Encryption

December 3, 2023

1 Main paper used for this Hybrid chaotic encryption algorithm

1.0.1 https://doi.org/10.1007/978-3-319-77383-4_87

[47]:
```
import tifffile
import numpy as np
from module import *
import time
from IPython.utils import io
from matplotlib import pyplot as plt
plt.rcParams["figure.figsize"] = (28,6)
```

[48]:
```
ndviArray = tifffile.imread(r"J:
  ↪\ProjectComputerVision\ProcessedData\ComputerVisionProject\NDVI\2022\LC08_L1TP_031032_202211
  ↪tif")
ndviFlat = ndviArray.flatten()
rows, cols = ndviArray.shape
arrayLength = rows*cols
```

[49]:
```
def Logistic(mu, x0):
    LogisticMap = np.full(arrayLength, np.nan)
    LogisticMap[0] = x0
    for i in range(1, arrayLength):
        LogisticMap[i] = float_mu * LogisticMap[i-1]*(1-LogisticMap[i-1])
    return LogisticMap

def Chebyshev(k,x0):
    ChebyshevMap = np.full(arrayLength, np.nan)
    ChebyshevMap[0] = x0
    for i in range(1, arrayLength):
        ChebyshevMap[i] = np.cos(k*np.arccos(ChebyshevMap[i-1]))
    return ChebyshevMap

def Hybrid(LogisticMap, ChebysehvMap):
    dotProd = LogisticMap * ChebysehvMap
    return dotProd
```

[50]:

```
%%timeit
HashInt = hashKeyInt("ashish240")
hash_0to1 = Hash0to1(HashInt)
```

```
2.19 µs ± 28.4 ns per loop (mean ± std. dev. of 7 runs, 100,000 loops each)
```

[51]:

```
%%timeit
# Convert hash to float in the range [3.5699456, 4.0]
# default & fixed range for this encryption to work.
float_mu = muFloatRange(hash_0to1)

#Starting seed value for X0 range[0,1]
xIniFloat = hash_0to1

# K >= 2 for chaotic state.
kFloat = kFloatRange(hash_0to1)
```

```
383 ns ± 8.04 ns per loop (mean ± std. dev. of 7 runs, 1,000,000 loops each)
```

[52]:

```
%%timeit
LogisticMap = Logistic(float_mu, hash_0to1)
ChebyshevMap = Chebyshev(kFloat, hash_0to1)
HybridMap = Hybrid(LogisticMap, ChebyshevMap)
encryptedNDVI = np.full(arrayLength, np.nan)
```

```
1.29 s ± 16.7 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```

[53]:

```
%%timeit
for i in range(0, arrayLength):
    float1 = ndviFlat[i]
    float2 = HybridMap[i]
    # Convert floats to 32-bit binary representations
    if np.isnan(float1):
        encryptedNDVI[i]=np.nan
        continue
    binary1 = int(bin(convert2Int(float1)),2)
    binary2 = int(bin(convert2Int(float2)),2)
    floatXor = binary1 ^ binary2
    encryptedNDVI[i] = convertBack(floatXor)
```

```
3.03 s ± 11.6 ms per loop (mean ± std. dev. of 7 runs, 1 loop each)
```

[54]:

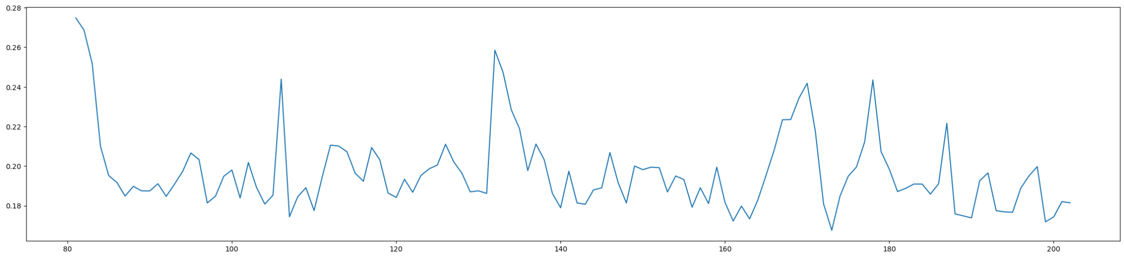
```
time_delta
```

[54]:

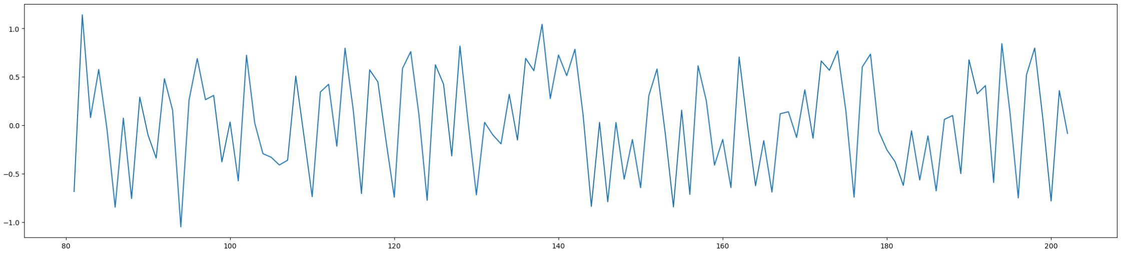
```
1.315302848815918
```

[55]:

