Apply_PCA

March 8, 2022

[16]:
```python
# libraries
import cv2
import numpy as np
import matplotlib.pyplot as plt
from sklearn.decomposition import PCA
```

[29]:
```python
# read images
Red = cv2.imread('images/Red.jpg',0)
Green = cv2.imread('images/Green.jpg',0)
Blue = cv2.imread('images/Blue.jpg',0)
Near = cv2.imread('images/Near.jpg',0)
Middle = cv2.imread('images/Middle.jpg',0)
Thermal = cv2.imread('images/thermal.jpg',0)
```

[30]:
```python
# compress images
img_compressed = (np.dstack((Red, Green, Blue, Near, Middle, Thermal))).
 ↪astype(np.uint8)
img_compressed_orginal = img_compressed.copy()
```

[31]:
```python
# reshape images (convert 3D array to 2D array)
img_compressed = img_compressed.reshape((774*773,6))
```

[40]:
```python
# get all Eigenvalues from a pca
pca = PCA(n_components = 6)
pca.fit_transform(img_compressed)

Eigenvalues = pca.explained_variance_

print(Eigenvalues)
```

```
[5528.4387433  1079.53432092   48.20155499   24.62477377   15.00501052
    6.87766381]
```

[41]:
```python
# create PCA, apply transforms, invert transforms
pca = PCA(n_components = 3)

compressed_transformed = pca.fit_transform(img_compressed)
```

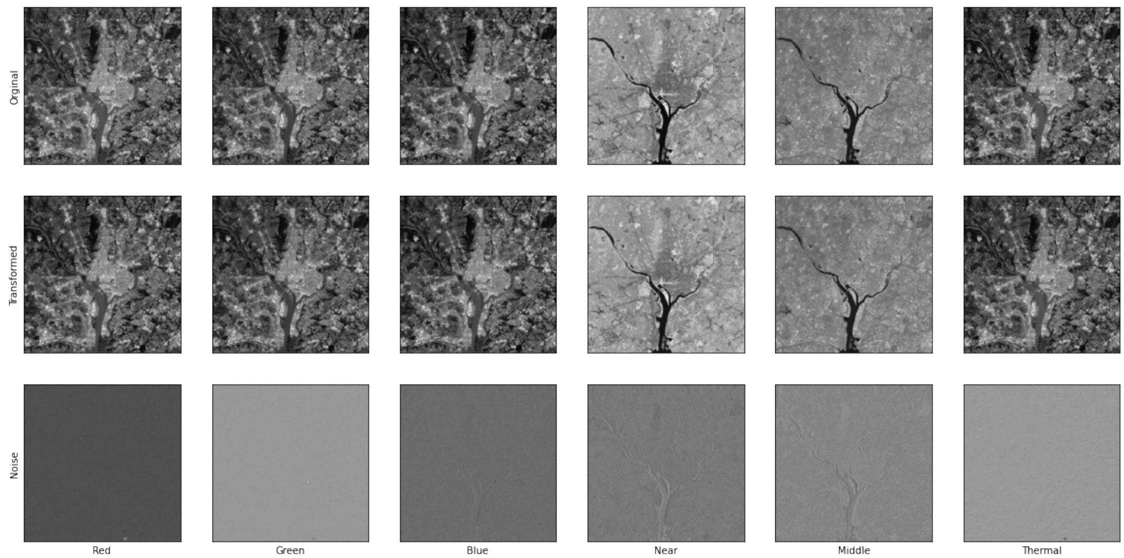
```
compressed_invert = pca.inverse_transform(compressed_transformed)
```

[42]:
```
# reshape images (convert 2D array to 3D array)
compressed_invert = compressed_invert.reshape((774,773,6))
```

