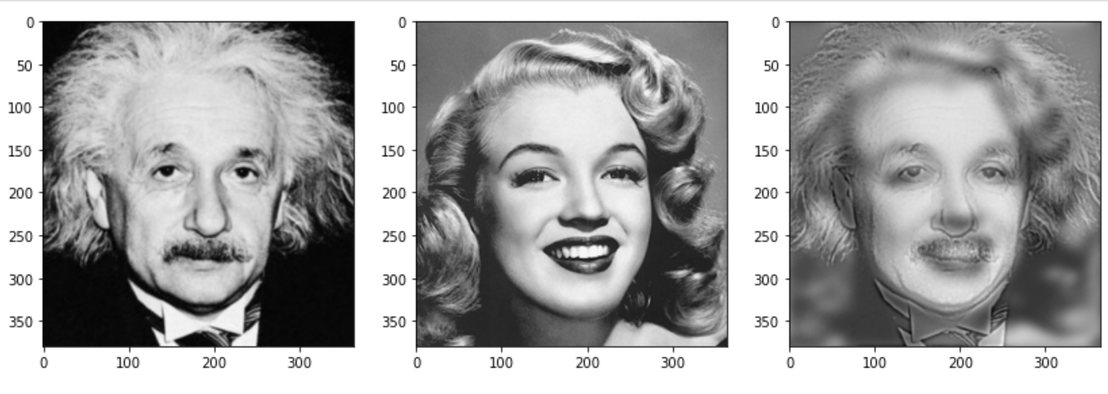
In [ ]:
```
conda install scipy
```

In [1]:
```
import numpy
from numpy.fft import fft2, ifft2, fftshift, ifftshift
from scipy import misc
from scipy import ndimage
import math
import cv2

def scaleSpectrum(A):
    return numpy.real(numpy.log10(numpy.absolute(A) + numpy.ones(A.shape)))

# sample values from a spherical gaussian function from the center of the image
def makeGaussianFilter(numRows, numCols, sigma, highPass=True):
    centerI = int(numRows/2) + 1 if numRows % 2 == 1 else int(numRows/2)
    centerJ = int(numCols/2) + 1 if numCols % 2 == 1 else int(numCols/2)

    def gaussian(i,j):
        coefficient = math.exp(-1.0 * ((i - centerI)**2 + (j - centerJ)**2) / (2 * sigma**2))
        return 1 - coefficient if highPass else coefficient

    return numpy.array([[gaussian(i,j) for j in range(numCols)] for i in range(numRows)])

def filterDFT(imageMatrix, filterMatrix):
    shiftedDFT = fftshift(fft2(imageMatrix))
    cv2.imwrite("images/dft.png", scaleSpectrum(shiftedDFT))

    filteredDFT = shiftedDFT * filterMatrix
    cv2.imwrite("images/filtered-dft.png", scaleSpectrum(filteredDFT))
    return ifft2(ifftshift(filteredDFT))

def lowPass(imageMatrix, sigma):
    n,m = imageMatrix.shape
    return filterDFT(imageMatrix, makeGaussianFilter(n, m, sigma, highPass=False))

def highPass(imageMatrix, sigma):
    n,m = imageMatrix.shape
    return filterDFT(imageMatrix, makeGaussianFilter(n, m, sigma, highPass=True))

def hybridImage(highFreqImg, lowFreqImg, sigmaHigh, sigmaLow):
    highPassed = highPass(highFreqImg, sigmaHigh)
    lowPassed = lowPass(lowFreqImg, sigmaLow)
    return highPassed + lowPassed

def playWithFiltering():
    marilyn = ndimage.imread("images/marilyn.png", flatten=True)
    highPassedMarilyn = highPass(marilyn, 20)
    lowPassedMarilyn = lowPass(marilyn, 20)
    cv2.imwrite("images/low-passed-marilyn.png", numpy.real(lowPassedMarilyn))
    cv2.imwrite("images/high-passed-marilyn.png", numpy.real(highPassedMarilyn))
    cv2.imwrite("images/sum-of-marilyns.png", numpy.real((highPassedMarilyn + lowPassedMarilyn)/ 2.0))
```

In [4]:
```
einstein = cv2.imread("images/einstein.png",0)
marilyn = cv2.imread("images/marilyn.png",0)
hybrid = hybridImage(einstein, marilyn, 25, 10)
cv2.imwrite("images/einstein-marilyn.png", numpy.real(hybrid))
```

Out[4]:
```
True
```

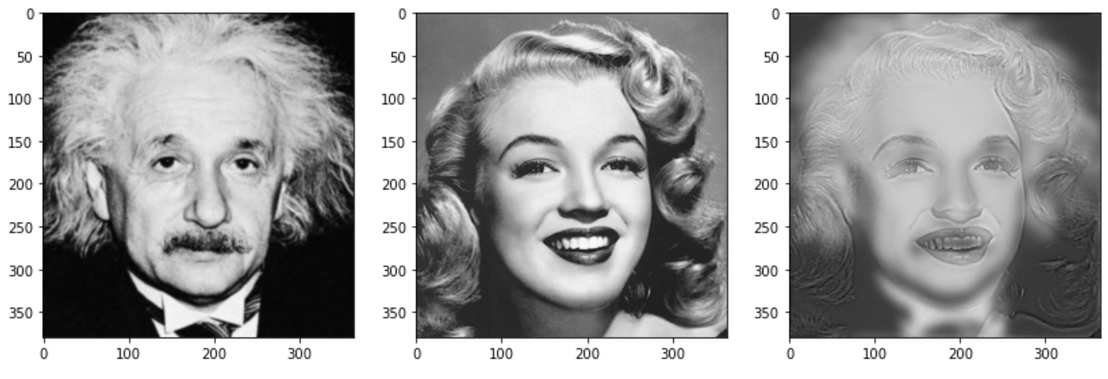
In [5]:
```
import matplotlib.pyplot as plt

plt.figure(figsize=(14, 18))
plt.subplot(131)
plt.imshow(cv2.cvtColor(einstein, cv2.COLOR_BGR2RGB))
plt.subplot(132)
plt.imshow(cv2.cvtColor(marilyn, cv2.COLOR_BGR2RGB))
plt.subplot(133)
plt.imshow(numpy.real(hybrid) , cmap ='gray')
plt.show()
```



In [6]:
```
einstein = cv2.imread("images/einstein.png",0)
marilyn = cv2.imread("images/marilyn.png",0)
hybrid = hybridImage(marilyn, einstein, 25, 10)
cv2.imwrite("images/marilyn-einstein.png", numpy.real(hybrid))
```

Out[6]:
```
True
```

In [7]:
```
plt.figure(figsize=(14, 18))
plt.subplot(131)
plt.imshow(cv2.cvtColor(einstein, cv2.COLOR_BGR2RGB))
plt.subplot(132)
plt.imshow(cv2.cvtColor(marilyn, cv2.COLOR_BGR2RGB))
plt.subplot(133)
plt.imshow(numpy.real(hybrid) , cmap ='gray')
plt.show()
```



In [ ]: