Computer Image Processing

Lecture 2

Introduction to image processing

Geometric transformations

Plan

1. **Methods of image transformations**
2. **Main functions for images on Matlab**
3. **Functions of image transformations on Matlab**

1.Methods of image transformations

Geometric transformations of an image

- scale,
- shift (translation),
- mirroring,
- rotation,
- distortion.

Geometric transformations

Shift (translation)

The horizontal and vertical image shift describes the equation

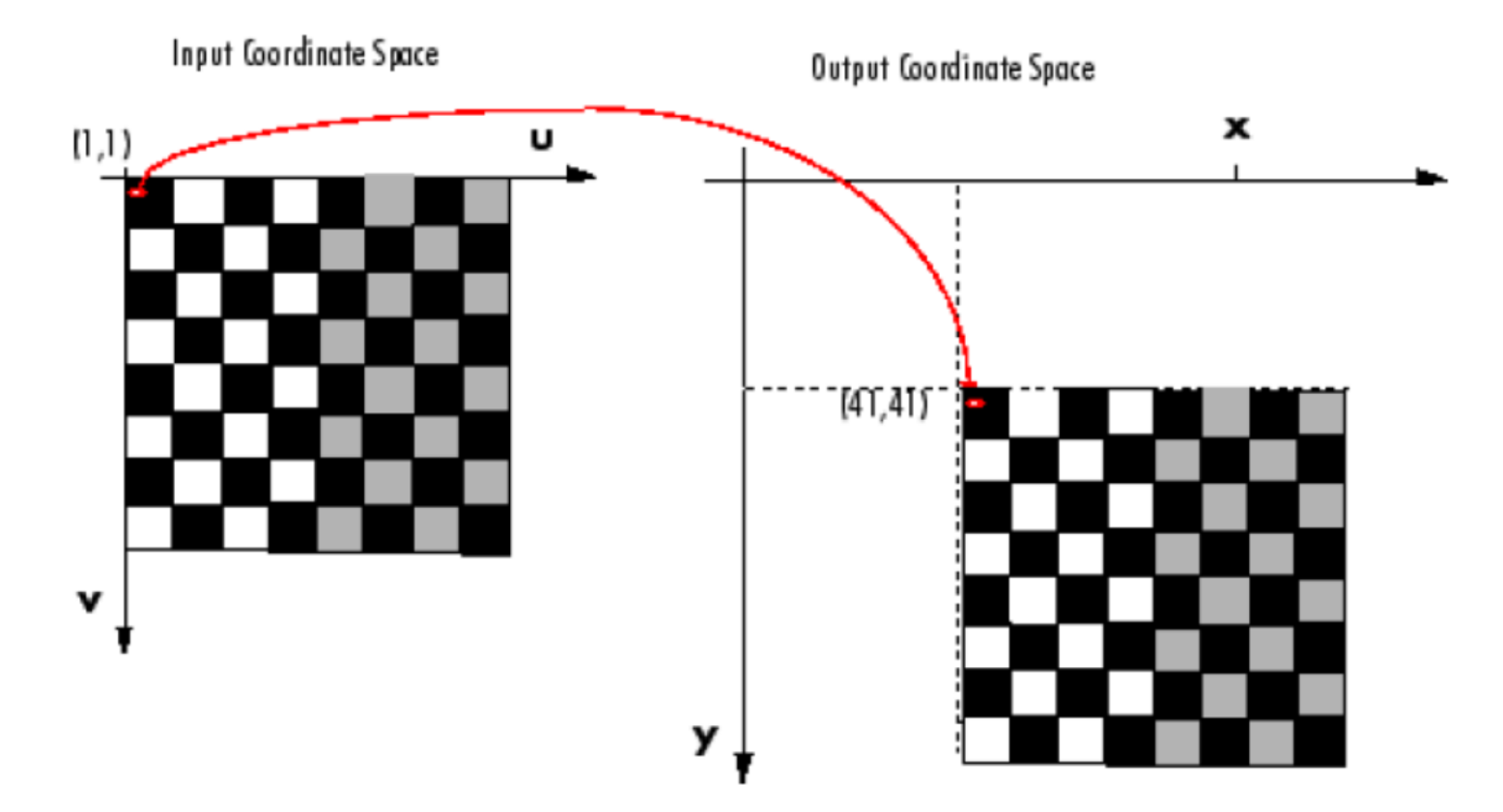
$$x_2 = x_1 + x_0$$
$$y_2 = y_1 + y_0$$

where:

x_0, y_0 - the value of the shift vector, horizontally and vertically, respectively

x_1, y_1 and x_2, y_2 – columns and rows of the source and resulting image matrices respectively

