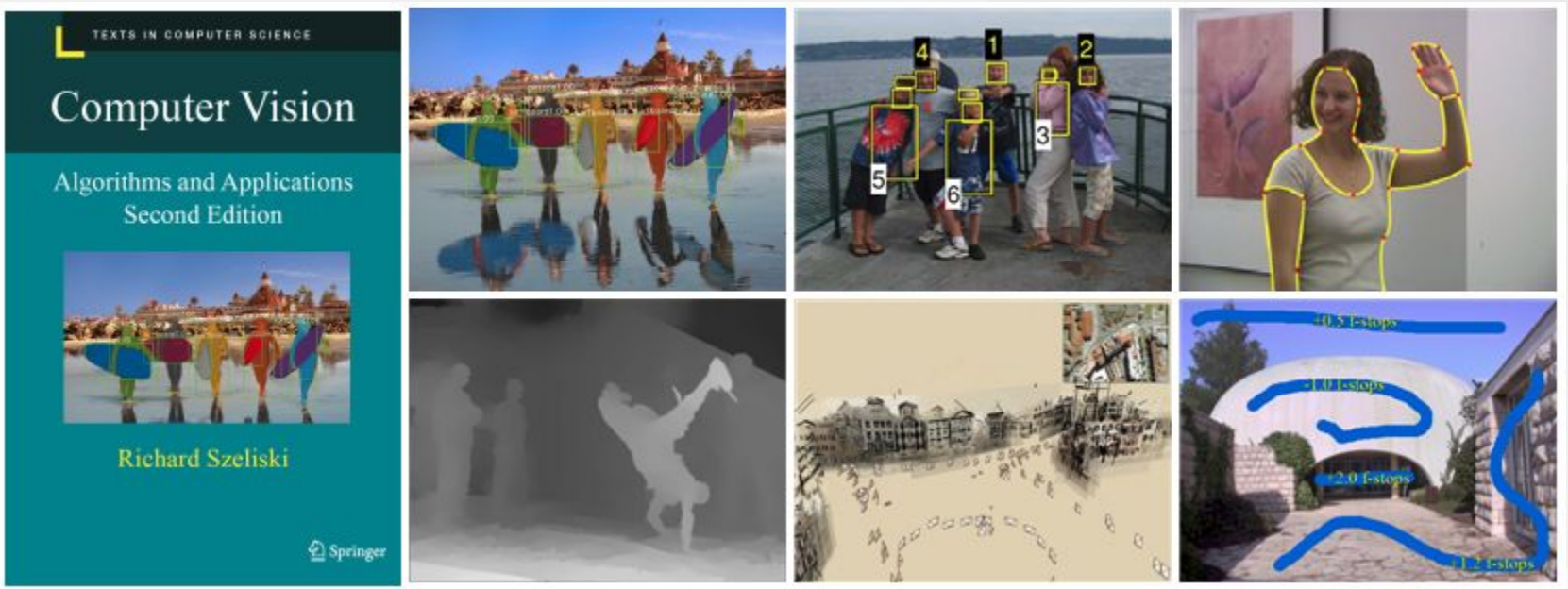
WSTĘP DO WIZJI KOMPUTEROWEJ

07.11.2023 Computer Vision Seminar 23/24

Agenda

1. Na czym polega wizja komputerowa?
2. Przykłady i zastosowania
3. Czym jest zdjęcie?
4. Przekształcenia globalne
5. OpenCV

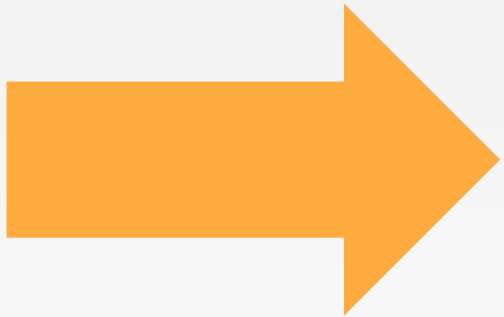
Computer Vision: Algorithms and Applications, 2nd ed.



