Chapter 10
Applying Optoelectronic Devices Fusion in Machine Vision:
Spatial Coordinate Measurement

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ABSTRACT

Machine vision is supported and enhanced by optoelectronic devices, the output from a machine vision system is information about the content of the optoelectronic signal, it is the process whereby a machine, usually a digital computer and/or electronic hardware automatically processes an optoelectronic signal and reports what it means. Machine vision methods to provide spatial coordinates measurement has developed in a wide range of technologies for multiples fields of applications such as robot navigation, medical scanning, and structural monitoring. Each technology with specified properties that could be categorized as advantage and disadvantage according its utility to the application purpose. This chapter presents the application of optoelectronic devices fusion as the base for those systems with non-lineal behavior supported by artificial intelligence techniques, which require the use of information from various sensors for pattern recognition to produce an enhanced output.

DOI: 10.4018/978-1-7998-0951-7.ch010

INTRODUCTION

The present chapter surged in the research continuity of a 3D Vision System for mobile robot navigation application, a 3D medical laser scanner, and a structural health monitoring system. With the objective of increasing the accuracy of the systems, digital and analog processing signals methodologies have been developed in order to find the energetic center of the optoelectronic signal handled by these systems. Into the task of systems overall robustness, its measurement data has been submitted to statistical analysis, finding a non-linear behavior of the systems, leading to the need of artificial intelligence applications such as neuronal network (NN) and support vector machine regression (SVMR), in a modern approach to the prediction of the non-linear measurement error of the systems to compensate it. In the process of obtaining enough information from a measurement system to extract from it a model to predict its measurement error. It has been done a search of attributes to build the training dataset and test dataset. Ha been found that the pattern recognition can be enhanced by the sensor fusion and redundancy theory. This theory refers to the synergistic use of information from various sensors to achieve the task required by the system. Input data (attributes) are combined, fused and grouped for proper quality and integrity of the decisions to be taken by the intelligent algorithm. Besides, the benefits can be extracted from the redundant data, the reduction of uncertainty and the increasing of precision reliability. By these reasons, the photodiodes and charge coupled devices (CCD) are fusion in the task of robust systems building for machine vision by Spatial Coordinates Measurement (Weckenmann, 2009; Elfes, 1992; Zhang, 2008; Shih, 2015). The specific properties of both, their advantages and limitations have been considered, since, the photodiode is the sensor who gives place to the laser-scanning and the CCD is the sensors who gives place to the close-range photogrammetry. The energetic center of the laser optoelectronic signals from the photodiode and the energetic center of the image signal from the CCD sensor are detected to combine these sensors outputs, and to exploit their natural synergy new experimental results are presented to demonstrate the increase of systems accuracy.

BACKGROUND

Optoelectronics is the study of any devices that produce an electrically-induced optical output or an optically-induced electrical output and the techniques for controlling such devices (Marston, 1999), it includes generation, transmission, routing, and detection of optoelectronic signals in a widespread of applications (Dagenais, 1995). Wherever light is used to transmit information, tiny semiconductor devices are needed to transfer electrical current into optical signals and vice versa. Examples include light-emitting diodes, photodetectors and laser diodes (Piprek, 2003).

Most optoelectronics devices applications have focused on single sensors and relatively simple processes to extract specific information from the sensor, however the use of multiple sensors by an optoelectronic device fusion technology deliver more advanced information and enable to develop intelligent and sophisticated optoelectronic systems, in special for machine vision applications (Yallup, 2014). More than one optoelectronic sensor may be needed to fully monitor the observation space at all times. Methods of combining multiple sensor data are in developing due to the availability and computational power of communications devices that support algorithms needed to reduce the raw sensor data from multiple sensors to convert it to the information needed by the system user (Klein, 2003).

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