Geometric transformations



Source image

Image after shifting

Geometric transformations

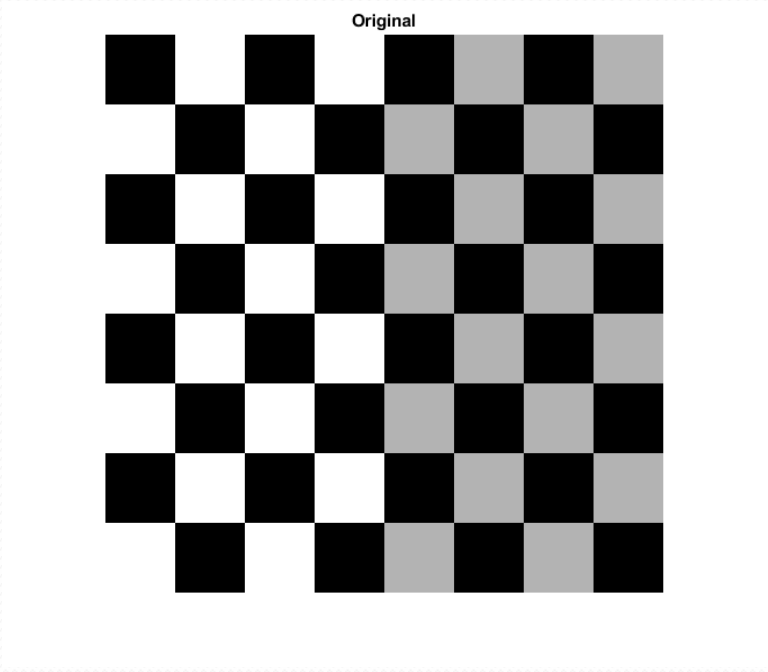
Rotation

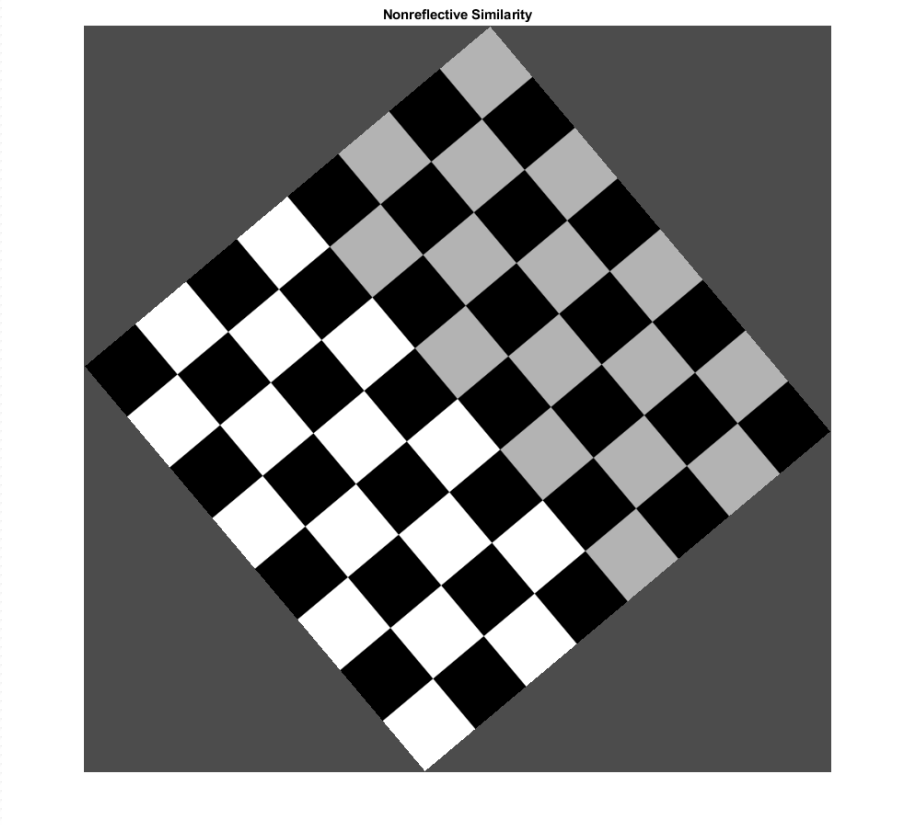
The value of the pixel in the image created after the rotation of the source image by the given angle α relative to the origin of the coordinate system can be described by the formula:

