Task8

2019 年 6 月 12 日

1 图像处理 +180776+ 胡欣毅 (Python 版)

2 上课随堂任务

1. 生成函数及边缘增强 [同第 5 周任务]
2. 阶跃函数柔化和边缘增强 [同第 5 周任务]
3. 卷积信号估计: 从 g(x)=f(x)*h(x) 中估计出 f(x)
4. 图像矫正 (仿射变换、透视变换)
5. 图像边缘增强
6. 课后补充

- 课后补充: 自编图像矫正函数, 提升速度

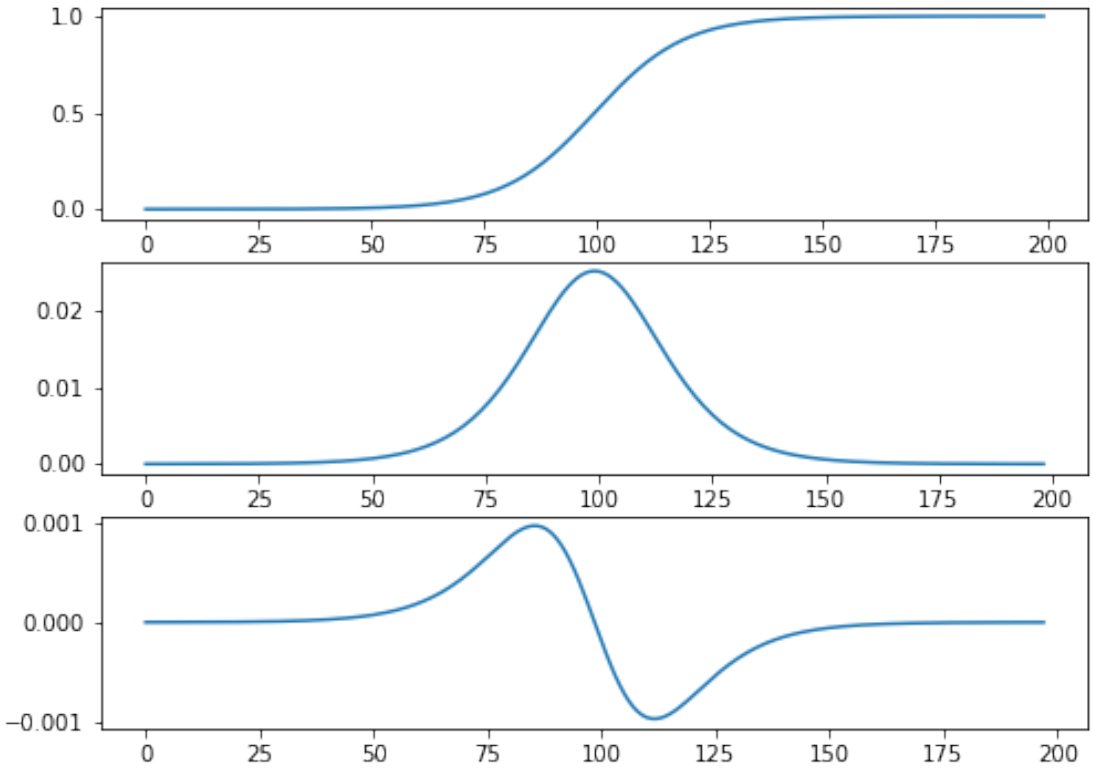
```
In [1]: import matplotlib.pyplot as plt
        import cv2
        import numpy as np
        import time
        %matplotlib inline
```

