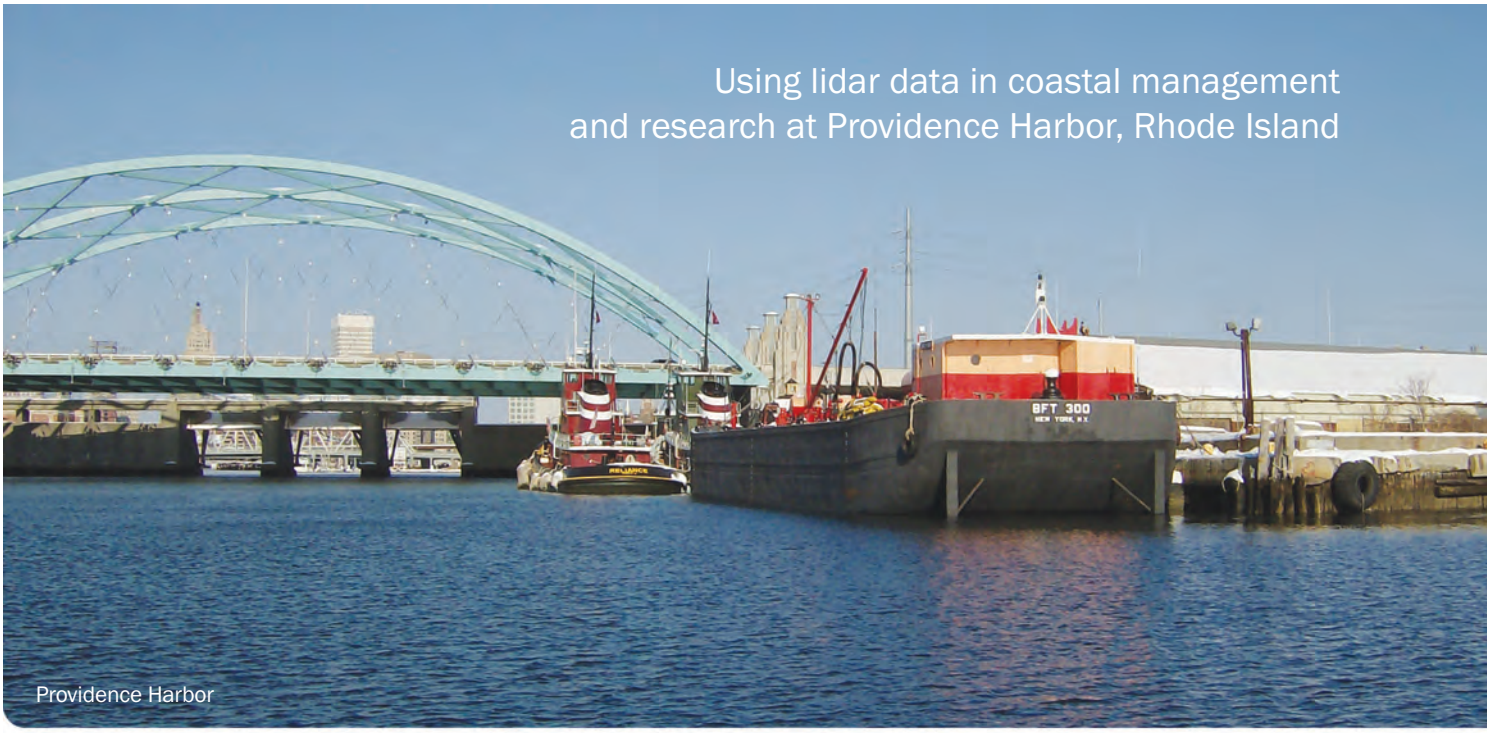
Coastal Management

ILRIS Application Note: IL-001 Rev A



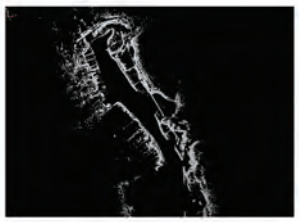
Using lidar data in coastal management and research at Providence Harbor, Rhode Island

Providence Harbor

To secure federal funds for both coastal management and future research, the Coastal Institute of the University of Rhode Island, along with the Coastal Resources Management Council (CRMC), approached Optech Incorporated, a leading manufacturer of lidar instruments, to assist in a feasibility study. The question was to investigate how effectively ILRIS HD georeferenced lidar data can contribute to shoreline stability analysis and change-detection studies. A secondary question was to investigate the possibility of integrating lidar data (3-dimensional XYZ point positions) of the Providence River shoreline with bathymetry (water depth) data.

