Cairo University
Faculty of Engineering

Moving Object Tracking and Range Detection using Image Processing Techniques

By

Adel Mohamed Elsayed Abonema

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
MASTER OF SCIENCE
in
Engineering Physics

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Moving Object Tracking and Range Detection using Image Processing Techniques

Key Words:

Visual Tracking, Moving Target Tracking, Range Estimation, Motion Detection, Image Segmentation, Frame Difference, Image Correlation, SIFT Feature Extraction.

Summary:

In this thesis tracking techniques are surveyed and classified. Three tracking techniques are selected and implemented. A new simple quantitative comparison method is proposed and used to compare such tracking techniques. Additionally range estimation techniques are also surveyed, and a geometrical based methodology has been proposed and tested.

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Abstract

The growing interest for moving object tracking for various real world applications creates the need of a quantitative comparison between tracking techniques. Current works customarily consider the evaluation of tracking techniques from an application point of view. In this thesis tracking techniques are surveyed and classified. Three tracking techniques which differ in its principal idea are carefully selected and implemented, namely; Difference tracking, Correlation tracking and Feature tracking using SIFT. A new simple quantitative comparison method is proposed and used to compare such tracking techniques. The results show that tracking technique employing SIFT features is found to be the most robust one, despite its high complexity and its low computing efficiency.

Additionally range estimation which may be a relatively new topic in the field of computer vision is considered. In this thesis range estimation techniques are also surveyed, and a geometrical based methodology has been proposed and tested giving results with acceptable accuracy.

I Introduction

1.1 Computer Vision and Image Processing

1.2 Visual Tracking

1.3 Range Estimation

1.4 Thesis Organizing

Chapter 1 : Introduction

1.1 Computer Vision and Image Processing

Computer vision is a field that includes methods for acquiring, processing, analyzing, and understanding images from the real world in order to produce numerical or information, usually in the form of decisions. As a scientific discipline, computer vision is concerned with the theory behind artificial systems that extract information from images. The image data can take many forms, such as video sequences, views from multiple cameras, or multi-dimensional data from a medical scanner. As a technological discipline, computer vision seeks to apply its theories and models to the construction of computer vision systems. [65]

Sub-domains of computer vision include scene reconstruction, event detection, motion detection, visual tracking, object recognition, learning, indexing, and image restoration. [66]

Computer vision interacts with many other fields, figure 1.1 take a simple look on this interaction.

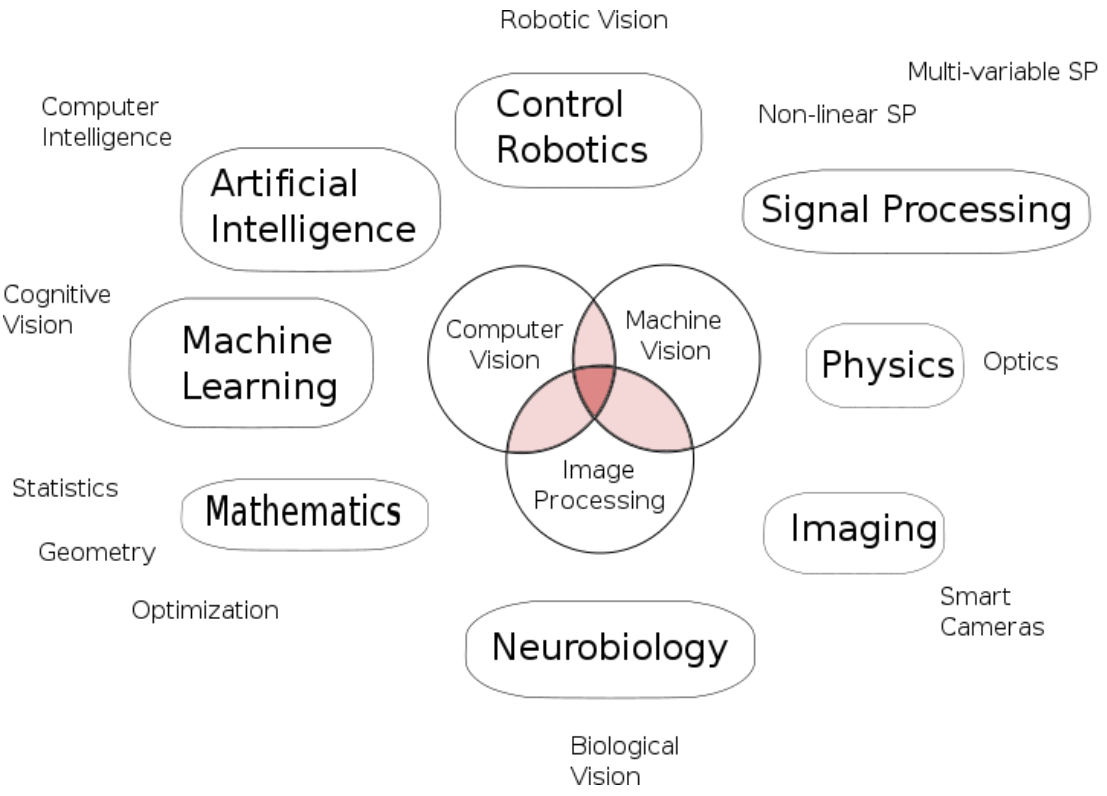

Figure 1.1 Computer vision and various other fields interaction.

There is no general agreement among authors regarding where image processing stops and computer vision starts. Sometimes a distinction is made by defining image processing as a discipline in which both the input and output of a process are images. On the other hand, computer vision ultimate goal is to use computers to emulate human vision, including learning and being able to make inferences and take actions based on visual inputs. The area of image analysis (image understanding) is in between image processing and computer vision. [63]

As mentioned there are no clear-cut boundaries in the continuum from image processing at one end to computer vision at the other. However, one useful paradigm is to consider three types of computerized processes in this continuum: low-, mid-, and high-level processes. Low-level processes involve primitive operations such as preprocessing to reduce noise, contrast enhancement, and image sharpening. A low-level process is characterized by the fact that both its inputs and outputs are images. Mid-level processing on images involves tasks such as segmentation, description of image objects to reduce them to a form suitable for computer processing, and recognition of individual objects. A mid-level process is characterized by the fact that its inputs generally are images, but its outputs are attributes extracted from those images (e.g., edges, contours, and the identity of individual objects). Finally, higher-level processing involves “making sense” of an ensemble of recognized objects, and at the far end of the continuum, performing the cognitive functions normally associated with vision. [63]

1.2 Computer Vision Applications

- Robot Vision.
- Visual Surveillance.
- Security and Identification.
- Events Detection.
- Military applications.
- Interaction Games.
- Visual Tracking.
- Automatic Navigation.