3 1. 生成函数及边缘增强

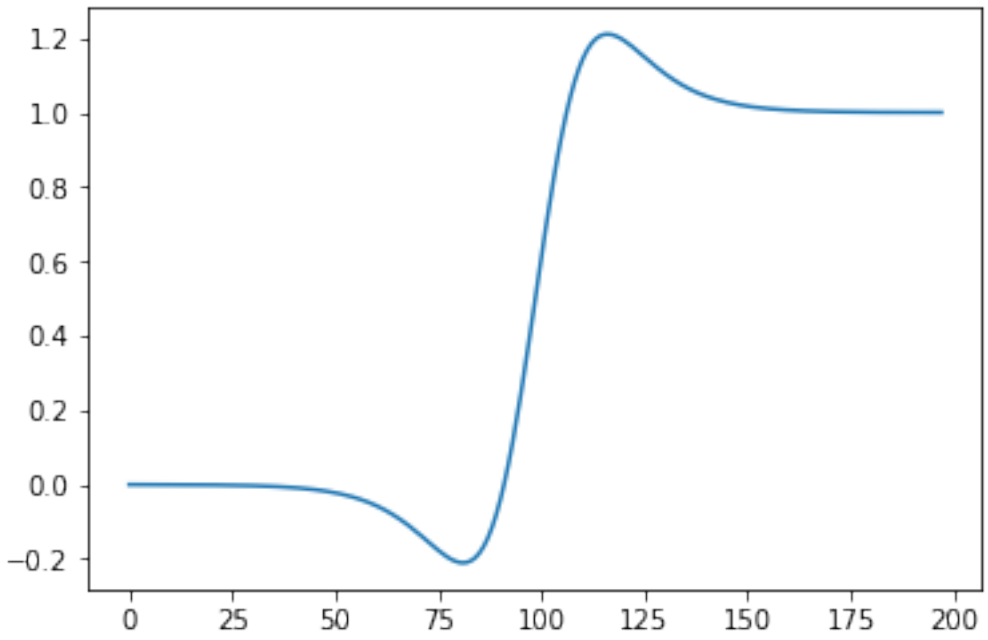
```
In [2]: def sigmoid(x):
            return 1. / (1. + np.exp(-x) )
```

```
In [3]: x = np.linspace(-10,10,200)
        y = sigmoid(x)
        dy = np.diff(y)
        ddy = np.diff(dy)
```

In [4]:
```
plt.figure(figsize=(8,6))
plt.subplot(311)
plt.plot(y)
plt.subplot(312)
plt.plot(dy)
plt.subplot(313)
plt.plot(ddy)
plt.show()
```

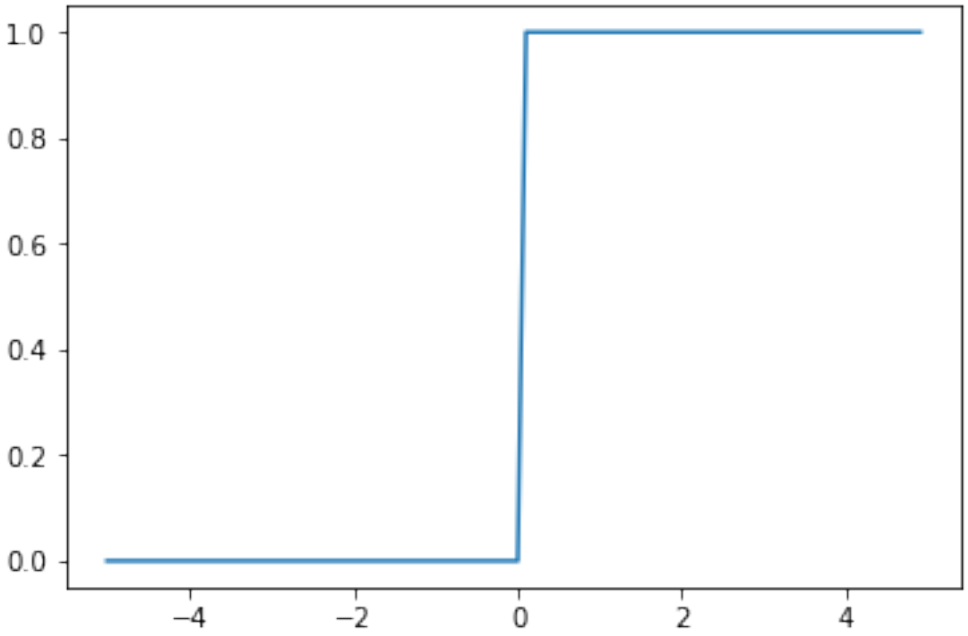


In [5]:
```
lamb = 400
out = y[1:-1] - lamb * ddy
plt.figure()
plt.plot(out)
plt.show()
```



4 2. 阶跃函数柔化和边缘增强

```
In [6]: def step_function(x):
            return np.array(x > 0, dtype=np.int)

In [7]: X = np.arange(-5.0, 5.0, 0.1)
        Y = step_function(X)
        plt.plot(X, Y)
        plt.show()
```

