Monitoring of shoreline position and beach morphodynamical changes using microwave marine radar

Hwa Chien[1], Hao-Yuan Chen[1], Jian-Wu Lai[2], Shih-Tzung Wei[1]

[1] Institute of Hydrological and Oceanic Sciences, National Central University, Taiwan
[2] Taiwan Ocean Research Institute, National Applied Research Labs

Coastal zone is the intersection among atmosphere, sea and land, where the processes involved are complex and intense owing to the interactions of human activities and nature. Due to the global climate change and sea level rise, and the occurrence frequency of extreme weather events exhibits an increasing trend, and therefore enhance the coastal hazard such as coastline erosion, coastal inundation and coastal ecosystem degradation. These hazards bring direct impacts to the coastal residents. The coastal situation can be represented by the coast state indicators (CSIs) which are a reduced set of parameters that can simply, adequately and quantitatively describe the dynamic-state and evolutionary trends of a coastal system. For example, the beach volume, which is one of the CSIs, can be described by the variables of beach width, beach height, beach slope etc., and these variables can be obtained by estimating the waterline position. The detecting of the waterline position is of an important task regarding to the coastal management.

In this study, we proposed a new method to detect the waterline position using microwave radar. According to the principle of the radar backscattering mechanisms, we distinguished the area of beaches and seas according to the corresponding temporal variation of the radar backscatter strength. After the processes of radar signals through radar intensity correction, spatial geometric correction, coordinate transformation and the standard deviation of radar backscatter intensity, we can obtain the waterline position by image processing methods, i.e. the high-contrast-edge method and the filter noise process.

In order to assess the feasibility of present method, we compare the results of waterline position with CCD image method and the actual DGPS-RTK survey. After the process of lens distortion correction and orthographic projection, the waterline estimation results of the CCD orthoimages agree with the results of radar method. The comparison of waterline estimation using DGPS-RTK survey shows good consistency with our method.

Furthermore, the topographic vertical profiles of the intertidal flat are obtained by combining the waterline position and the water level information. Using the chronological record by high-contrast-edge treatment, filtering noise process, we can obtain the change of waterline position with time, and obtain the time averaged topographic vertical profile of the intertidal flat by combining with water level information. Finally we use DGPS RTK to measure the topography of intertidal flat to confirm the accuracy that the radar estimated.

In this study during the strong winter northeast monsoon and summer southwest monsoon events, we estimate the change of topography at the south intertidal flat of Yong-An fishery port, and discuss the coastal erosion under the groin effect.