[43]:
```
# split images
R,G,B,N,M,T = cv2.split(compressed_invert)
```

[44]:
```
# plot results
fig, axs = plt.subplots(3, 6, figsize = (20,10))

# remove the x and y ticks
plt.setp(plt.gcf().get_axes(), xticks=[], yticks=[]);

axs[0, 0].imshow(Red, cmap = 'gray')
axs[0, 1].imshow(Green, cmap = 'gray')
axs[0, 2].imshow(Blue, cmap = 'gray')
axs[0, 3].imshow(Near, cmap = 'gray')
axs[0, 4].imshow(Middle, cmap = 'gray')
axs[0, 5].imshow(Thermal, cmap = 'gray')

axs[1, 0].imshow(R, cmap = 'gray')
axs[1, 1].imshow(G, cmap = 'gray')
axs[1, 2].imshow(B, cmap = 'gray')
axs[1, 3].imshow(N, cmap = 'gray')
axs[1, 4].imshow(M, cmap = 'gray')
axs[1, 5].imshow(T, cmap = 'gray')

axs[2, 0].imshow(Red - R, cmap = 'gray')
axs[2, 1].imshow(Green - G, cmap = 'gray')
axs[2, 2].imshow(Blue - B, cmap = 'gray')
axs[2, 3].imshow(Near - N, cmap = 'gray')
axs[2, 4].imshow(Middle - M, cmap = 'gray')
axs[2, 5].imshow(Thermal - T, cmap = 'gray')

y1 = axs.flat[0]
y1.set(ylabel='Orginal');

y2 = axs.flat[6]
y2.set(ylabel='Transformed');

y3 = axs.flat[12]
y3.set(ylabel='Noise' , xlabel='Red');

x2 = axs.flat[13]
x2.set(xlabel='Green');
```

```
x3 = axs.flat[14]
x3.set(xlabel='Blue');

x4 = axs.flat[15]
x4.set(xlabel='Near');

x5 = axs.flat[16]
x5.set(xlabel='Middle');

x6 = axs.flat[17]
x6.set(xlabel='Thermal');
```



[45]:
```
components = pca.components_

for row in components:
    print(row)
```

```
[ 0.49562519  0.47668624  0.4909174  -0.13700749  0.15238465  0.49409906]
[-0.00507487 -0.07471375 -0.00415145 -0.81660434 -0.57145841  0.03110479]
[-0.27227756 -0.11104941  0.84152949 -0.00200752 -0.01096658 -0.45303067]
```

[46]:
```
pca.explained_variance_
```

[46]:
```
array([5528.4387433 , 1079.53432092,   48.20155499])
```

[47]:
```
pca.explained_variance_ratio_
```

[47]:
```
array([0.82480993, 0.16106005, 0.00719138])
```

[48]:
```
Covariace_mat = pca.get_covariance()

for row in Covariace_mat:
    for col in row:
        print("%.2f" % col , end='\t\t')
    print()
```

```
1372.18         1303.87         1333.89         -369.93         419.55
1353.92
1303.87         1274.55         1287.38         -295.12         445.93
1297.64
1333.89         1287.38         1367.29         -367.24         414.64
1324.62
-369.93         -295.12         -367.24         828.53          381.44
-400.20
419.55          445.93          414.64          381.44          491.00
396.34
1353.92         1297.64         1324.62         -400.20         396.34
1369.14
```

[51]:
```
# mse
R_mse = ((Red - R)**2).mean()
G_mse = ((Green -G)**2).mean()
B_mse = ((Blue - B)**2).mean()
N_mse = ((Near - N)**2).mean()
M_mse = ((Middle - M)**2).mean()
T_mse = ((Thermal - T)**2).mean()

whole_MSE = ((img_compressed_orginal - compressed_invert)**2).mean()

print(f"Red picture MSE: {R_mse}")
print(f"Green picture MSE: {G_mse}")
print(f"Blue picture MSE: {B_mse}")
print(f"Near picture MSE: {N_mse}")
print(f"Middle picture MSE: {M_mse}")
print(f"Thermal picture MSE: {T_mse}")
print(f"Whole picture MSE: {whole_MSE}")
print('\n\n')
print(f"Total MSE Error: {R_mse + G_mse + B_mse + N_mse + M_mse + T_mse}")
print(f"sum of eigenvalues which wasn't use: {Eigenvalues[3:].sum()}")
```

```
Red picture MSE: 7.137310781434447
Green picture MSE: 7.875962353445088
Blue picture MSE: 0.7450398078586573
Near picture MSE: 7.198176113747016
Middle picture MSE: 15.247616624785454
Thermal picture MSE: 8.303264680437156
Whole picture MSE: 7.751228393617971
```

```
Total MSE Error: 46.507370361707814
sum of eigenvalues which wasn't use: 46.50744809410396
```