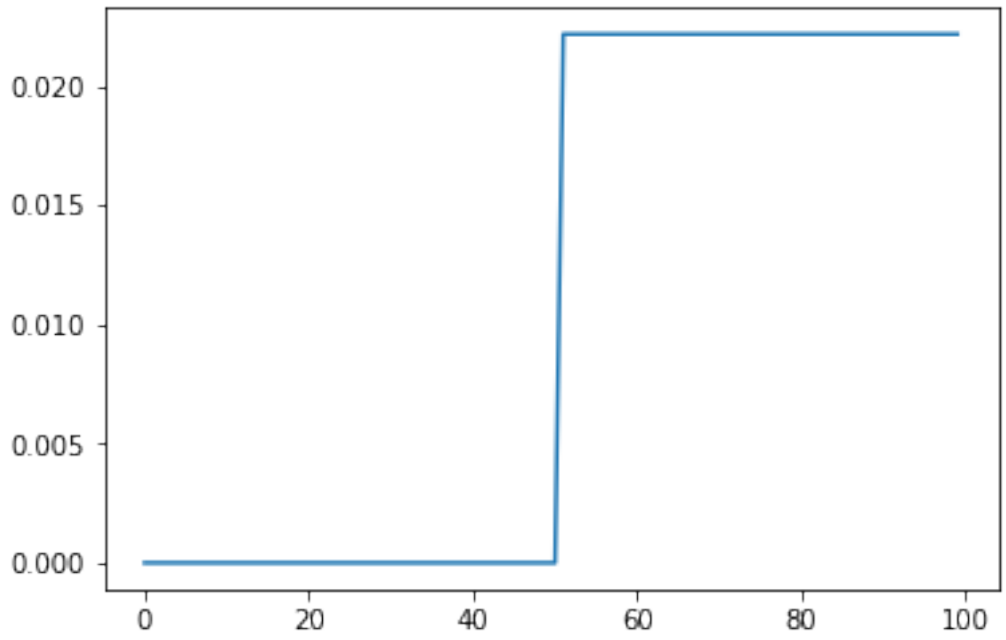


In [8]:
```
sigma = .2
```

In [ ]:
```
def gaosi(sigma,x):
    return np.exp(-x**2/(2*sigma**2) )/(np.sqrt(2*np.pi)*sigma)
```

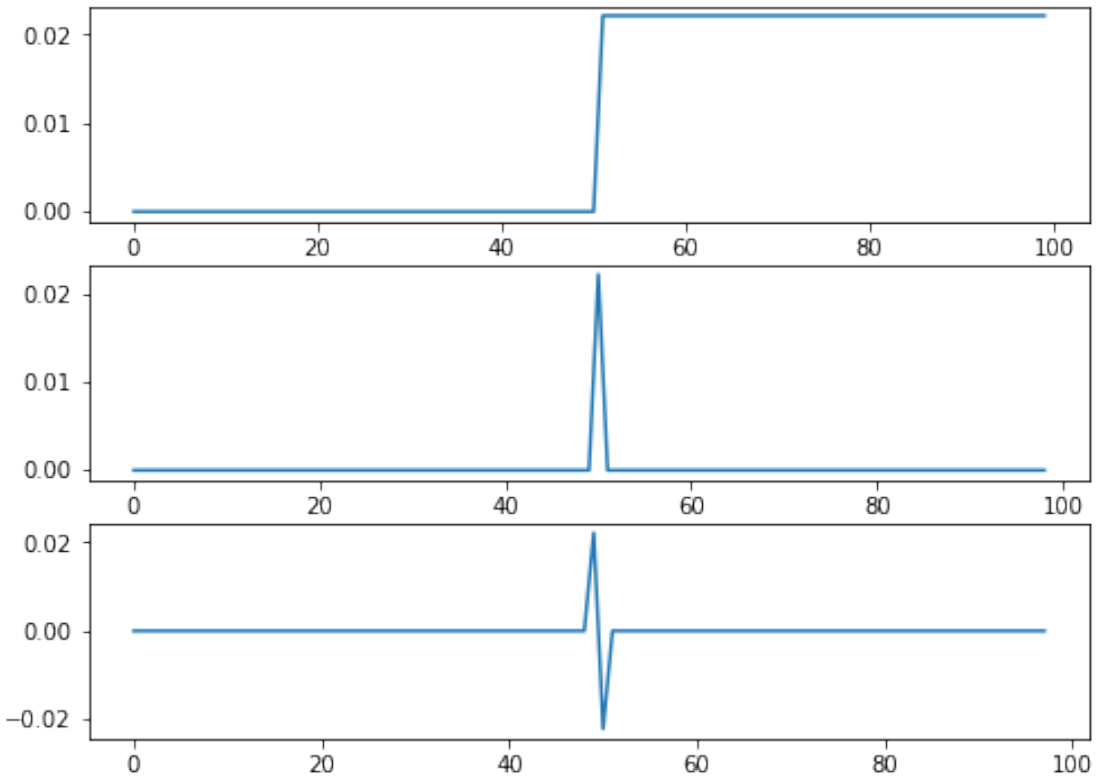
In [ ]:
```
import scipy.signal
gaosi_filter = gaosi(sigma, np.linspace(-3*sigma,3*sigma, 8*sigma ) )

out = scipy.signal.convolve(Y,gaosi_filter)
plt.figure()
plt.plot(out)
plt.show()
```

```
/home/huxinyi/miniconda3/envs/hxy/lib/python3.6/site-packages/ipykernel_launcher.py:2: Deprecat
```

