Task2

2019 年 6 月 19 日

1 图像处理 +180776+ 胡欣毅 (Python 版)

1.1 1. 题目清单（120/100）

0. 熟悉图像处理软件、平台，实现图像的读取与显示（例）
1. 【个人作业】课堂上的边缘提取算法的实现、并可视化（20/100）
2. 【小组作业】自行查找文献了解 SIFT、SURF 算法，并介绍（20/100）；
3. 【小组作业】实现 SIFT 算法（30/100）；
4. 【小组作业】实现 SURF 算法（附加题 20）；
5. 【小组作业】测试 SIFT 算法，并可视化（10/100）；
6. 【小组作业】准备 10 页左右 ppt，包括上述内容，并准备课堂抽查报告（20/100）。

1.2 2. 解答

1.2.1 2.1 第 1 题

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

In [2]: im = cv2.imread('../data/4.1.05.tiff')
        im.shape
        plt.imshow(im)
        plt.axis("off")# 去除坐标轴
        plt.show()
```

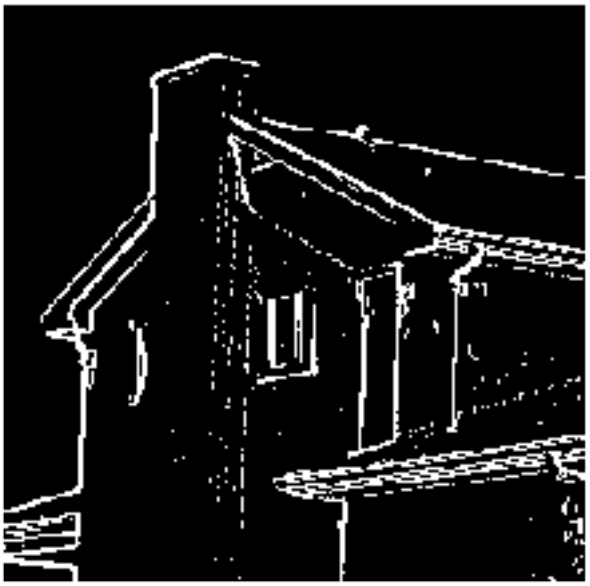
In [3]:
```
gray = cv2.cvtColor(im , cv2.COLOR_RGB2GRAY)
plt.imshow(gray,cmap='gray')
plt.axis("off")
plt.show()
```

1.3 一阶算子

Roberts 交叉梯度算子

$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix} \quad \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

```
In [4]: # Roberts
        Ker_x = np.array([[1,0],[0,-1]])
        Ker_y = np.array([ [0,-1],[1,0]])
        grad_x = cv2.filter2D(gray,  -1 , Ker_x )
        grad_y = cv2.filter2D(gray,  -1 , Ker_y )
        grad = np.abs(grad_x)  + np.abs(grad_y)
        grad = (grad > 25)*255
        plt.imshow(grad,cmap='gray')
        plt.axis("off")
        plt.show()
```



Prewitt 算子

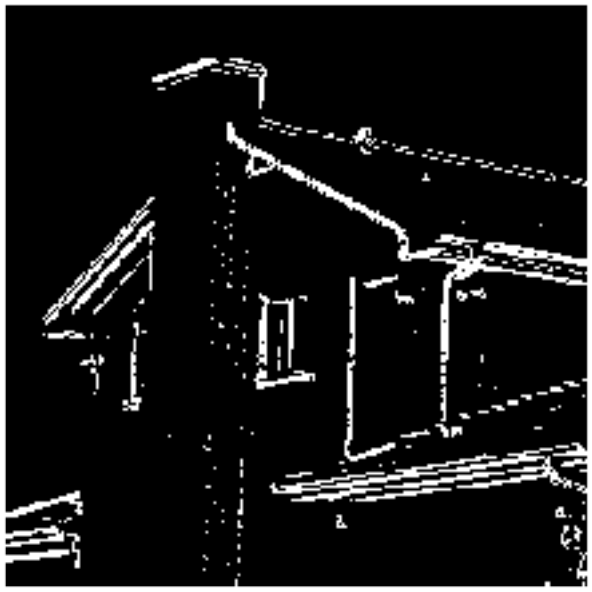
$$\begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix} \quad \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

