

Ocean wave motion detection with Hu-moments invariants using CCD images

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Computer vision (CV) is a research field in computer science for acquiring, processing, analyzing, and understating image and video to produce numerical or symbolic information. Among the various CV techniques, we used image moment to analyze the movements of ocean wave. Image moment is weighted average of image pixel intensities and we find that varying of moment between costal monitoring video frames can be associated with wave movement, such as period and height. Using the varying of image moment we analyze the numeric information of wave movement and tested our algorithm to the Gyoam beach in Gangwon province, Republic of Korea. To prove the algorithm we compared with the wave information collected by an acoustic wave gage (AWAC) and determine the usability of our system. We first extract a list of sample patches in the videos of coastal region that have immunity from external environments such as human or ship. Since general CCD camera is fixed, variance in the time domain of inlier video patch can caused by wave movement. To calculate the variance between the video patch, simple measure by difference the colors or intensity at each pixel can be used. But that is ineffective for a CCD video, because CCD video contains unwanted changes due to light variance or noise which make crucial miscalculation. Instead, we extract seven hu-moments that invariant a translation, scale, rotation and apply these for contour shape matching, which is a well-known technique for measuring the similarities between two shapes, between each sample in the different video frames. To comparing with ground-truth data, we also capture the wave movement by acoustic wave gage. After comparison, we found that the period of real wave were almost identical to the CCD image processing results. And amplitude of EV(i) and height of wave showed similar value changes relatively although absolute values are different. Length of higher amplitude region also has a similar pattern with wave length. Therefore our system can be used as a beach process monitoring system with low cost equipment.

Keywords: CCD, Hu-moments, Wave Period