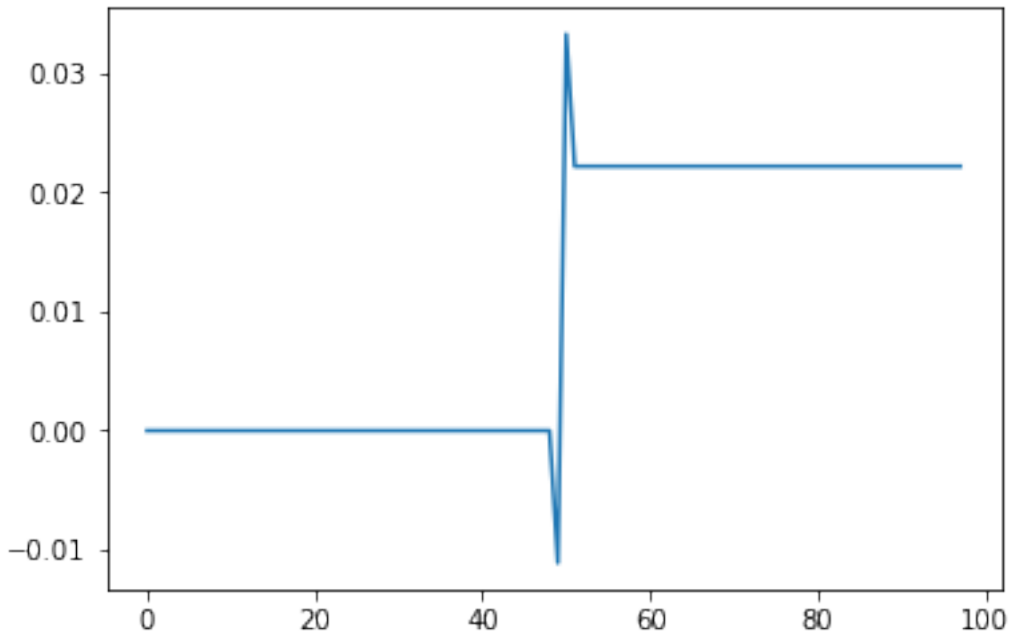



```
In [ ]: dout = np.diff(out)
        ddout = np.diff(dout)
```

```
In [ ]: plt.figure(figsize=(8,6))
        plt.subplot(311)
        plt.plot(out)
        plt.subplot(312)
        plt.plot(dout)
        plt.subplot(313)
        plt.plot(ddout)
        plt.show()
```



In [ ]:
```
lambd = .5
result = out[1:-1] - lambd * ddout
plt.figure()
plt.plot(result)
plt.show()
```



