AEROSPACE INFORMATION TECHNOLOGY

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# Remote Sensing

## Exercise 1

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## Task 1.1: RRI vs RHI

The Range-Height Indicator (RHI) and Plan Position Indicator (PPI) scopes are both types of radar displays, but they differ in the way they represent and measure radar data.
The PPI scope displays radar data in a horizontal plane, providing a bird's-eye view of the scanned area. It measures the azimuth angle (horizontal angle) and the range (distance) of the detected targets from the radar antenna.

On the other hand, the RHI scope displays radar data in a vertical plane, providing a side view or cross-section of the scanned area. It measures the elevation angle (vertical angle) and the range (distance) of the detected targets from the radar antenna.

In summary, while both the PPI and RHI scopes are used for analyzing radar data, the PPI scope provides information on the horizontal distribution of targets, while the RHI scope focuses on the vertical distribution and structure of targets, offering valuable insights not available with the PPI scope.

## Task 1.2: CW vs Pulsed

A radar system measures the range and speed of a target using different techniques.

Range: Range is the distance between the radar antenna and the target.
Speed: Speed is measured using the Doppler effect, which is the change in frequency of the returned radar signal due to the relative motion between the radar and the target.

Shortly, here is to properties can be detected using a Continuous Wave (CW) waveform and a Pulsed waveform radar:

- Continuous Wave (CW) radar: A CW radar system transmits a continuous signal, which means it doesn't have separate transmit and receive periods.
- Pulsed Waveform radar: A pulsed radar system transmits a series of short pulses, allowing it to measure both range and speed.

In summary, a Continuous Wave (CW) radar system can primarily measure the speed of a target, whereas a Pulsed waveform radar can measure both range and speed. Pulsed waveform radar's ability to measure both properties from its separate transmit and receive periods, which allow it to determine the time delay and analyze the Doppler shift.

## Task 1.3: Mono-static vs Bi-static

A monostatic radar system is generally more susceptible to picking up scatter from a stealth target compared to a bistatic radar system. On the other hand, a bistatic radar system has separate transmitter and receiver antennas positioned at different locations.

Well, Monostatic radar systems are generally more susceptible to picking up scatter from stealth targets than bistatic systems. Stealth technology focuses on minimizing radar reflections towards monostatic antennas, while bistatic systems, with separate transmitter and receiver antennas, may still receive scattered waves. However, bistatic systems are more complex, expensive, and harder to maintain.

## Task 1.4: Python programming: Split satellite image into tiles

First, install requires the library that is

```
#pip install rasterio opencv-python

```

Python Script that reads a single band Sentinel-2 image in JPEG2000 format (.jp2) and splits it into smaller rectangular tiles saved in TIFF format (.tif)

```python
import os
import cv2
import rasterio

def split_image_into_tiles(input_image, output_folder, tile_size):
    with rasterio.open(input_image) as src:
        width, height = src.width, src.height
        transform = src.transform

        for i in range(0, width, tile_size):
            for j in range(0, height, tile_size):
                tile_transform = rasterio.windows.transform(
                    rasterio.windows.Window(i, j, tile_size, tile_size),
                    transform
                )
                tile = src.read(window=rasterio.windows.Window(i, j, tile_size, tile_size), out_shape=(1, tile_size, tile_size), resampling=rasterio.enums.Resampling.bilinear)

                output_path = os.path.join(output_folder, f'tile_{i}_{j}.tif')
                cv2.imwrite(output_path, tile[0])

if __name__ == '__main__':
    input_image = r"C:\Users\recep\Desktop\SaTec\2.Semeter\Remote Sensoring\Exercise_1\sentinel2Image20m.jp2"
    output_folder = r"path\to\output\folder"
    tile_size = 512

    if not os.path.exists(output_folder):
        os.makedirs(output_folder)

    split_image_into_tiles(input_image, output_folder, tile_size)

```

Here is important that where your folder should be defined **'path/to/sentinel_image.jp2'** and **'path/to/output/folder'** with the path to the folder where you want to save the tiled .tif files.

**"C:\Users\recep\Desktop\SaTec\2.Semeter\RemoteSensoring\Exercise_1\path\to\output\folder\tile_0_0.tif"** I saved the tiled .tif tiles and adjust **"tile size"** output folder with name like from **tile_0_0 to tile_0_512.**