Chapter 39

Image Processing: A Practical Approach With Real World Applications Using Matlab

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ABSTRACT

This chapter gives an introductory to intermediate level text on the science of image processing. It employs the Matlab programming language to illustrate some of the elementary key concepts in modern image processing and pattern recognition. The approach taken is essentially practical and the chapter offers a framework within which the concepts can be understood by a series of well-chosen examples, exercises and computer experiments, drawing on specific examples from within science, medicine and engineering. Particularly, the modern applications such as agriculture, aquaculture, food industrial analysis and Hyperspectral images analysis are discussed in this chapter with illustrations using Matlab.

INTRODUCTION

Visual information is the most important type of information perceived, processed and interpreted by the human brain. One third of the cortical area of the human brain is dedicated to visual information processing. Digital image processing, as a computer-based technology, carries out automatic processing, manipulation and interpretation of such visual information. Image Processing systems are becoming popular due to easy availability of powerful personnel computers, large size memory devices, graphics softwares etc.

Image Processing plays an increasingly important role in many aspects of our daily life, as well as in a wide variety of disciplines and fields in science and technology, with applications such as television, photography, robotics, remote sensing, medical diagnosis and industrial inspection. Several applications of image processing technology for biology and agriculture have been developed in the collaborative
programmes involving scientists and engineers from electronics systems division, computer division, molecular biology & agriculture division, nuclear agriculture & biotechnology division and cell biology division.

In this chapter, section 2 gives an overview of MATLAB concepts in image processing. Section 3 describes fundamentals of image processing techniques needed for different applications. Image processing applications in agriculture, aquaculture, Species identification and hyperspectral images with the results are discussed in section 4, 5, 6 and 7 respectively. Section 7 gives conclude remarks of the chapter.

MATLAB

MATLAB is being used as a platform for laboratory exercises in the Image Processing. MATLAB is a data analysis and visualisation tool designed to make matrix manipulation as simple as possible. In addition, it has powerful graphics capabilities and its own programming language. In MATLAB a single variable is a 1 x 1 matrix, a string is a 1 x n matrix of chars. An image is a n x m matrix of pixels (studentnet.cs.manchester.ac.uk).

MATLAB is started from within the Windows environment by clicking the icon that should be on the desktop. MATLAB’s integrated development environment (IDE) has five components: the Command Window, the Workspace Browser, the Current Directory Window, the Command History Window and zero or more Figure Windows that are active only to display graphical objects. Figure 1 describes the MATLAB IDE. The Command window is where commands and expressions are typed and results are presented as appropriate.

The workspace is the set of variables that have been created during a session. They are displayed in the Workspace Browser. Additional information about a variable is available there, some variables can also be edited. The current directory window displays the contents of the current working directory and the paths of previous working directories. The working directory may be altered. MATLAB uses a search path to find files. The search path includes the current directory, all of the installed toolboxes plus any other paths that the user has added via the Set Path dialogue accessed from the File menu.

The command history window gives a historical view of the current and previous sessions. Commands appearing here can be reexecuted. MATLAB provides an editor for writing scripts. It is invoked by typing edit in the command window. Scripts are stored with the extension .m and are therefore also known as m-files. Help on any MATLAB command can be found in the Help Browser which is entered via the menu bar or by typing help browser in the command window.

Image Loading and Displaying

An image is loaded into working memory using the command

```matlab
>> f = imread('image file name');
```

The semicolon at the end of the command suppresses MATLAB output. Without it, MATLAB will execute the command and echo the results to the screen. We assign the image to the array f. If no path is specified, MATLAB will look for the image file in the current directory. The image can be displayed using
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