$$x_2 = x_1 + x_0$$
$$y_2 = y_1 + y_0$$

Shift and rotation operations are often used when combining images (e.g., scanned fragments, creating collages, etc.)

Rotation



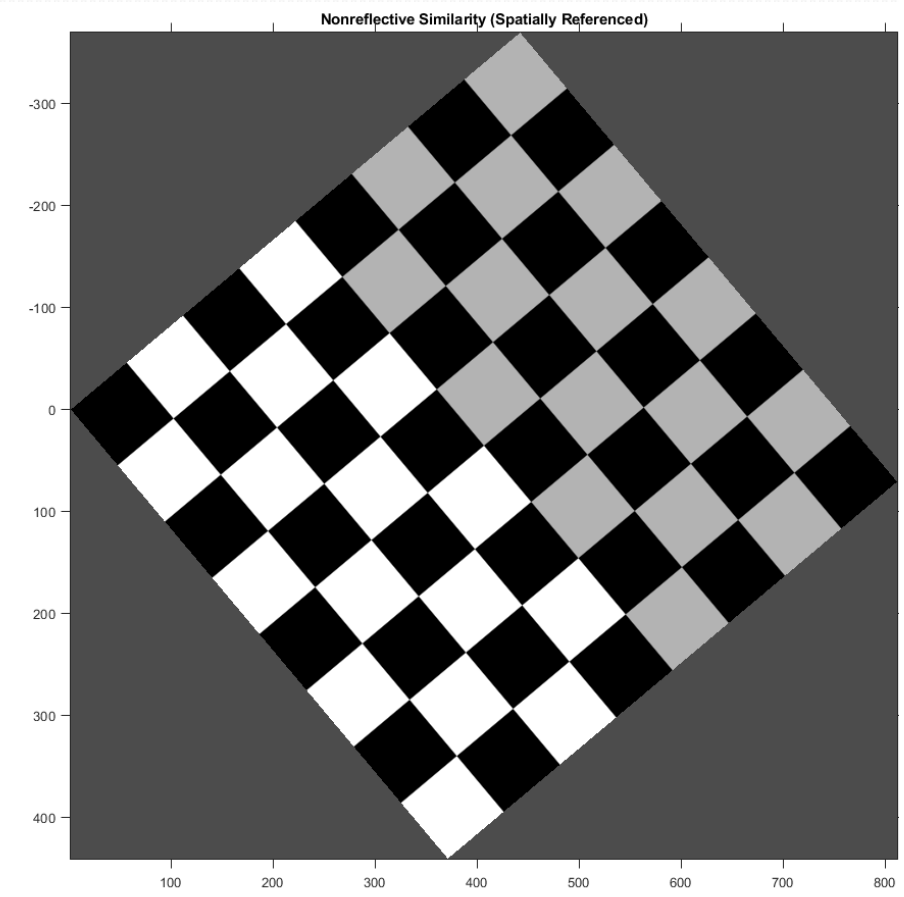


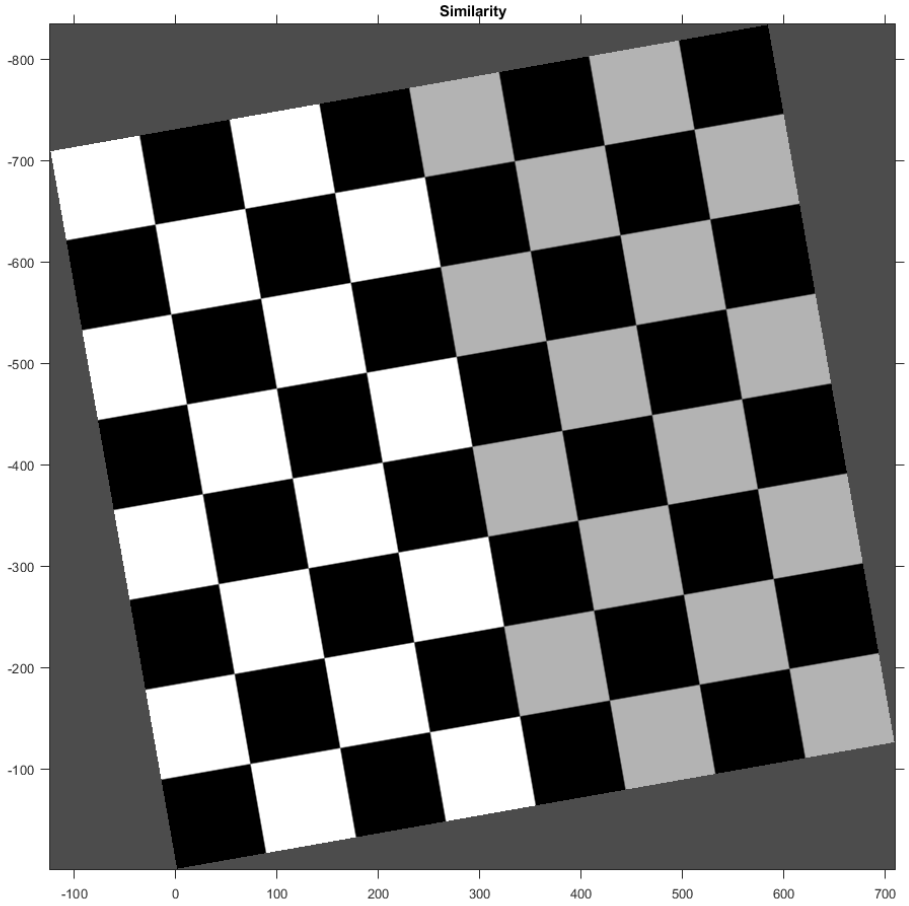
Source image

Image after rotation

Scale

```
% Try varying these 4 parameters.
 scale = 1.2; % scale factor
angle = 40*pi/180; % rotation angle
tx = 0; % x translation
ty = 0; % y translation
```





Source image

Image after scale, rotation, translation

Mirroring

127	255	220	112	255
110	90	0	190	110
0	127	100	255	120
27	45	91	127	0
255	200	190	185	140

Original Image

255	112	220	255	127
110	190	0	90	110
120	255	100	127	0
0	127	91	45	27
140	185	190	200	255

