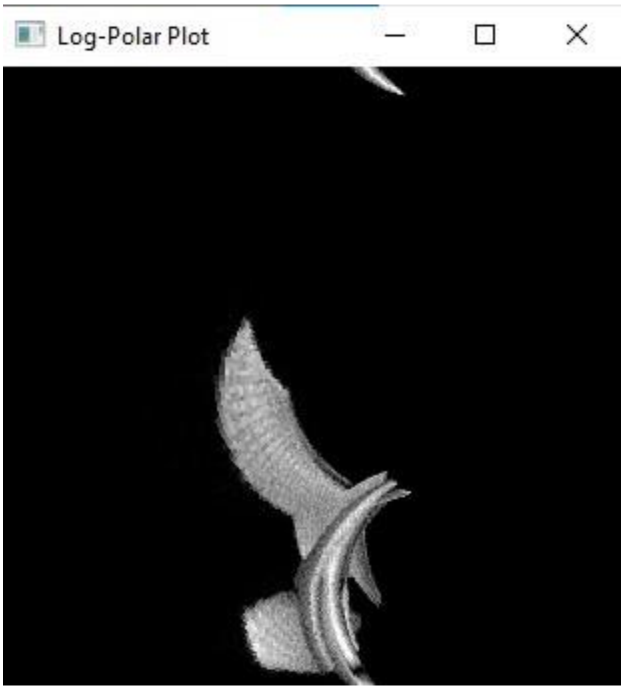


Output Image of car2:

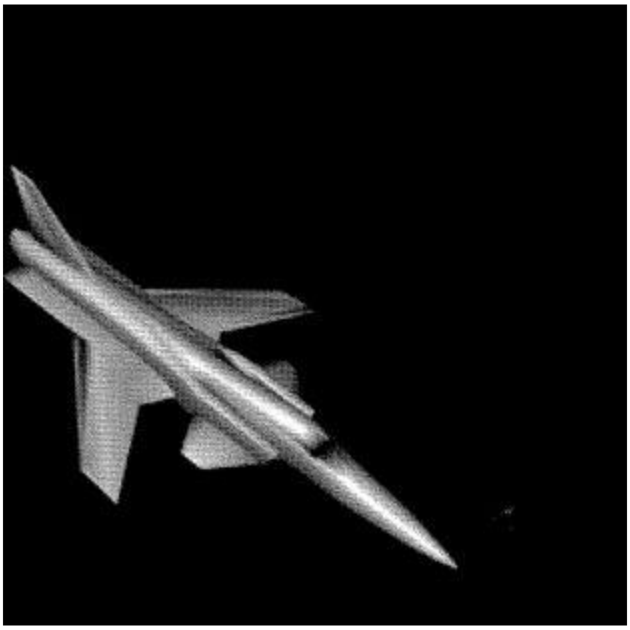
Input Image of Plane1:



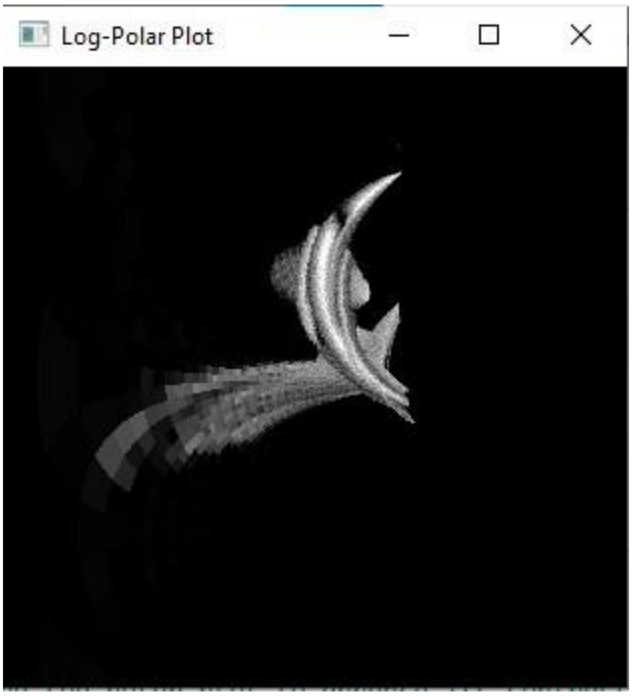
Output Image of Plane1:



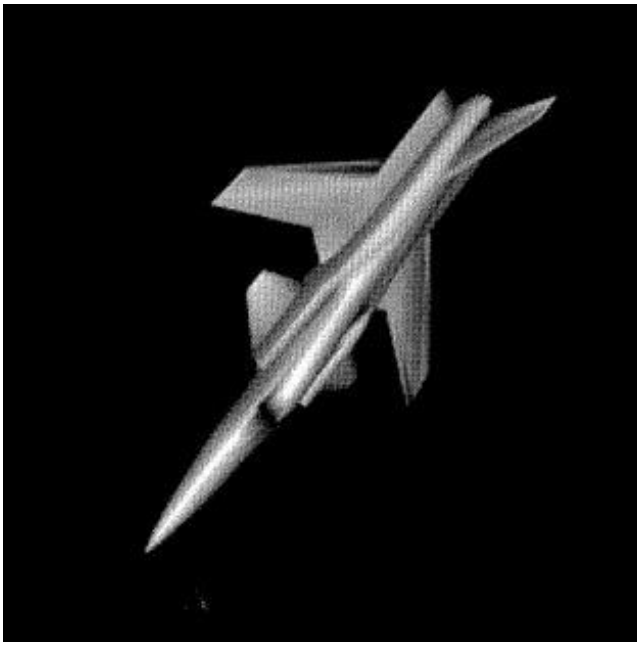
Input Image of Plane2:



