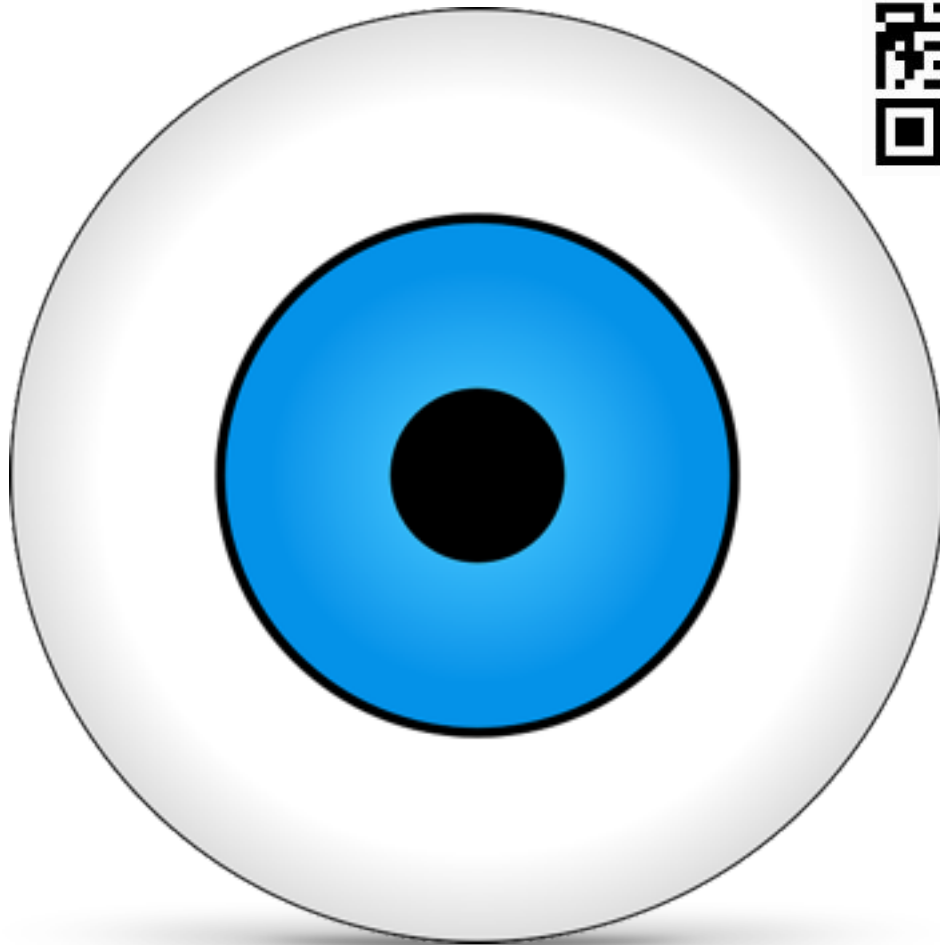# Computer Vision Resources

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LearnOpenCV.com

Author's Note

Congratulations! By downloading this resource guide you have embarked on a journey of learning. This guide is not a laundry list of all available computer vision resources. On the contrary, it is a curated list of things I find useful in my work. It is often wise to leave out ingredients from a recipe to improve it, and so I have decided to leave out resources that may overwhelm a beginner. However, if you do have a resource that you find useful, please email me at spmallick@learnopencv.com

Who is this guide for ?

This guide is for programmers, hackers, engineers, scientists, students and self-starters. It is for those creative people who have an itch to learn something new, and build something useful and beautiful. It is for people who take pride in their work, and are craftsmen at heart. It is for men and women who believe in sharpening their tools and improving their craft on a regular basis. It is for those who believe that learning is a continuous process, and that there are smart ways to learn fast. It is for tinkerers who can learn by reading, but prefer to learn by doing. Lastly, it is for people who invest in themselves by learning something new every day and are eager to contribute back to the community to enrich others!

Books

1. Computer Vision: Algorithms and Applications

Author : Richard Szeliski

Summary : This is by far the best book on computer vision I have used. This is a good basic reference book for a wide variety of computer vision topics — image formation, image processing, feature detection and matching, segmentation, image alignment, structure from motion, motion estimation, image stitching, computational photography, stereo correspondence, 3D reconstruction, image based rendering, and recognition.