```
In [5]: # Prewwitt
        Ker_x = np.array([ [-1, 0, 1], [-1, 0, 1], [-1, 0, 1]])
        Ker_y = np.array([ [1, 1, 1], [0, 0, 0], [-1, -1, -1]])

        grad_x = cv2.filter2D(gray,  -1 , Ker_x )
        grad_y = cv2.filter2D(gray,  -1 , Ker_y )
        grad = abs(grad_x)  + abs(grad_y)
        grad = (grad > 60)*255
        plt.imshow(grad,cmap='gray')
        plt.axis("off")
        plt.show()
```

Sobel 算子

$$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix} \quad \begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$$

In [6]:
```
# Sobel 核化滤波器
Ker_x = np.array([ [-1, 0, 1], [-2, 0, 2], [-1, 0, 1]])
Ker_y = np.array([ [1, 2, 1], [0, 0, 0], [-1, -2, -1]])

grad_x = cv2.filter2D(gray,  -1 , Ker_x )
grad_y = cv2.filter2D(gray,  -1 , Ker_y )
grad = abs(grad_x)  + abs(grad_y)
grad = (grad > 100)*255
plt.imshow(grad,cmap='gray')
plt.axis("off")
plt.show()
```



1.4 二阶算子

Laplace 算子

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & -4 & 1 \\ 0 & 1 & 0 \end{bmatrix} \quad \begin{bmatrix} 1 & 1 & 1 \\ 1 & -8 & 1 \\ 1 & 1 & 1 \end{bmatrix} \quad \begin{bmatrix} 1 & 4 & 1 \\ 4 & -20 & 4 \\ 1 & 4 & 1 \end{bmatrix}$$

In [7]:
```
# Laplace 算子
suanzi1 = np.array([[0, 1, 0],
```

```
                    [1,-4, 1],
                    [0, 1, 0]])

# Laplace 算子
suanzi2 = np.array([[1, 1, 1],
                    [1,-8, 1],
                    [1, 1, 1]])

grad = cv2.filter2D(gray,  -1 , suanzi2 )
# 取二阶导数较大的点替代二阶导数接近 0 的位置
grad = (np.abs(grad) > 90) * 255
plt.imshow(grad,cmap='gray')
plt.axis("off")
plt.show()
```

LOG 算子

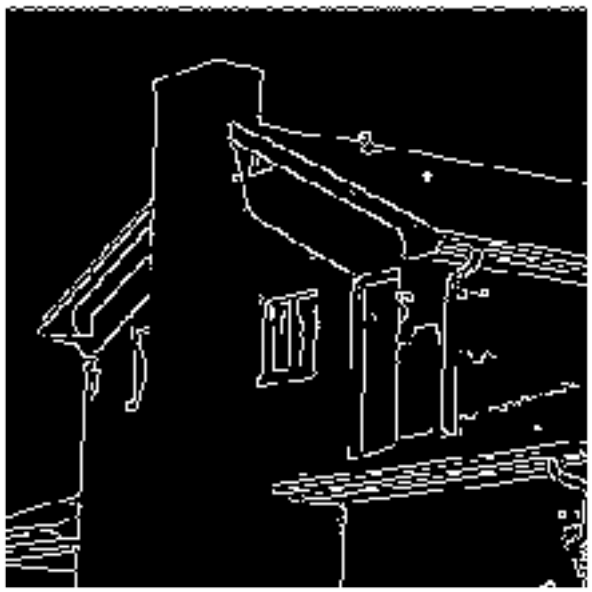
$$\begin{bmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 1 & 2 & 1 & 0 \\ 1 & 2 & -16 & 2 & 1 \\ 0 & 1 & 2 & 1 & 0 \\ 0 & 0 & 1 & 0 & 0 \end{bmatrix}$$

