Geophysical Research Abstracts
Vol. 19, EGU2017-13214, 2017
EGU General Assembly 2017
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Beach Observations using Quadcopter Imagery

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Beaches are the places where the interaction of the land and sea takes place, and it is under the influence of many environmental factors, including meteorological and oceanic ones. To understand the evolution or changes of beaches, it may require constant monitoring. One way to monitor the beach changes is to use optical cameras. With careful placements of ground control points, land-based optical cameras, which are inexpensive compared to other remote sensing apparatuses, can be used to survey a relatively large area in a short time. For example, we have used terrestrial optical cameras incorporated with ground control points to monitor beaches. The images from the cameras were calibrated by applying the direct linear transformation, projective transformation, and Sobel edge detector to locate the shoreline. The terrestrial optical cameras can record the beach images continuous, and the shorelines can be satisfactorily identified. However, the terrestrial cameras have some limitations. First, the camera system set a sufficiently high level so that the camera can cover the whole area that is of interest; such a location may not be available. The second limitation is that objects in the image have a different resolution, depending on the distance of objects from the cameras. To overcome these limitations, the present study tested a quadcopter equipped with a down-looking camera to record video and still images of a beach. The quadcopter can be controlled to hover at one location. However, the hovering of the quadcopter can be affected by the wind, since it is not positively anchored to a structure. Although the quadcopter has a gimbal mechanism to damp out tiny shakings of the copter, it will not completely counter movements due to the wind. In our preliminary tests, we have flown the quadcopter up to 500 m high to record 10-minnte video. We then took a 10-minute average of the video data. The averaged image of the coast was blurred because of the time duration of the video and the small movement caused by the quadcopter trying to return to its original position, which is caused by the wind. To solve this problem, the feature detection technique of Speeded Up Robust Features (SURF) method was used on the image of the video, and the resulting image was much sharper than that original image. Next, we extracted the maximum and minimum of RGB value of each pixel, respectively, of the 10-minutes videos. The beach breaker zone showed up in the maximum RGB image as white color areas. Moreover, we were also able to remove the breaker from the images and see the breaker zone bottom features using minimum RGB value of the images. From this test, we also identified the location of the coastline. It was found that the correlation coefficient between the coastline identified by the copter image and that by the ground survey was as high as 0.98. By repeating this copter flight at different times, we could measure the evolution of the coastline.