Free version : http://szeliski.org/Book/

Buy at Amazon (Hardcover)
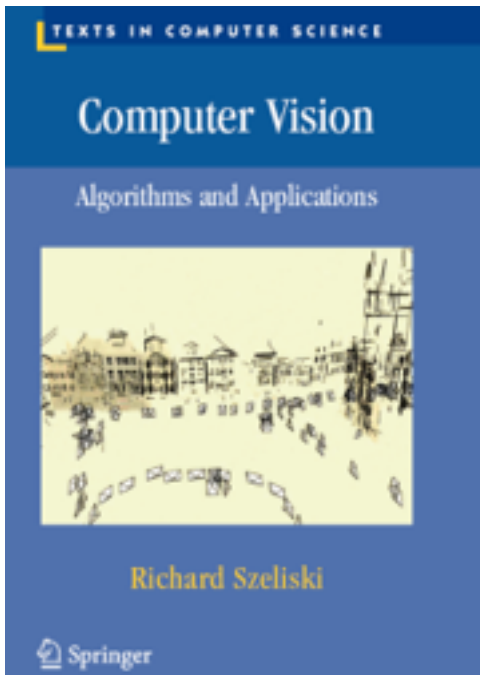
2. Digital Image Processing

Authors : Rafael C. Gonzalez and Richard E. Woods

Summary : This is a good introductory book in image processing. It may be challenging to understand Computer Vision literature without a basic understanding of image processing concepts. The book covers digital image fundamentals, image enhancement (spatial and frequency domains), image restoration, color image processing, wavelets and multi-resolution processing, image compression, morphological operations, segmentation, and a bit of object detection.

Buy at Amazon (Hardcover and Paperback)
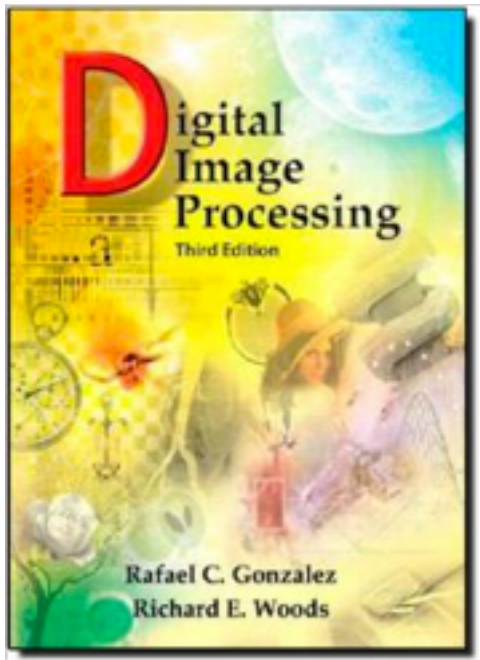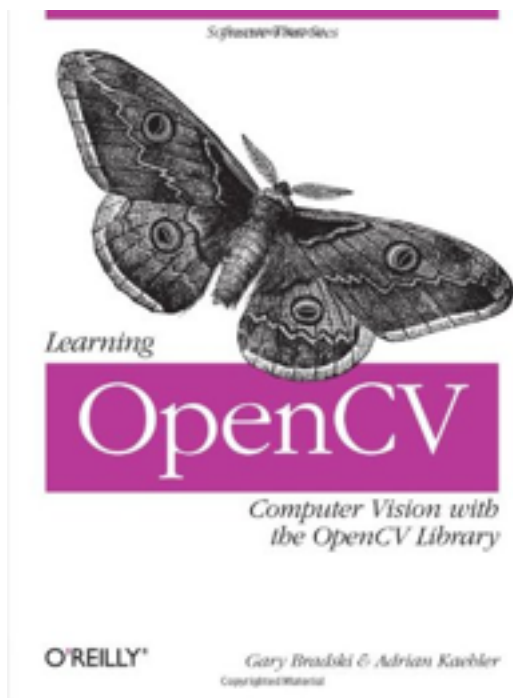
3. Learning OpenCV

Authors : Gary Bradski & Adrian Kaehler
Summary : Gray Bradski started OpenCV and this book is a great introductory book for learning OpenCV. The book comes with links to code samples and tutorials. The only downside is that this version of the book does not cover OpenCV 3. A revised version is expected to be released in 2015.

Note The examples are in the book are in C++ only.

Buy at Amazon

4. Practical Python and OpenCV

Authors: Adrian Rosebrock
Summary : Great introductory book for learning OpenCV using Python. It contains example code, and interesting case studies.This digital book comes with a 30-day money back guarantee, so it is risk free! You also receive free updates to the book as it is revised (e.g. when OpenCV 3 is released some of the code will be revised).