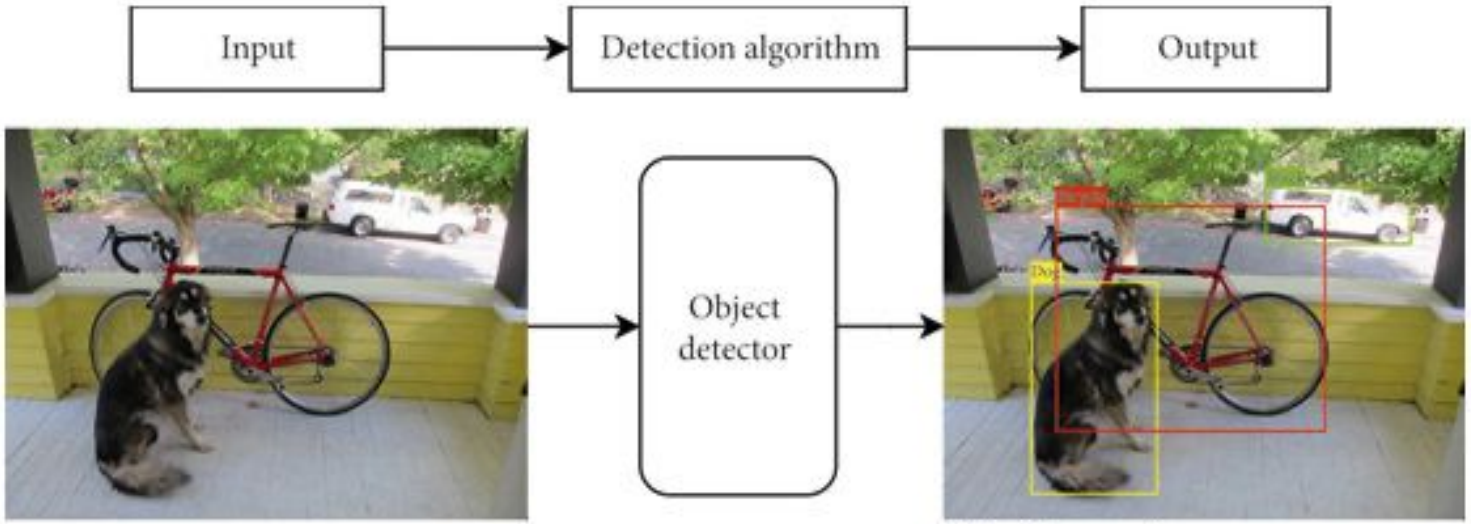
https://szeliski.org/Book/ https://www.cs.cornell.edu/courses/cs5670/2023sp/lectures/lectures.html

Na czym polega computer vision?

