

Enabling Technologies for Sports (5XSF0) Module 1

Introduction: Digital images in Matlab Part 1

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MATLAB

* MATrix LABoratory

- High-performance language for technical computing
- Array – basic data element, does not require dimensioning
- Toolboxes – application-specific solutions
- Image Processing Toolbox – for solving digital image processing problems

Matlab desktop

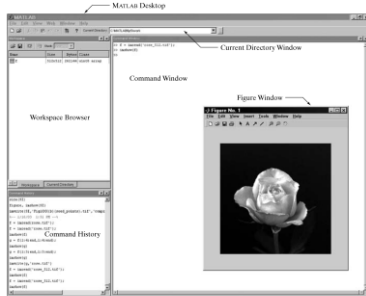


FIGURE 1.1 The MATLAB desktop and its principal components.

Getting help – (1)

* Help on Matlab

- Click on the question mark symbol (?) on the desktop toolbar
- Type `helpbrowser` at the prompt in the command window

* Help on an M-function

- Types of help information
 - H1 help – a one-line help
 - Help text block – detailed description

Getting help – (2)

* Getting help from command window

- `help <function_name>`
- `lookfor <keyword>`
 - displays all H1 lines that contain the keyword
- `lookfor <keyword> -all`
 - displays H1 lines of all functions that contain the keyword in either the H1 lines or the text block
- `type <function_name>`
 - displays the text block of the help for the function as well as its code

Digital image representation – (1)

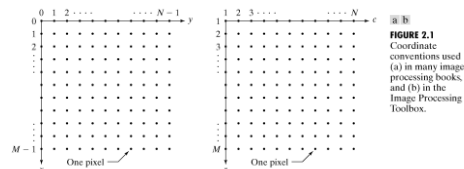


FIGURE 2.1 Coordinate conventions used (a) in many image processing books, and (b) in the Image Processing Toolbox.

Sampling – digitizing the coordinate values

Quantization – digitizing the amplitude (intensity) values

Digital image representation – (2)

$$f = \begin{bmatrix} f(1,1) & f(1,2) & \dots & f(1,N) \\ f(2,1) & f(2,2) & \dots & f(2,N) \\ \vdots & \vdots & \ddots & \vdots \\ f(M,1) & f(M,2) & \dots & f(M,N) \end{bmatrix}$$

Example: $f(7,3)$ is the element in the 7th row and 3^d column of the matrix (image) f .

Reading and displaying images

* `imread('filename')`

- Example: `f=imread('chestxray.jpg');`
- `size(f)`, `whos f` display size and additional information respectively

* `imshow(f)`

- `figure` – creates a new figure window
- `pixval(impixelinfo)` – shows cursor position and the corresponding intensity

Writing images – (1)

* `imwrite(f,'filename')`

- Option for a JPEG image –
`imwrite(f,'filename.jpg','quality',q)`
- Obtaining image file details – `imfinfo filename`

example: `>> imfinfo chestxray.tif`
`ans =`
 Filename: 'chestxray.tif'
 FileModDate: '18-Mar-2009 14:55:03'
 FileSize: 297030
 Format: 'tif'
 ...

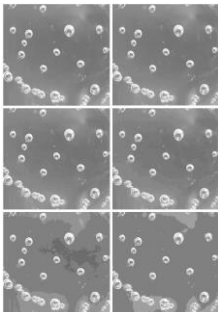
Writing images – (2)

some of the image formats supported by
`imread` and `imwrite`

Format Name	Description	Recognized Extensions
TIFF	Tagged Image File Format	.tif, .tiff
JPEG	Joint Photographic Experts Group	.jpg, .jpeg
GIF	Graphics Interchange Format [†]	.gif
BMP	Windows Bitmap	.bmp
PNG	Portable Network Graphics	.png
XWD	X Window Dump	.xwd

[†]GIF is supported by `imread`, but not by `imwrite`.

Writing images: example



a b
c d
e f

FIGURE 2.4
 (a) Original image.
 (b) through
 (f) Results of using
 jpg quality values
 $q = 50, 25, 15, 5,$
 and 0, respectively.
 False contouring
 begins to be barely
 noticeable for
 $q = 15$ [image (d)]
 but is quite visible
 for $q = 5$ and
 $q = 0$.