Mirror Image

Geometric transformations

Source image

Image after flipping about vertical axis

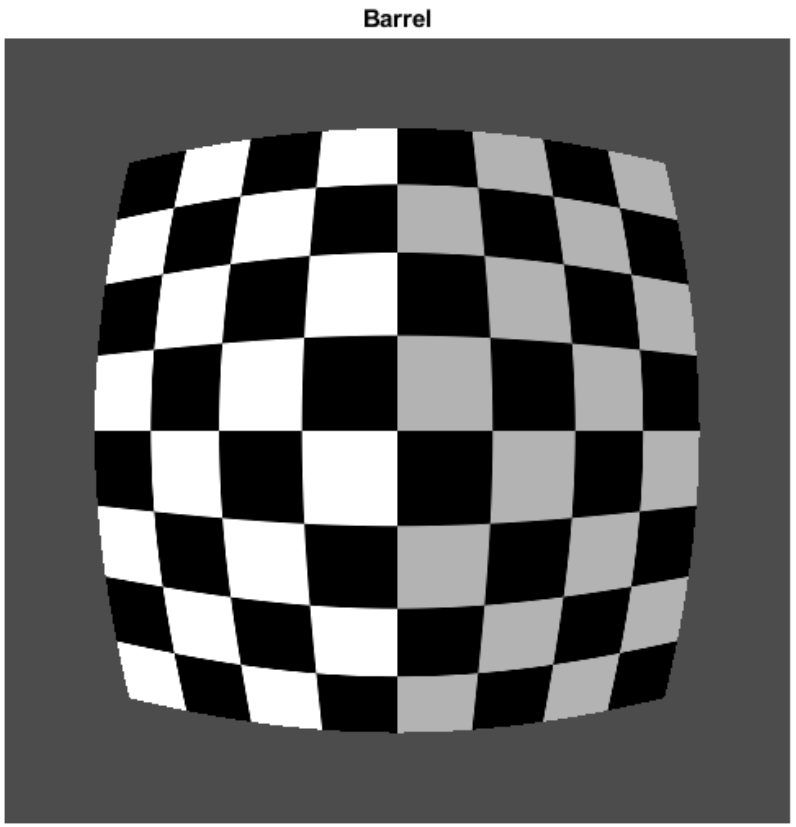
Geometric transformations

Source image

Image after flipping about horizontal axis

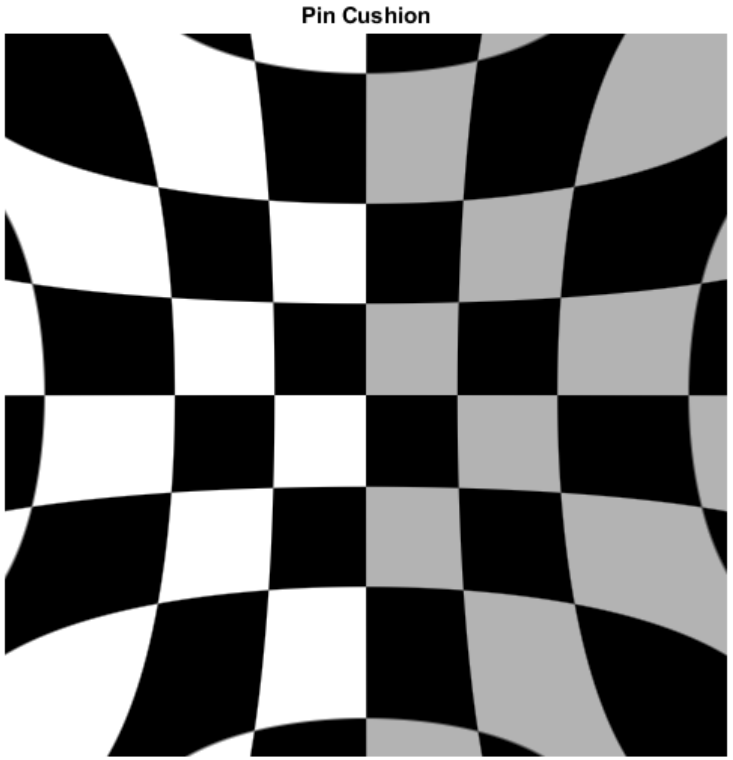
Distortion

- Barrel distortion perturbs an image radially outward from its center. Distortion is greater farther from the center, resulting in convex sides.



Distortion

- Pin-cushion distortion is the inverse of barrel distortion because the cubic term has a negative amplitude. Distortion is still greater farther from the center but the distortion appears as concave sides.



Example used distortion

Geometric camera calibration, correct for lens distortion

Geometric transformations

Source image

Image after some distortion

Geometric transformations

Source image

Image after perspective correction with the use of geometric distortion

2. **Main functions for images on Matlab**

Main functions of matlab for working with images:

- imread;
- imwrite;
- imshow;
- im2double;
- ind2gray;
- im2bw;
- imfinfo.