```
In [8]: Ker = np.array([[0, 0,1,0, 0],
                        [0,1, 2,1,0],
                        [1, 2, -16,2,1],
                        [0,1, 2,1,0],
                        [0, 0,1,0, 0] ])
        grad = cv2.filter2D(gray,  -1 , Ker )
        # 取二阶导数较大的点替代二阶导数接近 0 的位置
        grad = (np.abs(grad) > 165) * 255
        plt.imshow(grad,cmap='gray')
        plt.axis("off")
        plt.show()
```

Canny 算法

$$\frac{\partial^2}{\partial n^2}(G_\sigma * f) = 0$$

In [9]:
```
# 库函数版
canny_filter = cv2.Canny(gray,80, 180, 3)
plt.imshow(canny_filter,cmap='gray')
plt.axis("off")
plt.show()
```



In [10]:
```
# 自编函数版
def my_canny(src):
    # 高斯低通滤波器
    gass = cv2.GaussianBlur(src, (3,3), 0)
    # canny 核 四个角度 一阶
    ker = np.zeros((3,3,4))
    ker[...,0] = np.array([[0,0,0],
                           [0,-1,1],
                           [0,0,0]])
    ker[...,1]  = np.array([[0,0,1],
                            [0,-1,0],
```

```
                        [0,0,0]])
ker[...,2]  = np.array([[0,1,0],
                        [0,-1,0],
                        [0,0,0]])
ker[...,3]  = np.array([[1,0,0],
                        [0,-1,0],
                        [0,0,0]])
# 核 四个角度 二阶
ker2 = np.zeros((3,3,4))
ker2[...,0] = np.array([[0, 0,0],
                        [1,-2,1],
                        [0, 0,0]])
ker2[...,1]  = np.array([[0, 0,1],
                         [0,-2,0],
                         [1, 0,0]])
ker2[...,2]  = np.array([[0, 1,0],
                         [0,-2,0],
                         [0, 1,0]])
ker2[...,3]  = np.array([[1, 0,0],
                         [0,-2,0],
                         [0, 0,1]])

# 四个角度的差分
d = np.zeros(src.shape +(4,))
dd = np.zeros(src.shape +(4,))
for i in range(4):
    d[...,i] = cv2.filter2D(src, -1 , ker[...,i])
    dd[...,i] = cv2.filter2D(src, -1 , ker2[...,i])

n_f = np.ones_like(src)
for row in range(src.shape[0]):
    for col in range(src.shape[1]):
        # 法向
        n = np.where( np.abs(d[row,col,:]) ==\
                    np.max(np.abs(d[row,col,:]) ))[0][0]