OBRAZ

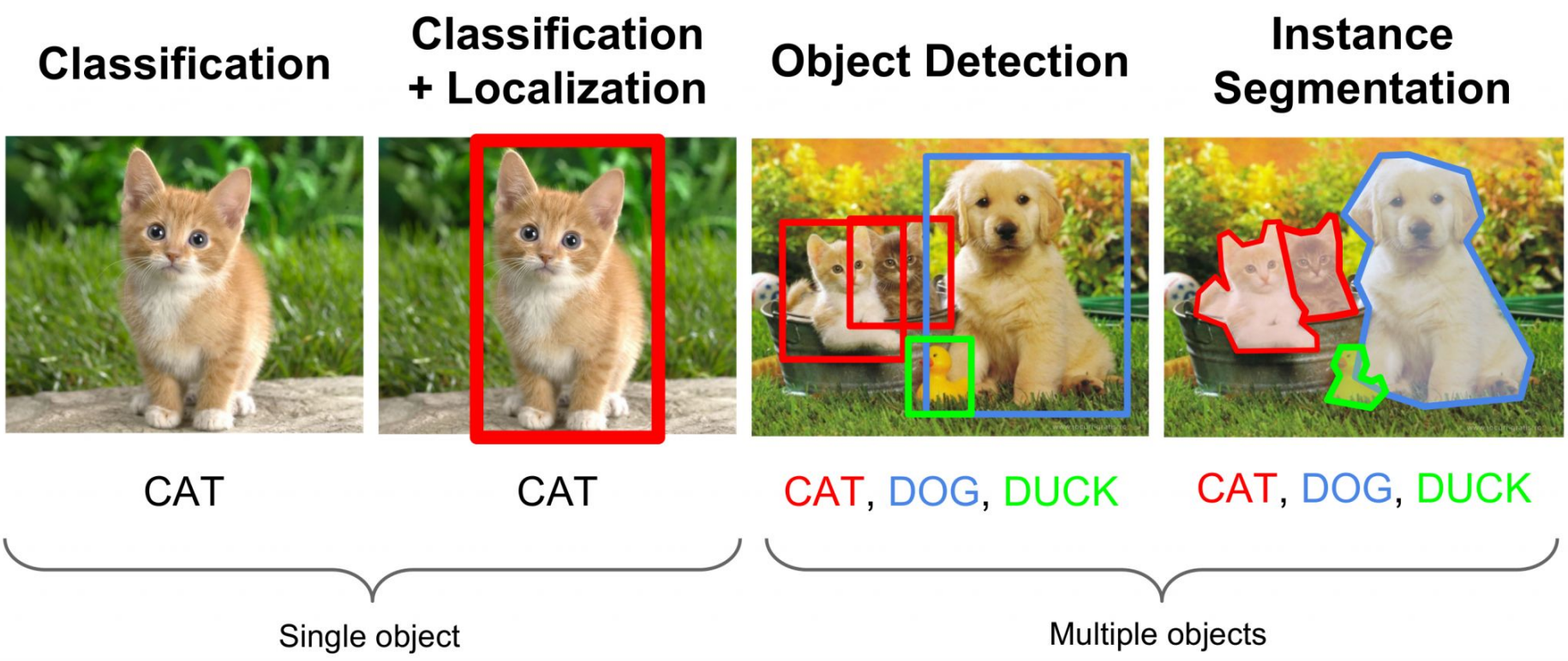


OPIS
INFORMACJA

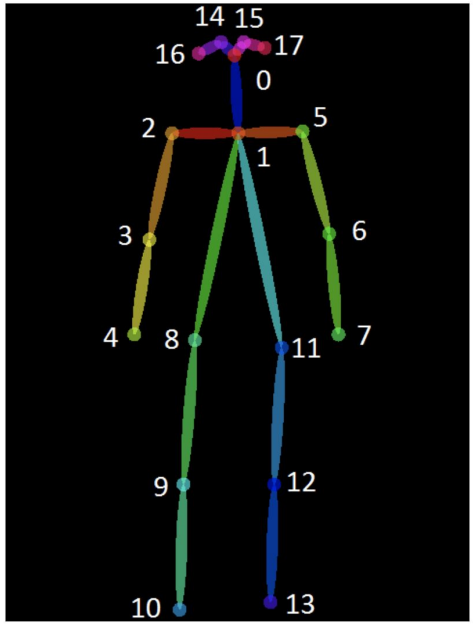


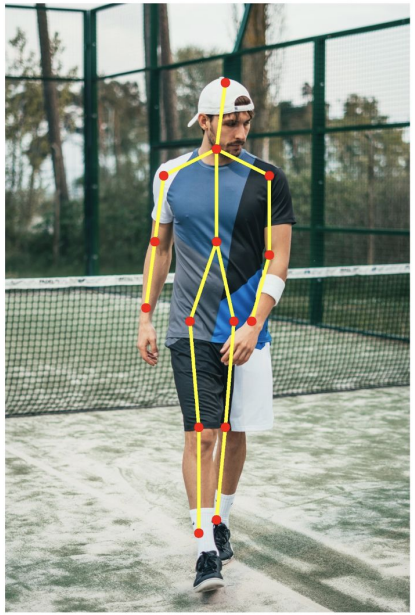
Detection results

- {105, 221, 187, 407, dog}
- {156, 501, 124, 341, bicycle}
- {480, 587, 84, 176, truck}


Classification
Classification + Localization
Object Detection
Instance Segmentation
CAT
CAT
CAT, DOG, DUCK
CAT, DOG, DUCK
Single object
Multiple objects

Oszacowanie pozy (pose estimation)





Czym jest zdjęcie cyfrowe?

