USING HIGH RESOLUTION LIDAR DATA FOR SHORELINE EXTRACTION

May, 12th 2003

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Abstract

Many recent advances in mapping technology have benefited the study of shoreline change. One of them is the airborne LIDAR-System (*Light Detection and Ranging*), which collects seamless high-resolution bathymetry and topography data in order to produce accurate digital elevation models (*DEM*). In 1999 the Hawaiian Islands were surveyed by SHOALS (*Scanning Hydrographic Operational Airborne Lidar Survey*). Using the Maui data, this project examines the capability as well as the strengths and weaknesses of LIDAR data for shoreline extraction. Therefore different methodologies are compared: automated shoreline extraction using LIDAR data, interactive shoreline extraction from LIDAR data, manually digitized shorelines using aerial photos. The results show that the latter method produces more accurate mean lower low water (*MLLW*) shorelines than the methodologies using LIDAR data. Without taking into account seasonal uncertainties, the difference from aerial photo shorelines to LIDAR data shorelines around Honokowai, West Maui, are about 20 m on rocky coastline, 15 m on coastline with both rocky and sandy areas, and 5 m on sandy coastlines. The calculation considers the temporal difference between the 1997 aerial photo shoreline and the 1999 LIDAR data shoreline by projecting the photo shoreline two years into the future. Although the 3D interactive method produces smoother shorelines than the automated 2D method, there is no significant improvement in terms of accuracy.
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Evaluation of Learning

This evaluation of learning should give you some insights into what I have learned during my MOP project. This project was tightly coupled to my work at the Coastal Geology Group of the University of Hawaii. Before I started with my project, I became skilled in the orthorectification of aerial photos and digitizing shorelines, which were then used to calculate erosion rates. This method is accurate in determine historical shoreline change, but very time and resource consuming.

Therefore I decided to evaluate an alternative method of shoreline extraction. I found that learning how to propose and think through my ideas was a very important part of my project. But even with comprehensive planning I realized that not everything worked according to schedule. At one point it became obvious that most of the data I was using not as good as I thought it would be. Even though I was a little bit disappointed about that, I was still convinced that it was worthwhile to finish the project. Negative results can also lead to good learning experiences.

The resolution of LIDAR data decreases rapidly on the beachface, probably because of absorption of the laser by white-water of breaking waves. In order to find the reason, I asked people from SHOALS and they offered me a copy of videos, which were taken during the survey. Unfortunately, they never followed through with the videos even though we placed several requests.

During my research project I learned a lot about software development and data management on the one hand and being responsible for your work on the other hand. I worked basically alone, but if help or advice was needed, the Coastal Geology Group provided support. I worked with several applications including PCI Geomatica, SHOALS-Toolbox, ArcView, Together 6.0, Adobe Photoshop, Adobe Illustrator, a few small tools and standard office applications like PowerPoint, Word and Excel. I also improved my knowledge about the UNIX operating system.

Besides that I collected background information about beach and shoreface morphodynamics thanks to a directed reading with my project advisor Charles Fletcher. This was very helpful for my project. Through this book I understood that the coastal zone is one of the most dynamic regions on the Earth and that very complex processes shape and change the coastline. Knowing that, I thought more critically about my project goal and realized that the LIDAR data as well as the aerial photos represents the beach and the shoreline only at a specific moment in time. So, in addition to the accuracy of the data it is very important to consider temporal (or seasonal) uncertainty, when extracting or comparing shorelines. Unfortunately this was out of scope for my project. Last but not least writing reports and discussing the project helped me to improve my English. It is still not perfect, but much better than a few months ago.