        n_f[row,col] = dd[row,col,n]
```

```
            return n_f
```

```
In [11]: canny_out = my_canny(gray)
         # 取二阶导数较大的点替代二阶导数接近 0 的位置
         canny_out = (canny_out > 25) * 255
         plt.imshow(canny_out,cmap='gray')
         plt.axis("off")
         plt.show()
```

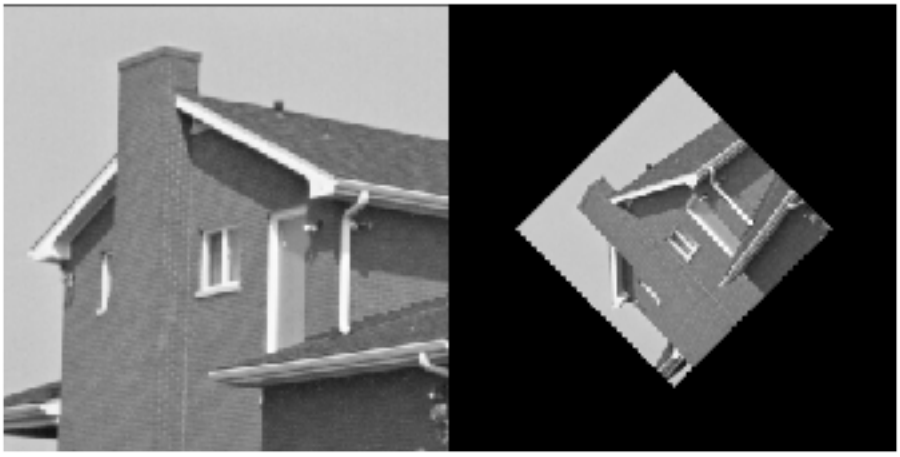
1.4.1 2.2 第 2 题 && 第六题见 slides 报告

1.4.2 2.3 第 3 题 && 第 5 题

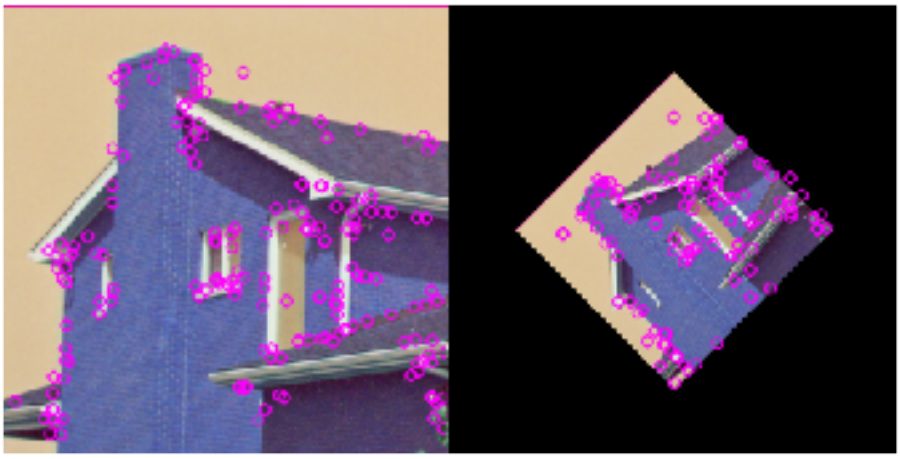
```
In [12]: def rotate(image, angle, center=None, scale=1.0):
             ##    h,w 尺寸
             (h, w) = image.shape[:2]
             if center is None:
                 center = (w // 2, h // 2)

             M = cv2.getRotationMatrix2D(center, angle, scale)
             # print(M) ## 旋转阵  +  旋转中心
```

```
    # 旋转
    rotated = cv2.warpAffine(image, M, (w, h))
    return rotated
```

In [13]:
```
#   参数设定

image = "../data/4.1.05.tiff"

model = cv2.xfeatures2d.SIFT_create()
# model = cv2.xfeatures2d.SURF_create()

img1 = cv2.imread(image)
gray1 = cv2.cvtColor(img1, cv2.COLOR_BGR2GRAY)
kp1, des1 = model.detectAndCompute(img1,None)
#des 是描述子

img2  = rotate(img1, 45,scale = .5 )
gray2 = cv2.cvtColor(img2, cv2.COLOR_BGR2GRAY)
kp2, des2 = model.detectAndCompute(img2,None)

# 水平拼接
together = np.hstack((img1, img2))
# cv2.imshow('src',together )
plt.imshow(together,cmap='gray')
plt.axis("off")
plt.show()

together = np.hstack((gray1, gray2))
# cv2.imshow('gray',together )
plt.imshow(together,cmap='gray')
plt.axis("off")
plt.show()