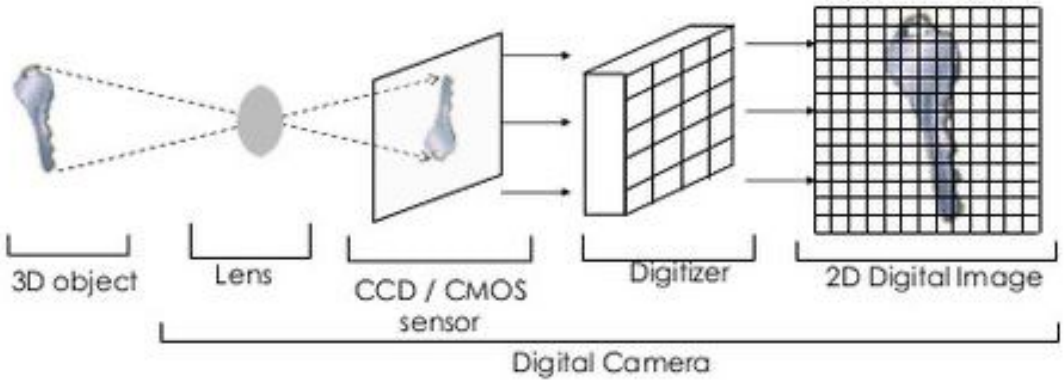
- Dwuwymiarowa funkcja f(x,y)
- x i y określają współrzędne
- Amplituda f w (x,y) jest określana jako intensywność zdjęcia w tym punkcie
- Wartości x, y i f są skończone

Lub inaczej: tablica składająca się z rzędów i kolumn pikseli o skończonych wartościach

Zdjęcie jako macierz

$$f(x,y) = \begin{bmatrix} f(0,0) & f(0,1) & f(0,2) & \dots & f(0,N-1) \\ f(1,0) & f(1,1) & f(1,2) & \dots & f(1,N-1) \\ \vdots & \vdots & \vdots & & \vdots \\ f(M-1,0) & f(M-1,1) & f(M-1,2) & \dots & f(M-1,N-1) \end{bmatrix}$$

