

# Chapter 1

## Introduction to 3D Imaging

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### ABSTRACT

*With the advent of 3D consumer products in the electronics market, 3D imaging is all set to take off. Last decade had seen a lot of research activity with respect to 3D imaging. It will not be wrong to say that this decade will be the decade of 3D imaging. This chapter briefly introduces 3D imaging with respect to various 3D consumer products and 3D standardization activity. It also discusses the challenges and the future of 3D imaging.*

### INTRODUCTION

3D imaging is not a new research area. Researchers are working with 3D data for the last few decades. Even 3D movies were introduced using the cardboard colored glasses. However, the consumers did not accept the results of that 3D research because of low quality visualization of 3D data. The researchers were limited by the hardware resources like processing speed and memory issues. But with the advent of multicore machines, specialized graphics processors and large memory modules, 3D imaging research is

picking up the pace. The result is the advent of various 3D consumer products.

3D imaging methods can be broadly divided into three categories, namely, contact, reflective and transmissive methods. The contact methods, as the name implies, recover the 3D shape of the object by having physical contact with the object. These methods are generally quite slow as they scan every pixel physically and they might modify or damage the object. Hence, they cannot be used for valuable objects like jewellery, historical artifacts etc. However, they provide very accurate and precise results. An example is the CMM (coordinate measuring machine) which is a contact 3D scanner (Bosch 1995). Such scanners are common in manufacturing and they are very

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precise. Another application of contact scanners is in the animation industry where they are used to digitize clay models.

On the other hand, reflective and transmissive methods do not come in physical contact with the object. The transmissive methods are very popular in the medical arena and include methods like CT (Computed Tomography) scanning, MRI (Magnetic Resonance Imaging) scanning and PET (Positron Emission Tomography) scanning (Cabeza, 2006). CT scanners are now installed in almost all the major hospitals in every country and they use X-rays for scanning. MRI and PET are more expensive than CT and are not as frequently used as CT scanners, especially in the third world countries. However, because of its usefulness MRI has become quite popular and is now available at major hospitals in third world countries. These technologies have revolutionized the medical profession and they help in accurate diagnosis of the diseases at an early stage. Apart from the medical profession, these 3D scanning technologies are used for non-destructive testing and 3D reconstruction for metals, minerals, polymers etc.

The reflective methods are based either on the optical or the non-optical sources. For non-optical based methods, radar, sonar and ultrasound are good examples which are now widely accepted and mature technologies. They are used by rescue services, medical professionals, environmentalists, defense personnel etc. They have wide range of applications and their cost varies from few hundred to hundred of thousands of dollars.

The optical based reflective methods are the ones that have direct effect on the everyday consumer. These methods are the basis for commercialization of consumer products including 3D TV, 3D monitors, 3D cameras, 3D printers, 3D disc players, 3D computers, 3D games, 3D mobile phones etc. The optical based reflective methods can be active or passive. Active methods use projected lights, projected texture and patterns for acquiring 3D depth data. Passive methods utilize

depth cues like focus, defocus, texture, motion, stereo, shading etc to acquire 3D depth data. Passive methods are also used in conjunction with active methods for better accuracy and precision.

## **3D TELEVISION**

We start with the introduction of 3D TV because it is the motivation for most of the other 3D consumer technologies. The first version of the TV was black-and-white TV. Although, there were multiple gray levels associated with it but the name associated with it was black-and-white TV. The first major transition was from black-and-white TV to color TV. It was a big revolution when that transition occurred. The earlier color TVs were analog. Then, digital color TVs were introduced followed by transition from standard resolution to high definition (HD) resolution of the images.

However, the era of 2D HDTV appears to be short because we are now witnessing the advent of 3D HDTV (Wikipedia HDTV). These, 3D HDTV are based on the stereoscopic technology and hence are known as stereoscopic 3D TV or S3D TV. Since, they also support high definition resolution; hence, they can be called S3D HDTV. All the major TV manufacturers have introduced S3DHDTV in the consumer market. They include various models from leading manufacturers like Sony, Panasonic, Mitsubishi, Samsung, LG, Philips, Sharp, Hitachi, Toshiba and JVC.

S3D HDTV can be switched between the 2D and 3D imaging modes hence maintaining the downward compatibility with 2D images and videos. Additionally, they provide software that can artificially shift the 2D images and videos to produce the stereo effect and hence the TV programs can be watched in 3D. However, the quality still needs to be improved. At this moment, the best 3D perception is achieved by the images and videos that are produced in 3D. As mentioned above, these products are based on stereovision.

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