5 3. 卷积信号估计

$$g(x) = f(x) * h(x)$$

$$min_{\hat{f}} \left\| \widehat{f(x)} - f(x) \right\| \tag{1}$$

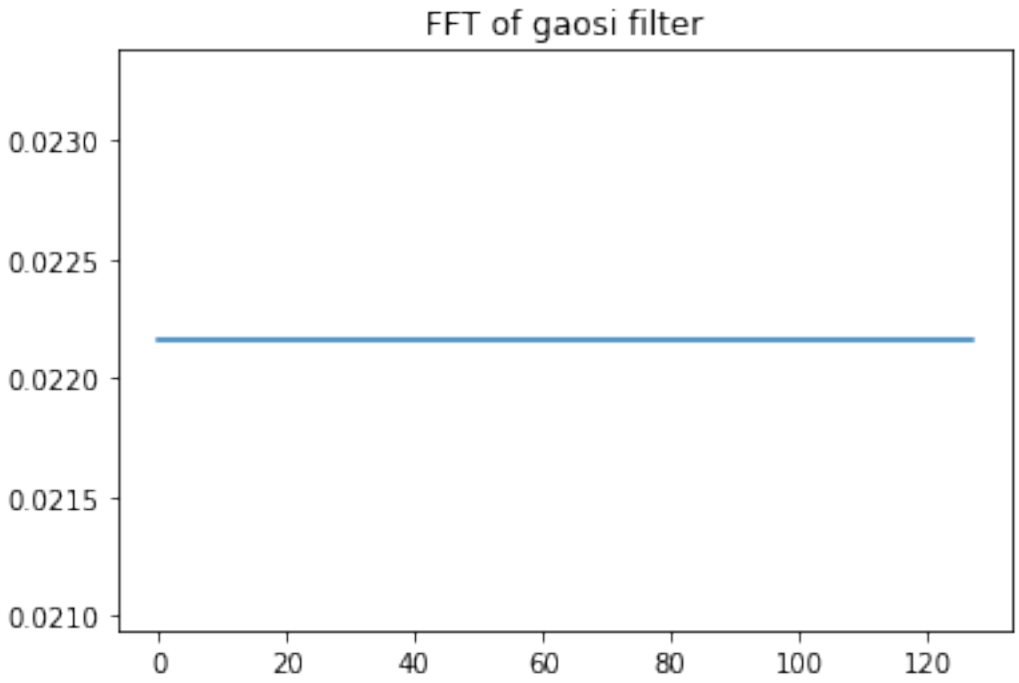
此设计中对应的关系

$$g = out \quad f = Y \quad h = gaosi\_filter$$

```
In [ ]: from scipy.fftpack import fft,ifft
        N = 128
        g_fft = fft(out,N)
        h_fft = fft(gaosi_filter,N)
        h_fft_conj = h_fft.conjugate()
        print(g_fft.shape,h_fft.shape)
```

```
(128,) (128,)
```

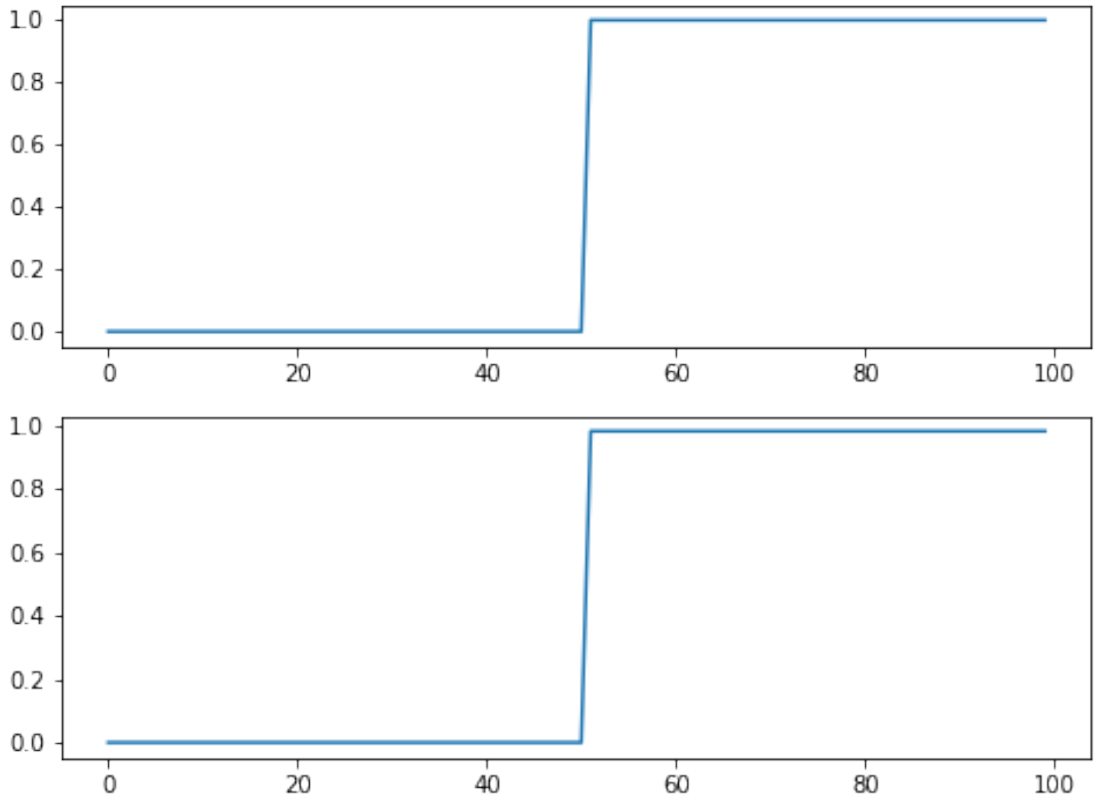
In [ ]:
```
plt.figure()
plt.plot(abs(h_fft))
plt.title('FFT of gaosi filter')
plt.show()
```