Image + action

imread

The *imread()* function reads images from the graphics files.

Syntax:

A = imread(filename)

It simply read the image and stores it in A.

A = imread(filename,fmt)

Reads image in grayscale or color from the specified file. If image is not present in current directory then please provide the full path of image.

A = imread(Name,Value)

It peruses the predefined picture or pictures from a multi-picture record. This grammar applies just to GIF, PGM, PM, PPM, CUR, ICO, TIF, SVS, and HDF4 documents. You should indicate a filename information, and you can alternatively determine fmt.

For example:

- `L1=imread('portrait.jpg');`

imwrite

Write image to graphics file

Syntax

imwrite(A,filename)
imwrite(A,map,filename)
imwrite(___,fmt)
imwrite(___,Name,Value)

For example:

```
imwrite(X,map,'myclown.png')
```

imwrite creates the file, myclown.png, in your current folder.

imshow

Display image

Syntax

imshow(I)
imshow(I,[low high])
imshow(I,[])
imshow(RGB)
imshow(BW)
imshow(X,map)
imshow(filename)
imshow(___,Name,Value)
himage = imshow(___)

For example:

```
rgbImage = imread("peppers.png");
imshow(rgbImage)
```

im2bw

Convert image to binary image, based on threshold

Syntax

BW = im2bw(I,level)

BW = im2bw(X,cmap,level)

BW = im2bw(RGB,level)

For example:

```
[X,map] = imread('peppers.png');
BW = im2bw(X,map,0.4);
```

im2double

Convert image to double precision

Syntax

I2 = im2double(I)

I2 = im2double(I,'indexed')

For example:

Read a sample image of data type uint8.

```
I = imread('peppers.png');
I2 = im2double(I);
```

ind2gray

Convert indexed image to grayscale image

Syntax

I = ind2gray(X,cmap)

For example:

```
[X, map] = imread('trees.tif');
I = ind2gray(X,map);
```

imfinfo

Information about graphics file

Syntax

info = imfinfo(filename)

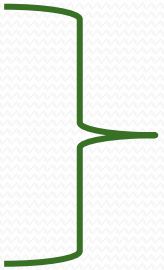
info = imfinfo(filename,fmt)

For example:

```
info = imfinfo('ngc6543a.jpg');
```

3.Functions of image transformations on Matlab

- Imrotate;
- Imresize;
- Imcrop;
- Set;
- Fliplr;
- Flipud.



`Image + action`

Imrotate

Rotate image

Syntax:

J = imrotate(I,angle)

J = imrotate(I,angle,method)

J = imrotate(I,angle,method,bbox)

For example:

```
L1=imread('portrait.jpg');
L2a=imrotate(L1,-60,'crop');
```

Imresize

Resize image

Syntax:

B = imresize(A,scale)

B = imresize(A,[numrows numcols])

[Y,newmap] = imresize(X,map,___)

___ = imresize(___,method)

___ = imresize(___,Name,Value)

For example:

```
I = imread('ngc6543a.jpg');
B = imresize(I,[100 100]);
B1=imresize(I, 0.5);
```

Imcrop

Crop image

Syntax:

Icropped = imcrop

Icropped = imcrop(I)

Xcropped = imcrop(X,cmap)

For example:

```
I = imread('llama.jpg');
I2 = imcrop(I,[75 68 130 112]);
```

Set

Set graphics object properties

Syntax:

set(H,Name,Value)
set(H,NameArray,ValueArray)
set(H,S)
s = set(H)
values = set(H,Name)

RGB	
Red	1 0 0
Green	0 1 0
Blue	0 0 1
White	1 1 1
Black	0 0 0

For example:

```
L1=imread('llama.jpg');
set(1,'Name',info.ColorType,'Color',[1 1 1]);
```

Fliplr and Flipud

- The "**fliplr**" (flip left-right) function flips the image (an array) about a vertical axis,
- "**flipud**" (flip up-down) - about a horizontal axis of the source image.

For example:

```
I1=imread('portrait.jpg');
I2 = fliplr(I1);
I3 = flipud(I1);
```