img3 = cv2.drawKeypoints(img1,kp1,img1,color=(255,0,255))
img4 = cv2.drawKeypoints(img2,kp2,img2,color=(255,0,255))
```



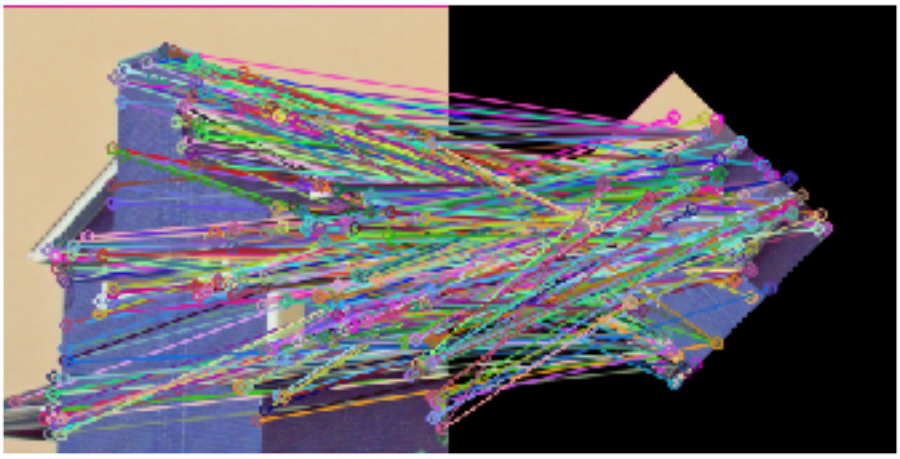
```
In [14]: together = np.hstack((img3, img4))
         # cv2.imshow("point", together)
         plt.imshow(together,cmap='gray')
         plt.axis("off")
         plt.show()
```



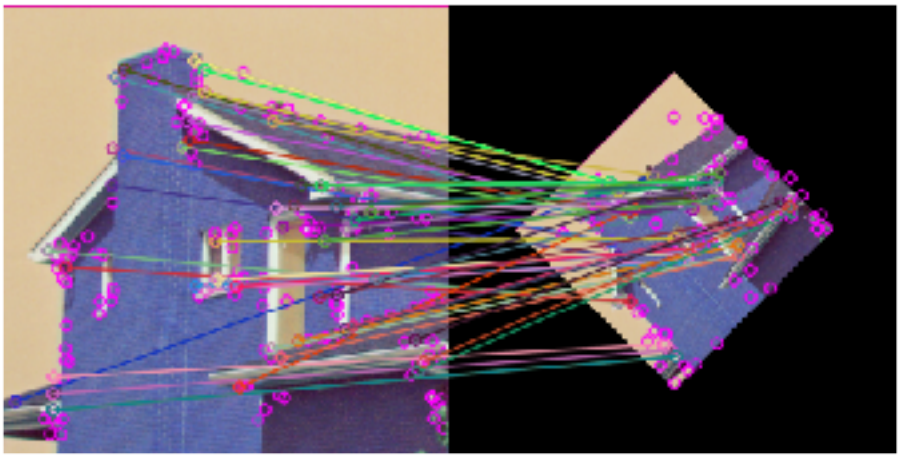
In [15]:
```
# FLANN 参数设计
FLANN_INDEX_KDTREE = 0
index_params = dict(algorithm = FLANN_INDEX_KDTREE, trees = 5)
search_params = dict(checks=50)
flann = cv2.FlannBasedMatcher(index_params,search_params)
```

In [16]:
```
matches = flann.knnMatch(des1,des2,k=2)
matchesMask = [[0,0] for i in range(len(matches)) ]

good = []
for m,n in matches:
    if m.distance < 0.7 * n.distance:
        good.append([m])
```

In [17]:
```
img5 = cv2.drawMatchesKnn(img1,kp1,img2,kp2,matches,None,flags=2)

# cv2.imshow("FLANN", img5)
plt.imshow(img5,cmap='gray')
plt.axis("off")
plt.show()
```



In [18]:
```
img6 = cv2.drawMatchesKnn(img1,kp1,img2,kp2,good,None,flags=2)