Visual image formation-Digital Version



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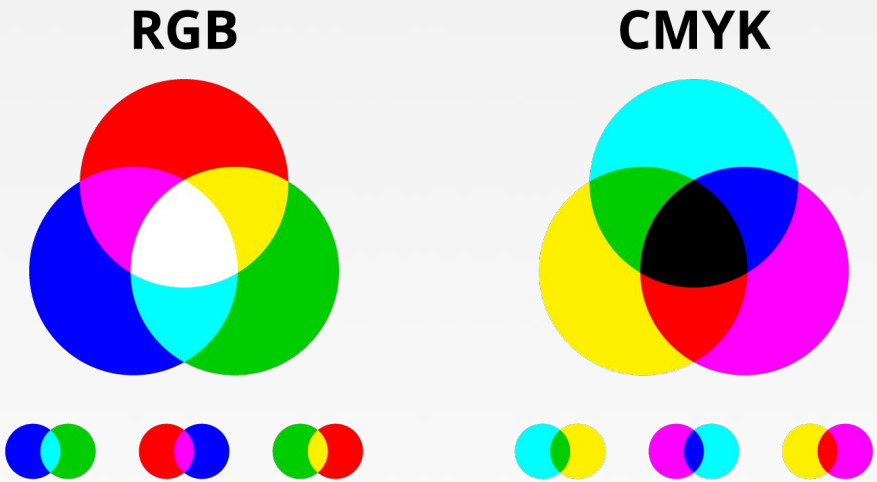
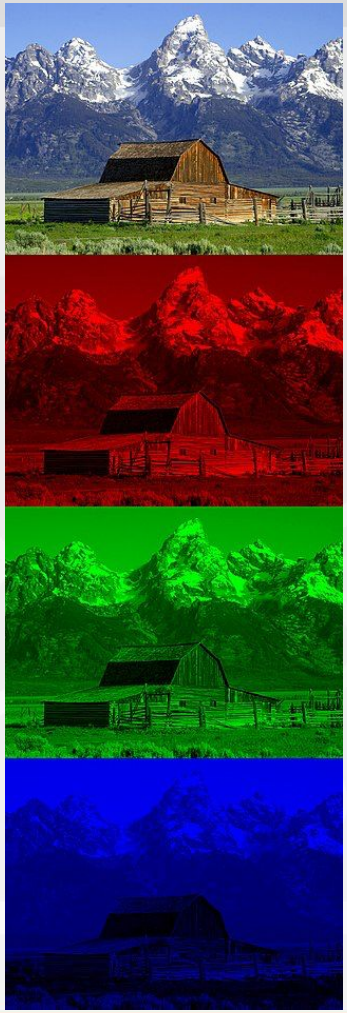
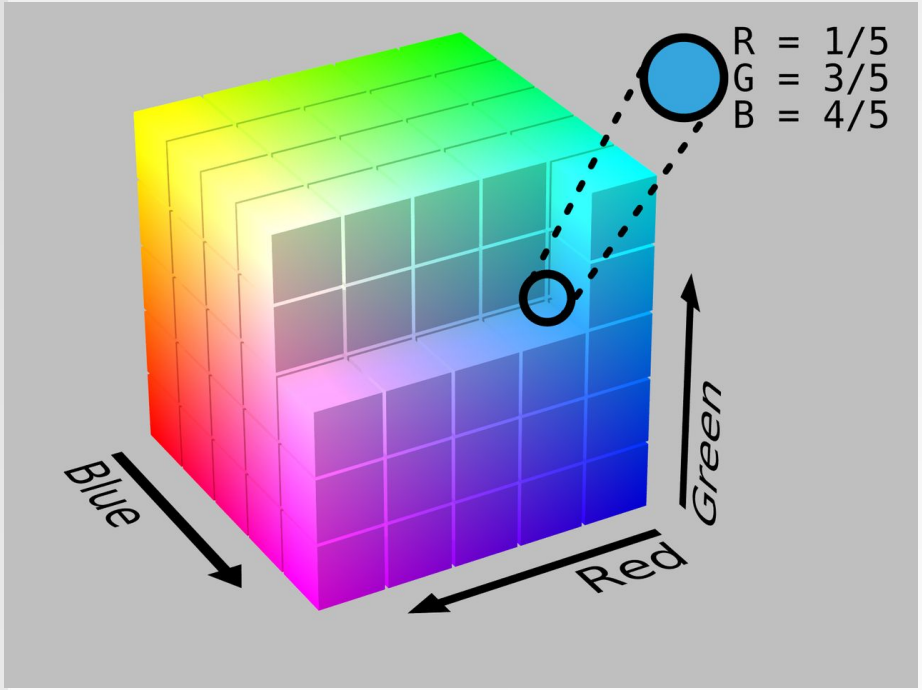
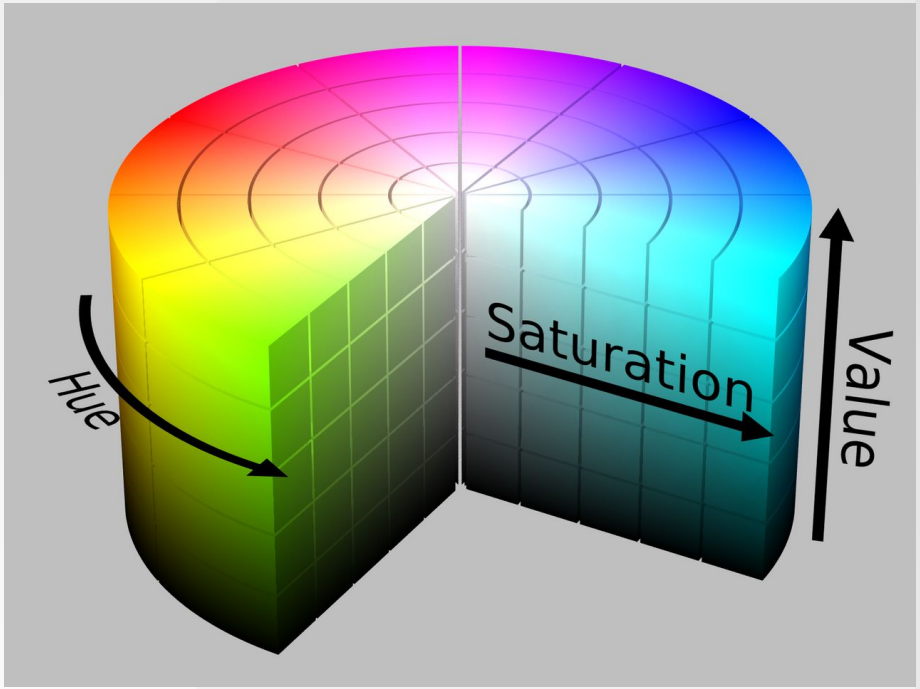
Model przestrzeni kolorów RGB