Array indexing

```
>> v=[1 3 5 7 9]
v =
    1    3    5    7    9
```

```
>> v(3)
ans =
     5
```

```
>> v(2:4)
ans =
     3     5     7
```

```
>> v(1:2:end)
ans =
     1     5     9
```

```
>> v(end:-2:1)
ans =
     9     5     1
```

```
>> x=linspace(1,10,4)
x =
     1     4     7    10
```

Matrix indexing

```

>> A=[1 2 3; 4 5
6; 7 8 9]
A =
     1     2     3
     4     5     6
     7     8     9

>> A(2,3)
ans =
     6

>> column3=A(:,3)
column3 =
     3
     6
     9

>> row1=A(1,:)
row1 =
     1     2     3

>> A(2:3,1:2)
ans =
     4     5
     7     8

```

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Matrix indexing

Example: image operations

```

fp=f(end:-1:1,:);
fc=f(257:768,257:768);
plot(f(512,:))
fs=f(1:2:end,1:2:end);

```

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Operators – (1)

Operator	Name	MATLAB Function	Comments and Examples
+	Array and matrix addition	plus(A, B)	a + b, A + B, or a + A.
-	Array and matrix subtraction	minus(A, B)	a - b, A - B, A - a, or a - A.
*	Array multiplication	times(A, B)	C = A * B, C(i, j) = sum(A(i, :)*B(:, j)).
.	Matrix multiplication	mtimes(A, B)	A*B, standard matrix multiplication, or p*A, multiplication of a scalar times all elements of A.
./	Array right division	rdivide(A, B)	C = A ./ B, C(i, j) = A(i, j) / B(i, j).
.\	Array left division	ldivide(A, B)	C = A .\ B, C(i, j) = B(i, j) / A(i, j).
/	Matrix right division	mrdivide(A, B)	A/B is roughly the same as A*inv(B), depending on computational accuracy.
\	Matrix left division	mldivide(A, B)	A/B is roughly the same as inv(A)*B, depending on computational accuracy.
^	Array power	power(A, B)	If A = a, B then C(i, j) = a(i, j)^B(i, j).
^.	Matrix power	mpower(A, B)	See online help for a discussion of this operator.
.'	Vector and matrix transpose	transpose(A)	A'. Standard vector and matrix transpose.
.'	Vector and matrix complex conjugate transpose	ctranspose(A)	A'. Standard vector and matrix complex transpose. When A is real, A' = A'.
+	Unary plus	plus(A)	+A is the same as A = A.
-	Unary minus	minus(A)	-A is the same as 0 - A or -1*A.
1	Colon		Discussed in Section 2.8.

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Operators – (2)

Operator	Name
<	Less than
<=	Less than or equal to
>	Greater than
>=	Greater than or equal to
==	Equal to
~=	Not equal to

TABLE 2.6 Relational operators.

Operator	Name
&	AND
	OR
~	NOT

TABLE 2.7 Logical operators.

Function	Comments
xor (exclusive OR)	The xor function returns a 1 only if both operands are logically different; otherwise xor returns a 0.
all	The all function returns a 1 if all the elements in a vector are nonzero; otherwise all returns a 0. This function operates columnwise on matrices.
any	The any function returns a 1 if any of the elements in a vector is nonzero; otherwise any returns a 0. This function operates columnwise on matrices.

TABLE 2.8 Logical functions.

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Flow control

Statement	Description
if	if, together with else and elseif, executes a group of statements based on a specified logical condition.
for	Executes a group of statements a fixed (specified) number of times.
while	Executes a group of statements an indefinite number of times, based on a specified logical condition.
break	Terminates execution of a for or while loop.
continue	Passes control to the next iteration of a for or while loop, skipping any remaining statements in the body of the loop.
switch	switch, together with case and otherwise, executes different groups of statements, depending on a specified value or string.
return	Causes execution to return to the invoking function.
try...catch	Changes flow control if an error is detected during execution.

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References

- Rafael C. Gonzalez, Richard E. Woods, Steven L. Eddins, "Digital Image Processing Using Matlab", Pearson Education, 2004
 - Chapter 1
 - Chapter 2

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