

STEREO IMAGE ANALYSIS OF AERIAL IMAGES FROM TWO UAVS FOR WAVE MONITORING IN SURF ZONE

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INTRODUCTION

UAVs have been considered as one of the most powerful tools for coastal monitoring. 3D Topography of sandy beaches can be obtained with automatic flight of single UAV and 3D shape reconstruction technique. Furthermore, UAVs have been utilized for wave monitoring (Holman et al., 2017) as the video images or a series of still images from aerial cameras enable us to observe wave propagations from higher viewpoints. Although there are some proposed techniques to extract wave celerity and direction from the aerial images by UAV, there doesn't seem to be enough trials to obtain wave height, which is one of the most important parameters to consider coastal problems such as beach morphological changes. In this study, stereo image analysis for 3D shape reconstruction was applied to stereo image pairs by two UAVs as a test of the applicability of the existing stereo measurement technique and also possibility of 3D wave deformation measurement in field.

STUDY AREA AND DEVICES

The measurement was conducted on Sendai Coast, which has a sandy beach with total length of about 12 km. Two UAVs (DJI, Phantom 4 Pro) were utilized for the measurement. After automatic flight to the designated locations and altitudes, video images with 60 fps and 4096 x 2160 resolution were almost simultaneously recorded by the two UAVs (Figure 1). As they don't have a function for the synchronized recording, the video image pair was carefully observed to find the frames which have the same instant for synchronization with 1/60 second of accuracy. The target area in this measurement was surf zone as image pattern matching for 3D reconstruction require surface textures and is expected to be only applicable to areas where there are entrained bubbles on or near water surfaces.

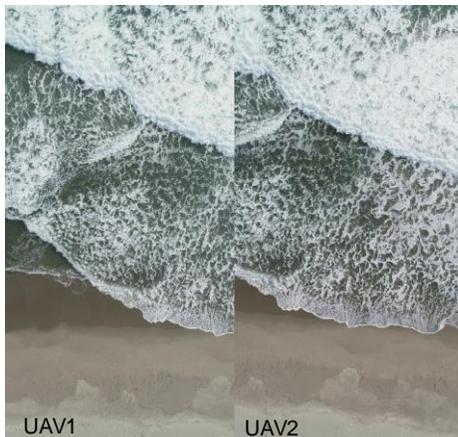


Figure 1 - An example of a stereo image pair by two UAVs

STEREO IMAGE ANALYSIS

The basic procedure of the stereo image analysis was following an existing technique proposed for more general purposes whose targets are basically solid objects. First, feature-based matching based on SURF is conducted for estimation of 3D geometry of the positions of the cameras and object surfaces. Second, area-based matching is conducted to obtain dense pairs of image coordinates for 3D point-cloud on object surface in the camera coordinate system. Finally, the camera coordinates are converted to the real-scale coordinates. In this study, the conversion was simply based on the horizontal distance between the UAVs. The detail of the analysis will be discussed in the presentation.

RESULTS AND DISCUSSIONS

In the area where there were bubbles on the water surface entrained by the breaking waves, surface shapes were successfully reconstructed by the stereo image analysis. However, when and where there are no clear surface textures on the surface, the results of the measurement have rather spiky shapes. Although there should be more investigation and discussion to apply this kind of technique for actual wave monitoring, the series of the test shows the applicability and possibility of 3D measurement of wave surfaces by UAVs.

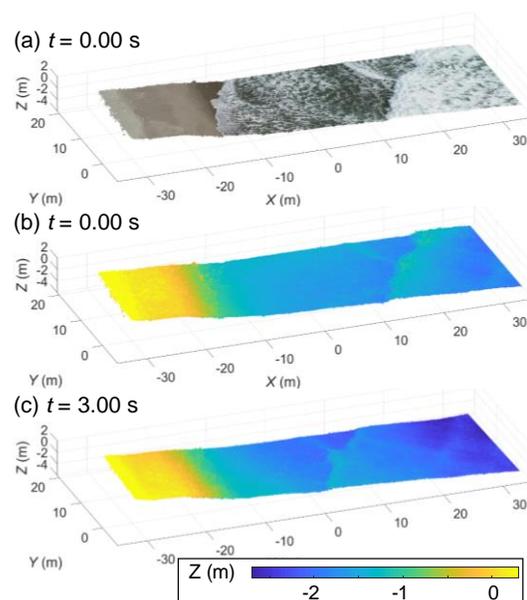


Figure 2 - An example of measured surface shapes

REFERENCES

Holman, Brodie and Spore (2017): Surf zone characterization using a small quadcopter: technical issues and procedures, IEEE Transactions on geoscience and remote sensing, Vol.55, No.4.