RGB i HSV (hue, saturation, value)





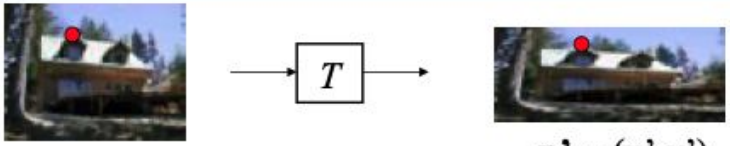
Zdjęcie jako funkcja - przekształcenia

As with any function, we can apply operators to an image

$g(x,y) = f(x,y) + 20$

$g(x,y) = f(-x,y)$

Parametric (global) warping



$\mathbf{p} = (x,y)$ $\mathbf{p'} = (x',y')$

- Transformation T is a coordinate-changing machine:

$$\mathbf{p'} = T(\mathbf{p})$$

- What does it mean that *T* is global?
  - Is the same for any point p
  - can be described by just a few numbers (parameters)
- Let's represent *T* as a matrix:

$$\mathbf{p'} = \mathbf{Tp}$$

$$\begin{bmatrix} x' \\ y' \end{bmatrix} = \mathbf{T} \begin{bmatrix} x \\ y \end{bmatrix}$$

- Przesunięcie, translacja
- Skalowanie
- Obrót
- Pochylenie

https://sites.google.com/pjwstk.edu.pl/grk/grk/przekszta%C5%82cenia-afiniczne?pli=1

Basic 2D Transformations

- Basic 2D transformations as 3x3 matrices

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & t_x \\ 0 & 1 & t_y \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

Translate

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} s_x & 0 & 0 \\ 0 & s_y & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

Scale

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} \cos\Theta & -\sin\Theta & 0 \\ \sin\Theta & \cos\Theta & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

Rotate

$$\begin{bmatrix} x' \\ y' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & sh_x & 0 \\ sh_y & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} x \\ y \\ 1 \end{bmatrix}$$

Shear

Podstawowe przekształcenia

Computer Vision: Algorithms and Applications, 2nd ed. (final draft, Sept. 2021)

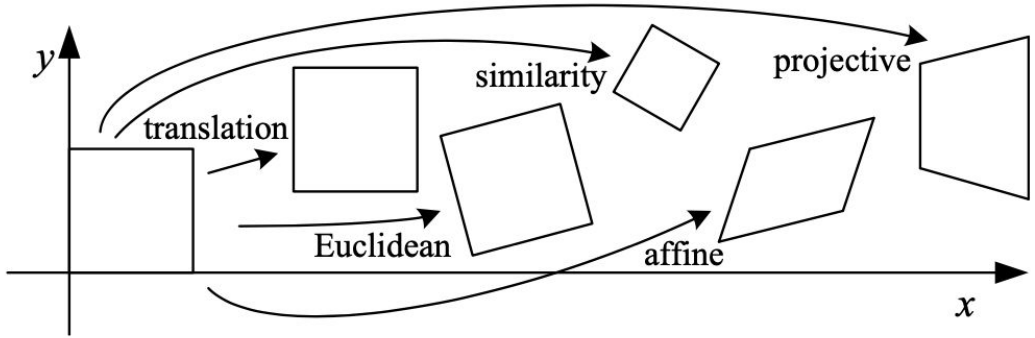


Figure 2.4 *Basic set of 2D planar transformations.*

Więcej o transformacjach: http://alumni.media.mit.edu/~maov/classes/comp_photo_vision08f/lect/08_image_warps.pdf

OpenCV: Python lub C++

Tutorial: https://learnopencv.com/getting-started-with-opencv/

Materiały

- Introduction to Basic Computer Vision & Image Processing

https://bishalbose294.medium.com/introduction-to-basic-computer-vision-image-processing-f692aa1a4f18

- Everything You Ever Wanted To Know About Computer Vision.

https://towardsdatascience.com/everything-you-ever-wanted-to-know-about-computer-vision-heres-a-look-why-it-s-so-awesome-e8a58dfb641e

- Awesome Computer Vision

https://github.com/jbhuang0604/awesome-computer-vision

- Google Colab - wstęp do CV

https://colab.research.google.com/drive/1EPOBn24plc-kTb5jgTbitpLoylRVKVRh?usp=sharing