$$\widehat{f} = \frac{\widehat{g} \times \widehat{h}^*}{\widehat{h} \times \widehat{h}^* + \lambda}$$

In [ ]:
```
lab = 0.00001
f_fft_guji = (g_fft*h_fft_conj)/(h_fft*h_fft_conj + lab )
f_guji = abs(ifft(f_fft_guji))
```

In [ ]:
```
plt.figure(figsize=(8,6))
plt.subplot(211)
plt.plot(Y)
plt.subplot(212)
plt.plot(f_guji[:100])
plt.show()
```



6 4. 图像矫正

6.1 4.1. 透视变换

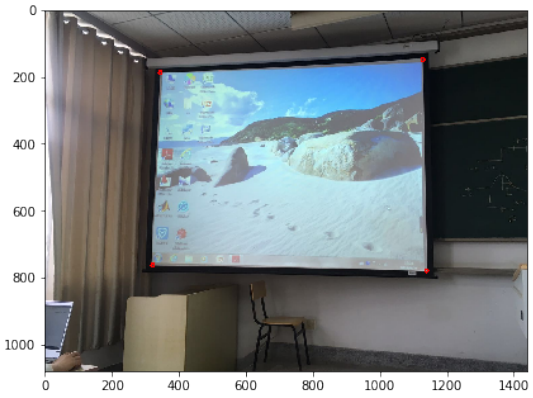
```
In [ ]: im = cv2.imread('../desktop.jpeg')
        im = cv2.cvtColor(im , cv2.COLOR_RGB2BGR)
        gray = cv2.cvtColor(im , cv2.COLOR_RGB2GRAY)
        plt.imshow(gray,cmap='gray')
        plt.axis("off")
        plt.show()
        gray.shape
```

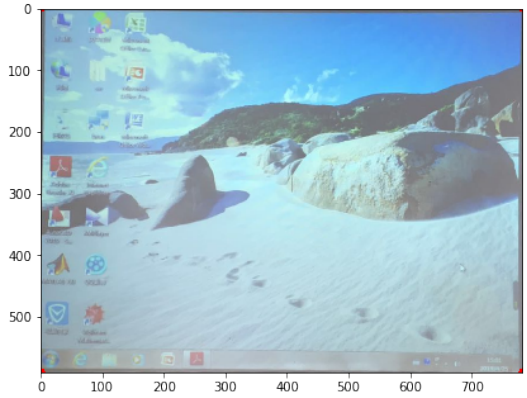
Out[ ]: (1080, 1440)