# cv2.imshow("FLANN", img6)
plt.imshow(img6,cmap='gray')
plt.axis("off")
plt.show()
```

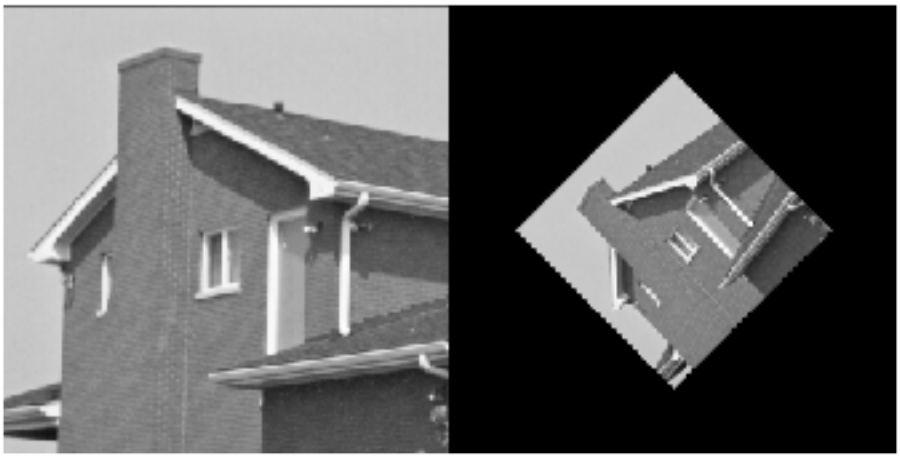


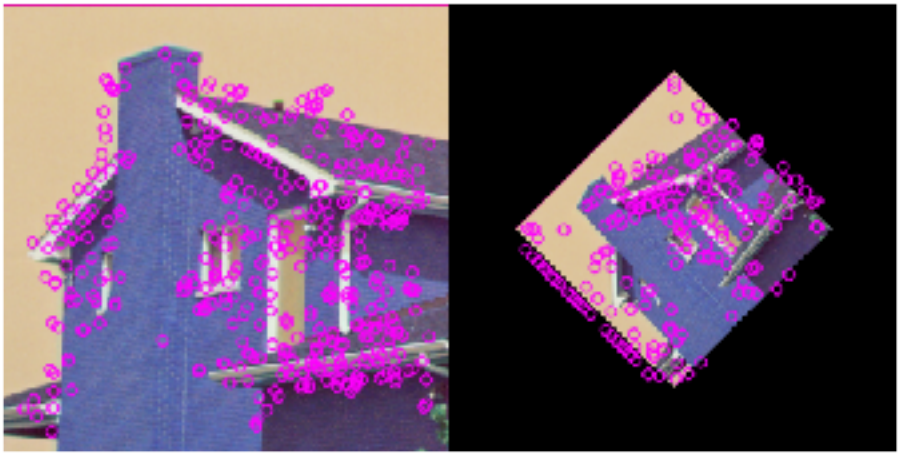
1.4.3 2.4 第 4 题

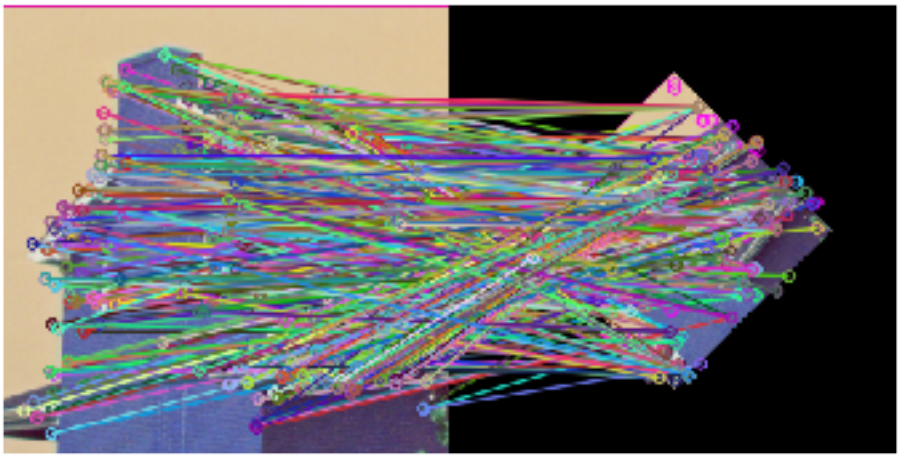
将上述的 SIFT 算法导入改为 SURF 即可

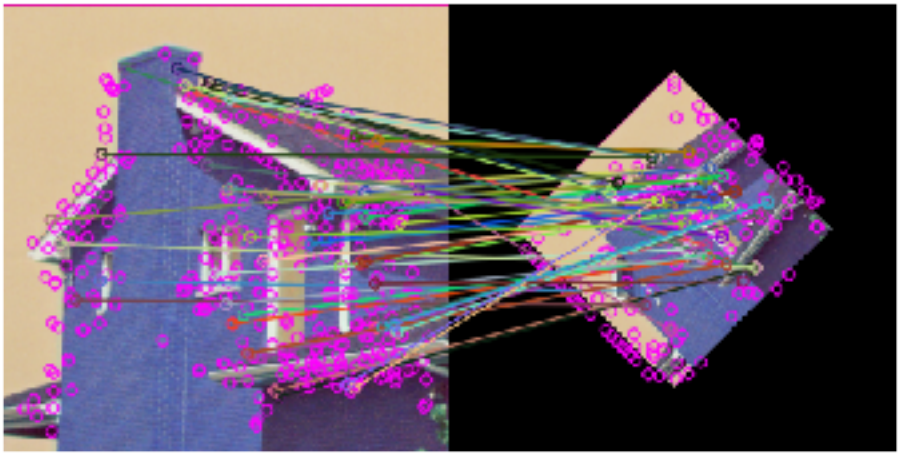
In [19]:
```
#   参数设定