```
plt.plot(ndviFlat[6000:6500])
plt.savefig("NDVI_points.png")
# plt.close()
```

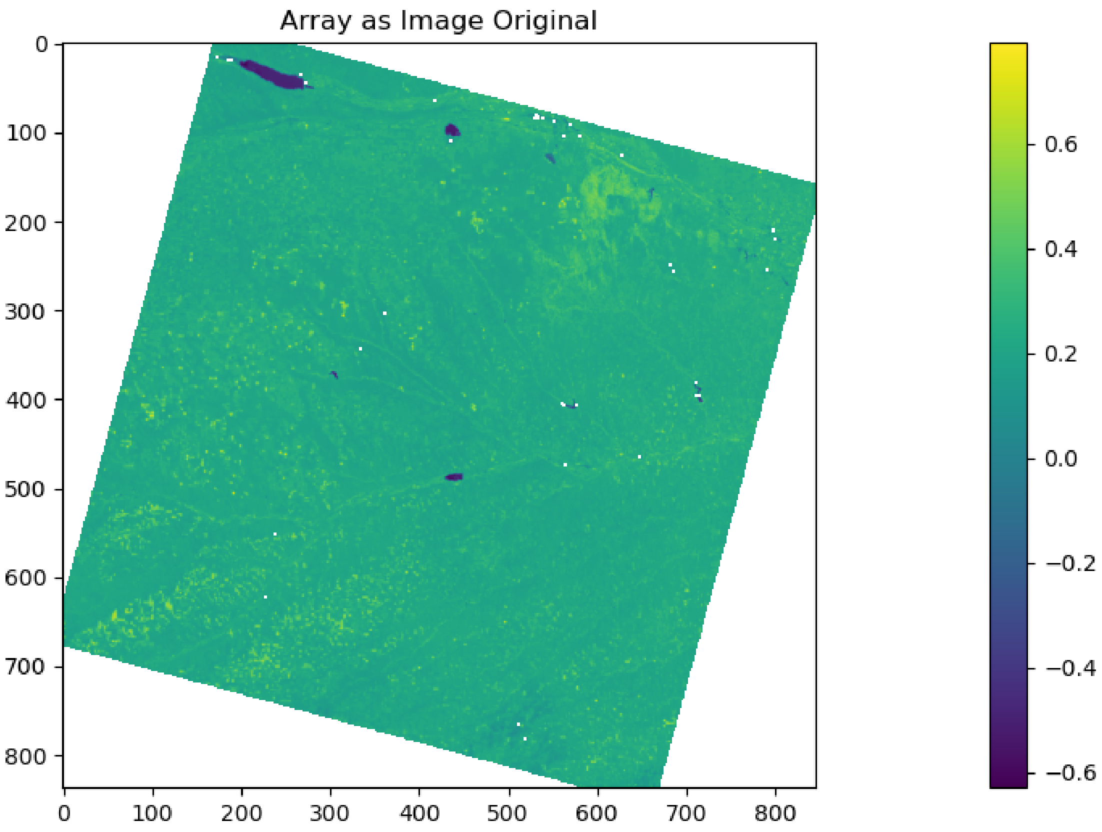