In [ ]:
```
# 原图中的左上、右上、左下、右下四个点
point1 = np.float32([[345, 189], [1128, 151],\
                     [322, 763], [1140, 780]])

# 长宽比
x_len=1128 - 345
y_len=780 - 189
# 变换后分别在左上、右上、左下、右下四个点
point2 = np.float32([[0, 0], [x_len-1, 0], \
                     [0, y_len-1], [x_len-1, y_len-1]])

# 生成透视变换矩阵
M = cv2.getPerspectiveTransform(point1, point2)

time_start = time.time()

# 进行透视变换
dst = cv2.warpPerspective(im, M, (x_len,y_len))
```

```
time_end = time.time()
print('调用库函数的时间: ',time_end-time_start,'s')

for point in point1:
    cv2.circle(im, tuple(point), 5, (255, 0, 0), 4)

for point in point2:
    cv2.circle(dst, tuple(point), 5, (255, 0, 0), 4)

plt.figure(figsize=(15,12))
plt.subplot(121)
plt.imshow(im,cmap='gray')
plt.subplot(122)
plt.imshow(dst,cmap='gray')
plt.show()
dst.shape
```

调用库函数的时间: 0.001871347427368164 s





Out[ ]: (591, 783, 3)

In [ ]:
```
# 自己的透视变换
M_inv = np.linalg.inv(M)
myim = np.zeros((y_len, x_len,3))
for y in range(y_len):
```

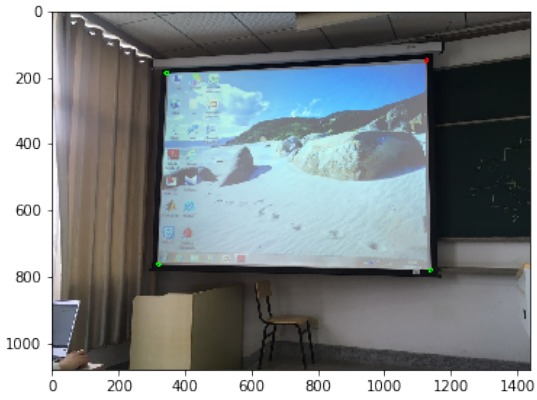
```
            for x in range(x_len):
                xy1 = M_inv.dot(np.array([[x],[y],[1]]))
                xx ,yy = xy1[0] / xy1[2] , xy1[1]/xy1[2]
                myim[y,x,:] = im[np.clip(yy,0,1440).astype(int),\
                                 np.clip(xx,0,1080).astype(int) , :]
        plt.imshow(myim.astype(int),cmap='gray')
        plt.axis("off")
        plt.show()
```

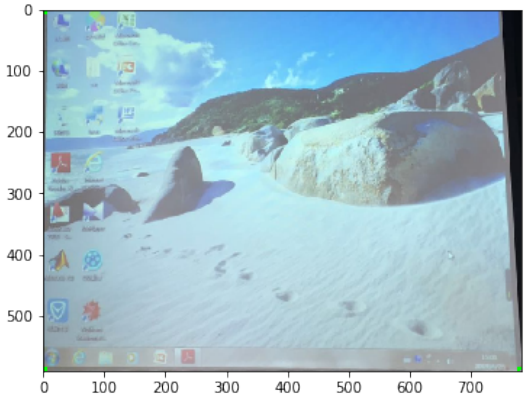
6.2 4.2. 仿射变换

In [ ]:
```
# 原图中的左上、右上、左下、右下四个点
point1 = np.float32([[345, 189], [322, 763],\
                     [1140, 780]])


# 长宽比
x_len=1128 - 345
y_len=780 - 189
# 变换后分别在左上、右上、左下、右下四个点
point2 = np.float32([[0, 0], [0, y_len-1], \
```

```
                                [x_len-1, y_len-1]])

    M = cv2.getAffineTransform(point1,point2)

    time_start = time.time()

    dst = cv2.warpAffine(im,M,(x_len,y_len))

    time_end = time.time()
    print('调用库函数的时间：',time_end-time_start,'s')

    for point in point1:
        cv2.circle(im, tuple(point), 5, (0, 255, 0), 4)

    for point in point2:
        cv2.circle(dst, tuple(point), 5, (0, 255, 0), 4)

    plt.figure(figsize=(13,10))
    plt.subplot(121)
    plt.imshow(im,cmap='gray')
    plt.subplot(122)
    plt.imshow(dst,cmap='gray')
    plt.show()
    dst.shape
```

```
调用库函数的时间： 0.0012640953063964844 s
```





```
Out[ ]: (591, 783, 3)
```

```
In [ ]: # 自己的仿射变换
        M1 = np.vstack( (M, np.array([0,0,1])) )
        M_inv = np.linalg.inv(M1)
        myim = np.zeros((y_len, x_len,3))
        for y in range(y_len):
            for x in range(x_len):
                xy1 = M_inv.dot(np.array([[x],[y],[1]]))
                #print(xy1.reshape(1,-1))
                myim[y,x,:] = im[np.clip(xy1[1],0,1440).astype(int),\
                                 np.clip(xy1[0],0,1080).astype(int) , :]
        plt.imshow(myim.astype(int),cmap='gray')
        plt.axis("off")
        plt.show()
```