image = "../data/4.1.05.tiff"

model = cv2.xfeatures2d.SURF_create()

img1 = cv2.imread(image)
gray1 = cv2.cvtColor(img1, cv2.COLOR_BGR2GRAY)
kp1, des1 = model.detectAndCompute(img1,None)
#des 是描述子

img2  = rotate(img1, 45,scale = .5 )
gray2 = cv2.cvtColor(img2, cv2.COLOR_BGR2GRAY)
kp2, des2 = model.detectAndCompute(img2,None)

# 水平拼接
together = np.hstack((img1, img2))
# cv2.imshow('src',together )
plt.imshow(together,cmap='gray')
plt.axis("off")
plt.show()

together = np.hstack((gray1, gray2))
# cv2.imshow('gray',together )
plt.imshow(together,cmap='gray')
plt.axis("off")
plt.show()

img3 = cv2.drawKeypoints(img1,kp1,img1,color=(255,0,255))
img4 = cv2.drawKeypoints(img2,kp2,img2,color=(255,0,255))
together = np.hstack((img3, img4))
# cv2.imshow("point", together)
plt.imshow(together,cmap='gray')
plt.axis("off")
```

```
plt.show()

matches = flann.knnMatch(des1,des2,k=2)

matchesMask = [[0,0] for i in range(len(matches)) ]

good = []
for m,n in matches:
    if m.distance < 0.7 * n.distance:
        good.append([m])

img5 = cv2.drawMatchesKnn(img1,kp1,img2,kp2,matches,None,flags=2)
plt.imshow(img5,cmap='gray')
plt.axis("off")
plt.show()

img6 = cv2.drawMatchesKnn(img1,kp1,img2,kp2,good,None,flags=2)
plt.imshow(img6,cmap='gray')
plt.axis("off")
plt.show()
```









2 图像处理 +180776+ 胡欣毅 (C++ 版)

2.1 2. 个人作业

c++

得到的图像效果与 Python 类似

2.2 2. 小组作业

c++