Buy at PyImageSearch.com

Software & Libraries

OpenCV (http://opencv.org/)

Summary

The biggest and the most extensive open source computer vision library. OpenCV has more than 47 thousand people of user community and estimated number of downloads exceeding 10 million.

Languages

C/C++ with interfaces to Python and Java.

Platforms

Windows, Linux, Mac OS, iOS, Android, Raspberry Pi, and NVIDIA Jetson TK1.

License (http://opencv.org/license.html *)*

BSD : It is free for both academic and commercial use.

Note : Not all parts of OpenCV are free.

VLFeat (http://www.vlfeat.org/)

Summary

Computer vision algorithms specializing in image understanding and local features extraction and matching.

Languages

C with interfaces in MATLAB

Platforms

Windows, Mac OS X, and Linux.

License

BSD : It is free for academic and commercial use.

SimpleCV (http://simplecv.org/)

Summary

SimpleCV is an open source wrapper around computer vision libraries such as OpenCV that hides some of its complexities.

Languages

Python

Platforms

Windows, Mac OS X, Linux, and Raspberry Pi.

License

    BSD : It is free for academic and commercial use.

MATLAB CV Toolbox (http://www.mathworks.com/products/computer-vision/)

Summary

    A computer vision toolbox for MATLAB.

Languages

    MATLAB

Platforms

    Windows, Mac OS X and Linux.

License

    MATLAB's license. Requires Image Processing Toolbox. The total cost of installing MATLAB ($2,150) + Image Processing Toolbox ($1, 000) + Computer Vision Toolbox ($1,350) = $4500. Student licenses are much cheaper though (few hundred dollars).

Python Libraries

One of the main advantages of using OpenCV with Python is the vast number of scientific libraries available for Python. Here are a few libraries you will find useful. The first three libraries — NumPy, SciPy and Matplotlib — are part of the SciPy stack. When used together, they pretty much replace MATLAB.

1. **NumPy (http://www.numpy.org) :** NumPy adds support for large, multi-dimensional arrays and matrices to Python. It also consists of a large library of high-level mathematical functions to operate on these arrays. OpenCV images are read in as NumPy arrays. Several other math, image processing, and machine learning libraries are built on top of NumPy.
2. **SciPy** (**http://scipy.org/scipylib/index.html**) : SciPy is a powerful scientific library built on top of NumPy. It's sub packages include linalg (linear algebra), optimize (optimization and root-finding routines), stats (statistical distributions and functions), ndimage (N-dimensional image processing), interpolate (interpolation and smoothing splines) , fftpack (Fast Fourier Transform routines), cluster (Clustering algorithms) and many more.
3. **matplotlib** (**http://matplotlib.org/**) : An excellent 2D plotting library for Python that is every bit as powerful as MATLAB. You can generate plots, histograms, power spectra, bar charts, scatterplots, etc, with just a few lines of code.

4. **scikit-learn** (**http://scikit-learn.org/**) : As a computer vision programmer / engineer, you will inevitably need a good machine learning library and scikit-learn serves that purpose well. It uses numpy/scipy idioms and provides algorithms for preprocessing data, classification, regression, clustering, dimensionality reduction, and model selection.

Web APIs

1. **Alchemy API** (**http://www.alchemyapi.com/products/alchemyvision**) : A deep learning based API for auto tagging images based on the content of the image. If you upload an image of a cat, it will return "cat" as a tag. Deep learning based large scale recognition is a hot topic of research these days. If you have been following **ImageNet Large Scale Visual Recognition Challenge (ILSVRC)**, you probably know that even though IBM is first to market with its API, several other teams from Google, Facebook, Microsoft, Baidu, and several universities are doing much better in the competition. Hope they come up with an API too!

2. **CloudSight** (**http://cloudsightapi.com/**) : What is better than computer vision ? Well, human vision! CloudSight API does visual recognition using a combination of computer vision and human crowd sourcing. You can use their app called CamFind to see how well it works.

3. **Face++** (**http://www.faceplusplus.com/**) : An API for face detection, facial landmark detection, face search, and face recognition.

4. **TinEye** (**https://services.tineye.com/TinEyeAPI**) : Search the entire web for an image using TinEye's reverse image search.

5. **OCRSDK** (**http://ocrsdk.com**) : Upload an image containing text and get back the results as text. They provide sample code and it works well for standard scanned text.

6. **CloudCV** (**http://cloudcv.org**) : CloudCV describes itself as a Large-Scale Distributed Computer Vision as a Cloud Service. It is not a commercial product, but is being developed by Machine Learning and Perception Lab at Virginia Tech. They do image stitching and object detection / classification in the cloud.

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