7 5. 图像边缘增强

获取模糊图像

$$f_{out}$$

```
In [ ]: f_out = cv2.cvtColor(dst , cv2.COLOR_RGB2GRAY)
        plt.imshow(f_out,cmap='gray')
        plt.axis("off")# 去除坐标轴
        plt.show()
```

```
In [ ]: # Laplace 算子
        Laplace = np.array([[1, 1, 1],
                            [1,-8, 1],
                            [1, 1, 1]])
```

计算

$$\Delta f$$

```
In [ ]: deta_f = cv2.filter2D(f_out,-1,Laplace)
        plt.imshow(deta_f,cmap='gray')
        plt.axis("off")# 去除坐标轴
        plt.show()
```

```
In [ ]: labd = .2
        re_build = np.clip(abs(f_out - (labd * deta_f).astype(int)),0,255)
```

```
In [ ]: plt.figure(figsize=(12,10))
        plt.subplot(121)
        plt.imshow(f_out,cmap='gray')
        plt.axis("off")
        plt.subplot(122)
        plt.imshow(re_build,cmap='gray')
        plt.axis("off")
        plt.show()
```

```
In [ ]: # 图像清晰度值
        def getImageVar(image):
            imageVar = cv2.Laplacian(image, cv2.CV_64F).var()
            return imageVar
```

```
In [ ]: print(getImageVar(f_out),getImageVar(re_build.astype(float)))
```

8 6. 课后补充

8.1 6.1.1. 透视变换

$$\mathrm{dst}(x,y) = \mathrm{src}\left(\frac{M_{11}u + M_{12}v + M_{13}}{M_{31}u + M_{32}v + M_{33}}, \frac{M_{21}u + M_{22}v + M_{23}}{M_{31}u + M_{32}v + M_{33}}\right)$$

$$M = \begin{bmatrix} \alpha \\ \beta \\ \gamma \end{bmatrix}$$

$$x = \frac{M_{11}u + M_{12}v + M_{13}}{M_{31}u + M_{32}v + M_{33}} = \frac{\alpha T}{\gamma T} \qquad y = \frac{M_{21}u + M_{22}v + M_{23}}{M_{31}u + M_{32}v + M_{33}} = \frac{\beta T}{\gamma T}$$

$$\begin{bmatrix} \alpha - x \times \gamma \\ \beta - y \times \gamma \end{bmatrix} T = 0$$

$$T = \begin{bmatrix} u \\ v \\ 1 \end{bmatrix}$$

8.2 6.1.2. 透视变换改进

$$\begin{bmatrix} x' \\ y' \\ w \end{bmatrix} = M \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} \qquad \frac{1}{w}\begin{bmatrix} x' \\ y' \\ w \end{bmatrix} = \begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = \frac{1}{w} M \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} \qquad M^{-1} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = \begin{bmatrix} u' \\ v' \\ t' \end{bmatrix} \qquad \begin{bmatrix} u \\ v \end{bmatrix} = \begin{bmatrix} u'/t' \\ v'/t' \end{bmatrix}$$

8.3 6.2. 仿射变换

$$\begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = M \begin{bmatrix} u \\ v \\ 1 \end{bmatrix} \qquad M^{-1} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix} = \begin{bmatrix} u \\ v \\ 1 \end{bmatrix}$$

8.4 6.3. 插值方法

双线性插值

8.5 6.4. 各个版本计算时间对比

调用 opencv 仿射变换库函数运行: 0.022718s
自编仿射变换函数运行: 0.542926s
调用 opencv 透视变换函数运行: 0.007209s
自编透视变换函数 (solve 解方程) 运行: 0.938072s
自编透视变换函数 (Mat 取逆解方程) 运行: 1.11784s
自编透视变换函数优化版运行: 0.557861s

9 图像处理 +180776+ 胡欣毅 (C++ 版)

c++ 、 霍夫变换边缘点检测 c++