Chapter 13
Comparative Study of Stereo Correspondence Techniques for Underwater Images

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ABSTRACT

The aim of the chapter is to provide an overview of the computer vision techniques involved in stereo correspondence of underwater images, which is one of the important steps in the 3D reconstruction of underwater objects and scenes. The author provide briefly the various categories of techniques for 3D reconstruction of objects. Also, the author provides steps involved in the 3D reconstruction of objects using stereo vision technique, particularly, more focused on stereo correspondence step and its techniques available in the literature. Further, they present some of the local and global stereo correspondence methods employed for underwater stereo images with simulation results. Finally, the author presents a visual comparison of local and global stereo correspondence techniques employed for underwater stereo images.

INTRODUCTION

3D reconstruction is the process of capturing the shape and appearance of real objects. The form that this representation takes is very much defined by the methods and algorithms utilized. Any given reconstruction implementation is also explicitly tied to the available input data. Techniques and workflow vary significantly between different approaches, causing difficulties categorizing some developments; however, prior work from Seitz et al. (1998) has gone some way to creating a taxonomy of 3D reconstruction algorithms. The 3D reconstruction framework discussed within this section is loosely based on this work and specifically their categorization of the fundamental building blocks of such a system. Figure 1 shows the taxonomy of shape acquisition methods.

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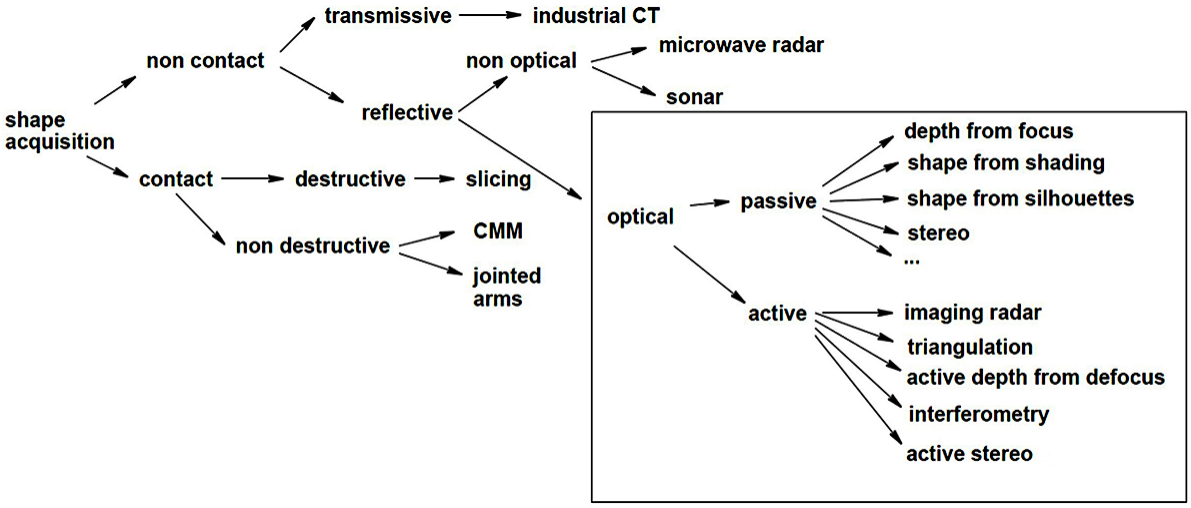
Figure 1. Short taxonomy of shape acquisition methods



ACQUISITION BY CONTACT

Acquisition by contact is performed by touching the object surface on each relevant side with an ad-hoc instrument. These instruments are quite slow and cannot be used on some typology of objects. Moreover, they do not provide information on object appearance.

Acquisition Without Contact

Acquisition without contact is performed by indirect techniques based on a certain energy source. The returned signal is measured by the use of digital cameras or special sensors. In this class, optical and laser technologies are the most used. The optical technologies again can be divided into passive or active. The last one (called also active sensing systems) can acquire data very fast and accurately: these are the reasons why they are the most popular existing technologies.

Active Optical Systems

Active optical systems are constituted by a source and a sensor, where the source emits a certain illuminant pattern, and the sensor acquires returned marks reflected by the object surface.

Passive Optical Systems

Passive optical systems are, in general, based (i) on the acquisition of many RGB images taken from various points, (ii) on the reconstruction of an object by contours and, (iii) on the integration of such contours for the reconstruction of the model 3D. These systems determine the object coordinates only by the use of the information contained in the acquired images (for example, photogrammetry and acquisition by silhouette). They are extremely economical, simple to use, and produce a complete model; on the contrary, the quality and accuracy of the produced model can be quite low.