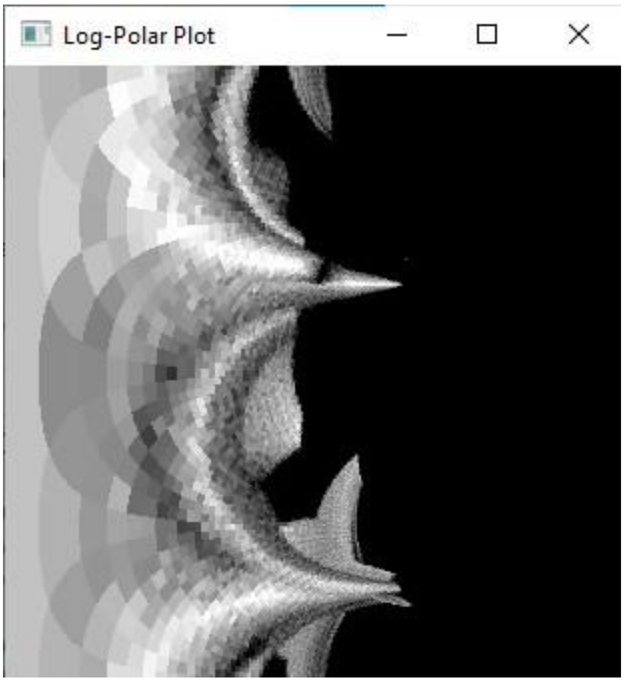
Output Image of Plane2:



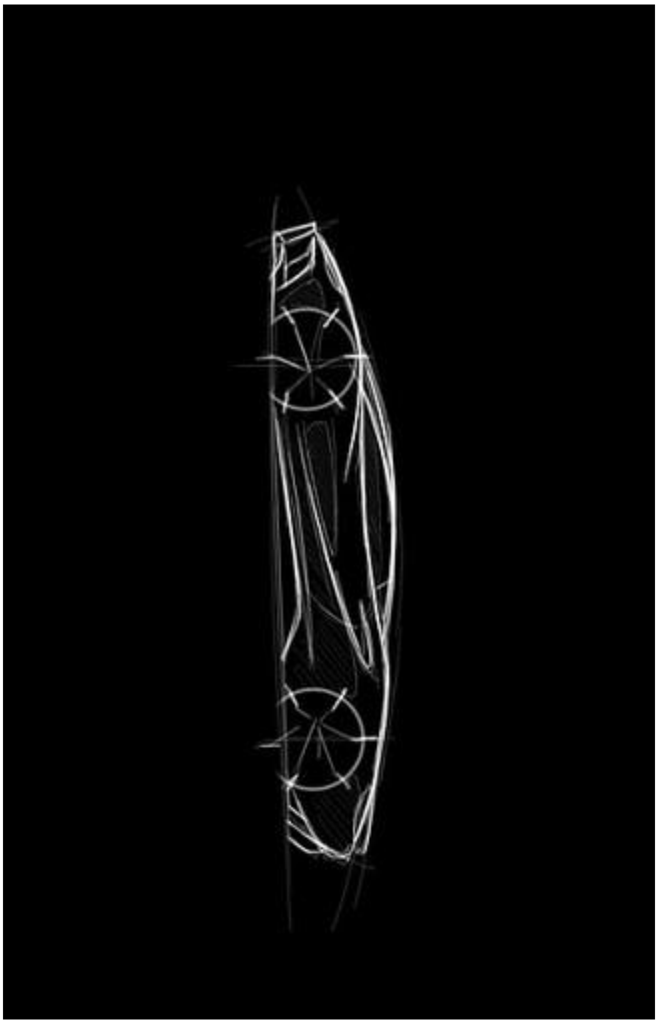
Input Image of Plane_rotated:



Output Image of Plane_rotated:



Input Image of Car_rotated:



Output Image of Car_rotated:

DISCUSSIONS & CONCLUSIONS:

I have taken the Car and Plane image and produced their log polar plot. After that using the code of shift parameters and transformation I have translated the car and plane images with certain numbers mentiond below

Translation for car1 : -4.25, 2.5 (x,y)

Translaton for car2 : 4.5,-3.5 (x,y)

And there after I rotated the images to see their log polar plots.

What I observed is there is no much difference in the view of the log polar plot of the rotated images as it makes the differenece in the rotation.

<u>Could you quantify (or find a way to gauge) what happened in the log-polar plots to express the degree of rotation and the extent of translation.</u>

In real terms, the "**angle of rotation**" parameter refers to the amount of rotation applied to the image. This can be expressed in degrees or radians, depending on the context. The "**extent of translation**" parameter refers to how far the image is moved horizontally and/or vertically from its original position. This can be expressed in pixels or some other unit of distance.

The Angle of rotation & Extent of Translations of the above input images:

<u>For Car:</u>

```
Angle of rotation: 56.87 degrees
Extent of translation: 1.00
```

<u>For Car1:</u>

```
Angle of rotation: 104.84 degrees
Extent of translation: 0.51
```

<u>For Car2:</u>

```
Angle of rotation: 95.93 degrees
Extent of translation: -0.49
```

<u>For car_rotated:</u>

```
Angle of rotation: 135.83 degrees
Extent of translation: 0.85
```

<u>For Plane:</u>

```
Angle of rotation: 114.23 degrees
Extent of translation: 0.95
```

<u>For Plane1:</u>

```
Angle of rotation: 212.31 degrees
Extent of translation: 0.99
```

<u>For Plane2:</u>

```
Angle of rotation: 213.46 degrees
Extent of translation: 0.60
```

<u>For Plane_rotated:</u>

```
Angle of rotation: 94.06 degrees
Extent of translation: 0.52
```