

## Measurement of water surface using Stereo Matching

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### ABSTRACT

It is important to grasp water surface profile when we discuss various phenomena in coastal zone. For example, sediment transport and rip current are determined mainly by the spatial distribution of waves in surf zone. Measurement of sea waves using Euler's method is a general. However it is difficult to determine spatial distribution of waves. Over the past decade, a considerable number of studies have been conducted on the wave plane distributions by using two video camera images. These studies analyzed azimuth difference of digital images taken by video cameras. The problem of these studies is to find the same element between two images. Generally, they put the targets or tracers in images to solve azimuth difference. Such kind of method which comes from Particle Image Velocimetry (PIV) method is effective to measure surface profile. However, it is extremely difficult to put the appropriate number of targets or tracers on water surface densely to determine the location of the surface accurately. In this study, the authors proposed the procedure to measure surface profile by applying stereo matching method of two images of the sea surface without any targets or tracers. The validity of the proposed procedure was examined through the experiment in a wave basin.

KEY WORDS: Stereo images, Measurement of water surface

### INTRODUCTION

Generally, water surface displacement or water level have been measured in Eulerian method using ultra sonic wave sensors, capacitance type wave gages or pressure sensors at fixed points. In case where we want to measure spatial distribution of wave profile or surface displacements densely, we have to put a lot of sensors in positions and it cost a lot. Some important studies have been conducted on measuring wave profile using stereo image. In the early stages, it is difficult to measure the time history of water surface, because the matching analyse was carried out manually (Hattori and Sato, 1979). Recently, performance of computer and digital camera were improved in quality and it facilitates the analysis of the stereo photograph (Stefan, Werner, Folke and Christian, 2004).

The important point of 3D measurement by using stereo images is the matching of the image that is the identification of the same point from two photographs.

Justin et al.(2005) developed 3D measurement method by using three stereo images. They had proposed that when it had mismatching the two images, image of third camera have provided another matching chance.

Hatanaka et al. (2004) developed another technique to measure surface displacement by applying PIV. Although they could measure water surface exactly, it seemed that it was difficult to keep tracers in the objective reason.

In this study, the authors propose a 3-D measurement of water surface by stereo matching method of the images of high performance digital cameras by analyzing epipolar line.

### 3-D MEASUREMENT

#### Pinhole camera model

In this study, a so-called pinhole camera model is applied. Coordinate system of the pinhole camera is shown in figure 1.

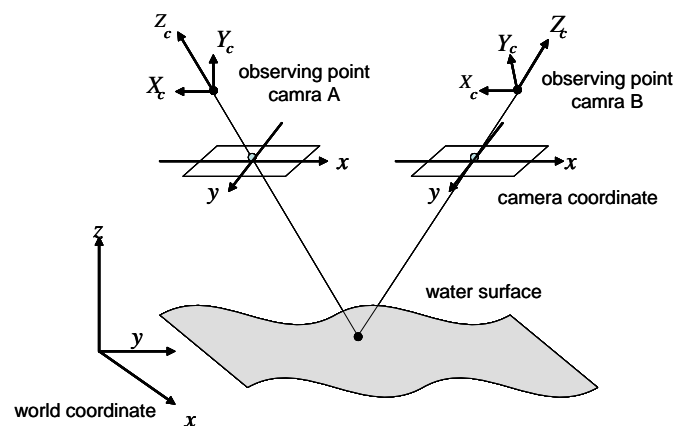


Fig. 1 Coordinate system of pinhole camera model