

Inspection of Waterfront Facilities Using Vessel-Based Remote Sensing Mitchell, Del Bello, Suarez

American Association of Port Authorities Facilities Engineering Conference October 20-22, 2015 Waterfront facilities are impacted by erosion, settlement, debris, and wave damage.

But they are difficult to monitor for change.

Remote sensing of the target area from the water using multibeam and mobile laser scanning is often valuable for inspection and assessment

Repeat observations over time provide empirical detection and tracking of change

UGRO

Bathymetric (Hydrographic) Survey Techniques



Bathymetric (seafloor) terrain surveys

Multibeam bathymetric echosounder (MBES):

- Creates <u>swathes</u> of survey data (not just a single beam)
- Creates continuous seafloor map
- Variable swath width (width vs. detail) and can be rotated

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- Creates continuous seafloor map
- Variable swath width (width vs. detail) and can be rotated
 - Physically or electronically with new sensors!



Rotated Multibeam Sensor for surveying laterally to the waterline







Acoustic Marine Survey (Multibeam)





Primary Use: for Safe Navigation & Charts





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Acoustic marine survey sensors play a critical role in producing data for safe navigation – charts.

Dredging Projects





The data is also essential for volumetric surveys for dredging as well as for marine construction, maintenance and demolition projects.

Dredging Projects





Dredging Projects





- Feasibility/Ripability
- Template Design
- Volume Estimates
- Slope stability assessment – Key for dredging in front of berths
- Dredge Monitoring
- Material Disposal & Reuse
 - Survey of site after dredging operations

Dredging Volume Calculations





BOAT-MAP™





By incorporating mobile laser scanning, a hydrographic survey can be extended above the waterline.

Mobile Laser Scanning (MLS)

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A valuable supplement to multibeam when surveying at the waterline

- Uses a laser for surveying above water to capture additional features
- Often longer ranging laser required, especially in dangerous waters
- Some projects benefit from supplemental capture from land



Integrating Bathymetry and Laser Scanning



Multibeam Bathymetry Echosounder (MBES) Data

- Sonar (sound) based ranging technology
- Wide coverage on both sides of vessel
- Millions of individual point observations

Integrating Bathymetry and Laser Scanning



Mobile Laser Scanning Data (LiDAR)

- Laser (light) based ranging technology
- Scan land and features beside vessel
- Millions of individual point observations

Integrating Bathymetry and Laser Scanning





National City Marine Terminal



Project Example:

National City Marine Terminal



Underwater facility inspection performed to provide advice on condition, suggested maintenance/repairs and estimation by Moffatt & Nichol.

Inspection supplemented by remote sensing, particularly of revetment.



7 berths + 2,000' of rubble-mound revetment
2013 dive inspection for 4 berths
7,370 linear feet surveyed – all 7 berths and revetment
2 days (1 day laser; 1 day multibeam)
30 million survey points
151 cross-sections cut





National City Marine Terminal





- Visual inspection is still critical
- But more difficult to capture empirical observations
- Difficult to integrate above and below water observations together





National City Marine Terminal



- Remote sensing can span the land/water interface
- But lacks the detail and resolution of an underwater inspection
 - Cracking/spalling much more difficult to identify
 - Occlusions (shadows) hide the back side of piles























Single Cross-Section





Comparative Analysis: Current Condition vs. Design





PDF Map Book





CROSS SECTION NUMBER 24

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Data integrated into Google Earth environment.





Wrap-up





- Hydrographic surveys can capture significant detail (but do not replace hands-on underwater inspection
- Laser scanning can be used to extend hydrographic surveys above the waterline
- Data can empirically assess condition changes from design over time





Thank you for your time.

Questions?



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