Python Applied to Machine Learning and Statistics

Lecture 03: Computer Vision with Python

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September 16, 2016

OpenCV

OpenCV: Advantages

- BSD license... free for both academic and commercial use.
- Windows, Linux, Mac OS, iOS and Android.

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- A lot of modules:

- Image processing
- I/O
- High-level GUI
- Video Analysis
- Camera Calibration and 3D Reconstruction
- Feature Detection and Description
- Object Detection
- Machine Learning
- Clustering and Search in Multi-Dimensional Spaces
- Computational Photography
- Images stitching
- Operations on Matrices
- Background Segmentation
- Optical Flow
- Stereo Correspondence
- Super Resolution
- Video Stabilization
- Image Registration
- RGB-Depth Processing
- Surface Matching
- Structure From Motion
- Deformable Part-based Models
- . . .

Input and Output

- Reading images.

```python
import cv2

img = cv2.imread(path)
img = cv2.imread(path, 0)       # Grayscale
```

- Show images.

```python
cv2.namedWindow('winname')     # Optional
cv2.imshow('winname', img)
cv2.waitKey(0)
cv2.destroyWindow('winname')   # Optional
```

- Store images (allows parameters like quality, compression, binarization).

```python
cv2.imwrite(path, img)
```

Input and Output: Video

- Opening a video stream.

```
cap = cv2.VideoCapture(0)                 # Default camera

while(True):
    ret, frame = cap.read()
    if ret:
        cv2.imshow(’img’, frame)
        if cv2.waitKey(1) & 0xFF == ord(’q’):
            break
    else:
        break
cap.release()
```

- Video from file.

```
cap = cv2.VideoCapture(’video.avi’)
```

Image representation

- In C++ OpenCV has its own data type... `Mat`
- In python, images are represented as `numpy` matrices.

- Grayscale: `img.shape` → `(rows, cols)`.
- Color: `img.shape` → `(rows, cols, channels)`.

- Default type: `np.uint8`... [0..255]
- Possible conversion to other types using `numpy` operators: `img.astype(np.float64)`.

Colorspaces

- Default colorspace: `BGR`.
- Function to perform colorspace conversion: `cvtColor`

```
hsv = cvtColor(img, cv2.COLOR_BGR2HSV)
gray = cvtColor(img, cv2.COLOR_BGR2GRAY)
bgr = cvtColor(hsv, cv2.COLOR_HSV2BGR)
```

- Splitting and merging channels.

```
b, g, r = cv2.split(img)
img = cv2.merge([b, g, r])
```

- Splitting using `numpy` slices:

```
b = img[:, :, 0]
g = img[:, :, 1]
r = img[:, :, 2]
```

Direct manipulation, ROIs, masks

- Random access

```
px = img[42, 21]
img[42, 21] = [0, 0, 253]
```

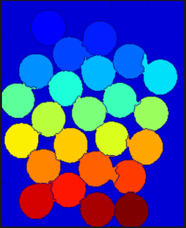
- Region of Interest

```
roi = img[100:200, 150:200]
img[200:300, 220:270] = roi
```

- Apply a mask

```
img = cv2.bitwise_and(img, img, mask=mask)  # Using OpenCV
img[mask == 0] = 0                          # Using numpy
```

Thresholding, morphologic op., watershed



- Thresholding

```
cv2.threshold(gray, 0, 255,
                   cv2.THRESH_BINARY_INV +
                   cv2.THRESH_OTSU)
```

- Morphologic operations

```
kernel = np.ones((3,3), np.uint8)
dst = cv2.dilate(img, kernel, iterations=3)
```

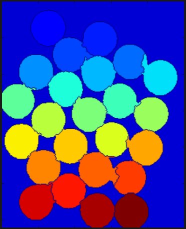
- Distance transform

```
dst=cv2.distanceTransform(img, cv2.DIST_L2,
    5)
```

- Watershed

```
markers = cv2.connectedComponents(fground)
dst = cv2.watershed(img, markers)
```

Thresholding, morphologic op., watershed



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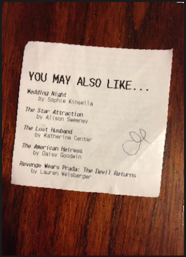
Segment the coins using these or other functions.

Blur, Edge detection, Contours and Perspective



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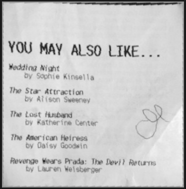
The Star Attraction
by Alison Sweeney

The Lost Husband
by Katherine Center

The American Heiress
by Daisy Goodwin

Revenge Wears Prada: The Devil Returns
by Lauren Weisberger



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- Gaussian Blur

```
gray = cv2.GaussianBlur(gray, (k, k), 0)
```

- Edge detection

```
edged = cv2.Canny(gray, 75, 200)
```

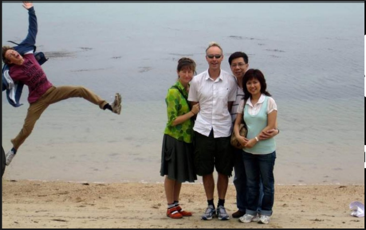
- Contours

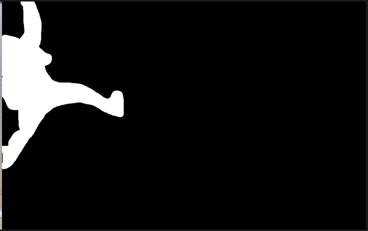
```
cnts, _ = cv2.findContours(edged.copy(),
                           cv2.RETR_LIST,
                           cv2.CHAIN_APPROX_SIMPLE)

cv2.contourArea(c)
peri = cv2.arcLength(c, True)
approx = cv2.approxPolyDP(c, k * peri, True)
```

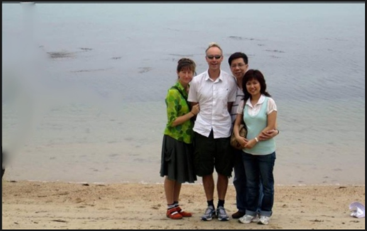
- Perspective transform

```
M = cv2.getPerspectiveTransform(rect, dst)
warped = cv2.warpPerspective(img, M,
                             (mxwidth, mxheight))
```

Image inpainting





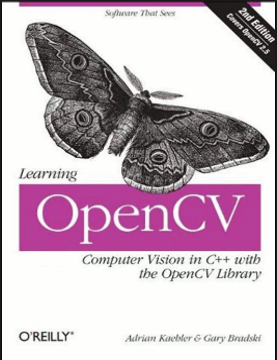


```
dst = cv2.inpaint(img, mask, 10, cv2.INPAINT_TELEA)
```

Resourcers

pyimagesearch

be awesome at building image search engines



Software That Sees

2nd Edition

Covers OpenCV 2.x

Learning

OpenCV

Computer Vision in C++ with the OpenCV Library

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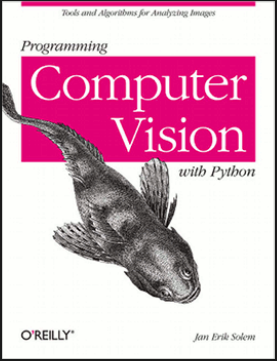
Adrian Kaehler & Gary Bradski



Tools and Algorithms for Analyzing Images

Programming

Computer Vision

with Python

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Jan Erik Solem