The CRMC had recently acquired a survey boat well-equipped to acquire underwater measurements such as sounding against digital charts of local waters, water current speeds, high-resolution sonar imaging of the ocean floor, and sedimentary profiles beneath the sea floor. What the agencies needed was additional technology to be installed on the boat that could simultaneously measure the harbor environment above the waterline while bathymetric readings were collected under the waterline.

Study site



Overview of lidar data acquired

In particular, the CRMC specified the following requirements for the lidar survey instrument and resultant data for above-water measurement:

- The instrument must be useful in collecting long lines of data from a mobile platform
- The instrument should be able to revert to a stationary position to fill in details blocked by obstructions
- The instrument should allow for data collection at long ranges
- Data must be sufficiently dense to support analysis of beach erosion and deformation monitoring (that is, approximately 20 points per square meter or 0.1 m between points and free of shadowing)
- Lidar data can be integrated with bathymetry data collected from the boat or obtained from the state archives (secondary objective)
- Lidar data should be as accurate as possible to accommodate the wide range of accuracy expected in bathymetry data.

Survey-grade data of New Providence River bridge

Set-up and pre-scan preparation – Day 1

(Time: Approximately 7 hours)

Set-up and preparation for first-time installation included:

- Mounting the POS and positioning the ILRIS HD scanner onto the boat (1 hour)
- Calibrating the POS (4 hours)
- Performing a quick ILRIS HD test scan (20 min)
- Receiving GPS base station coordinates and generating the SBET and other calibration numbers (50 min) for processing the ILRIS HD data acquired on the next day.

The ILRIS HD scanner and POS were secured to a custom-made mounting platform attached to the roof of the boat's cabin. ILRIS HD was positioned to scan from the port side of the boat, at approximately 90° to the vessel's traveling direction.

Photo of unloading facility

Scanning and data processing – Day 2

(Time: Approximately 5 hours)

Highlights of the scan in progress (4 hours):

- Re-mounting the POS and ILRIS HD onto the boat (1 hour)
- Scans 1-2: Performed at a fairly constant speed of 2.5 knots
- Scan 3: Speed was increased to 5 knots, 12 knots, and then to approximately 17 knots near the end of the scan
- Completing 4 scans of the shoreline along the circuit of Providence Harbor (3 hours).

Data processing at an impressive speed after the 3-hour scan (35 minutes):

- Downloading data from the GPS station at the dock (20 minutes)
- Processing the lidar data on the boat using PolyWorks software (15 minutes).

Lidar image of unloading facility

Immediate results

- Clients could observe the 3D point clouds of the above-water environment immediately after data processing on the boat (within 35 minutes after the scan)
- At the end of the survey, ASCII XYZi files were delivered to clients on the same day as data collection
- Total size of the delivered lidar data was 132.4 MB, with an average XYZ file size of 26.5 MB each
- Spatial details rendered visible were impressive: footings of an old tank farm on the east side of the river were now apparent—a detail that had not been visible to the naked eye because of surrounding vegetation
- Optech's ILRIS technician incorporated sample bathymetry data into the ILRIS HD lidar data, except for a slight offset in the Z vector that, researchers speculated, could be corrected without much difficulty.

Potential of the ILRIS HD scanner and lidar data in coastal management and research

Within 35 minutes of the survey, observers from both the Coastal Institute and CRMC were excited to see the 3D point cloud images of above-surface details that the ILRIS HD captured. From this experiment, the ILRIS HD has fulfilled all of the agencies' primary requirements:

1) ILRIS HD can scan from a mobile platform and on a stationary position
2) ILRIS HD can scan at long range (over 1250 meters)
3) ILRIS HD can generate XYZ data (georeferenced lidar data) that is sufficiently dense to be used by the agencies to monitor shoreline stability and erosion in Providence Harbor.

The results of this experiment have also confirmed that the agencies' secondary objective—incorporating existing bathymetric data with ILRIS HD lidar data—is achievable.

The CRMC observers are confident that the quality of the ILRIS HD data would definitely support ongoing change-detection studies. A viable data set will support the argument to invest in lidar as a complementary technology to the remote sensing assets that agencies already have in place.

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