```
[56]: plt.plot(encryptedNDVI[6000:6500])
      plt.savefig("NDVI_Encrypted_points.png")
      # plt.close()
```

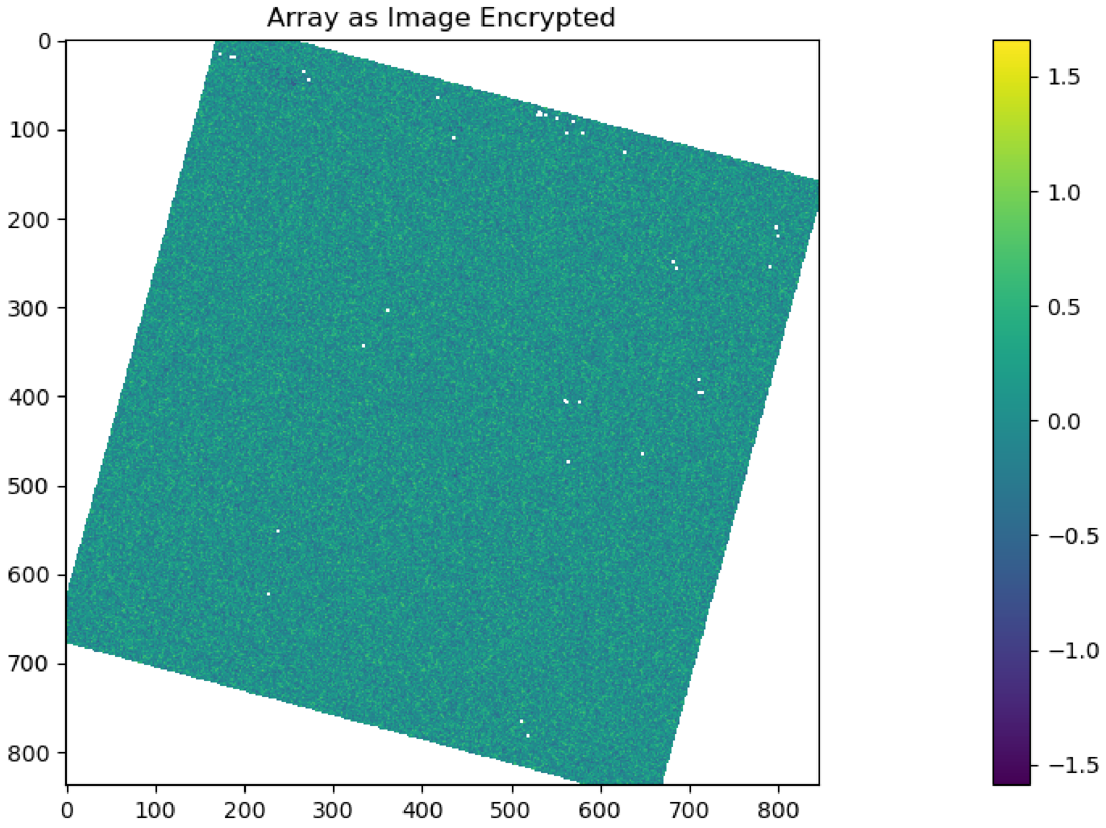


```
[57]: ndviEncryptedArray = encryptedNDVI.reshape(rows,cols)
      tifffile.imwrite("NDVI_Encrypted.tif",ndviEncryptedArray)
      tifffile.imwrite("NDVI_Original.tif",ndviArray)
```

```
[58]: # Display the array as an image
      plt.imshow(ndviArray, cmap='viridis')  # 'viridis' is just an example colormap,␣
       ↪you can choose another
      plt.title('Array as Image Original')
      plt.colorbar()  # Add a colorbar for reference
      plt.show()
```



[59]:
```
# Display the array as an image
plt.imshow(ndviEncryptedArray, cmap='viridis')  # 'viridis' is just an example␣
 ↪colormap, you can choose another
plt.title('Array as Image Encrypted')
plt.colorbar()  # Add a colorbar for reference
plt.show()
```


Array as Image Encrypted
0
100
200
300
400
500
600
700
800
0
100
200
300
400
500
600
700
800
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5

```
[ ]:
```