Florida Department of Transportation Research

Non-Contact Scour Monitoring for Highway Bridges

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Current Situation

Bridge scour occurs where bridge supports redirect the force of water currents, digging out the river or inlet bed and reducing the bearing capacity of the support. Bridge scour accounts for 52% of U.S. bridge failures. Increasing heavy rainfall and flood events that result in periodic higher river levels have likely increased bridge scour. Activities like dredging or seawalls that alter channel or shoreline shapes can also increase scour. In addition, bridge scour can be difficult to monitor. Instruments are available that can aid in detecting bridge scour, but the current state of practice relies primarily on visual inspection by divers, a method with its own limitations and worker hazards.

Flooding from a hurricane created heavy flows that created scours around the bridge supports.

Research Objectives

Florida Atlantic University researchers demonstrated a non-contact green laser-based scour monitoring technique that is safer and quickly deployable.

Project Activities

The researchers reviewed the literature for current remote scour detection methods. One group of methods requires sensors to be installed underwater near the structure of interest and have limited scope; they also have high installation costs and produce only limited information. Another group of methods, based on multi-beam sonar, can monitor scour over an extended area of riverbed, but the devices must be deployed on the water surface using a manned or unmanned floating platform, and the acoustic beams of these devices tend to be wide and miss potentially important finer evidence of scour. Thus, scour is still mostly detected by divers' visual inspection, which is time-consuming, potentially unsafe, laborious, and less cost-effective. Thus, the researchers' method could have important advantages over existing methods. The method uses a green laser like a laser range finder, but in a scanning mode so that it detects the shapes of surfaces, not just a single distance.

Therefore, the next phase of the project focused on making the laser-based system viable by determining the factors that affect its measurements and making the necessary corrections for the possible murkiness of natural waters (turbidity) and the way water can distort a beam of light (refraction). The researchers developed corrections for refraction through both air and water allowing accurate depth measurements and georeferenced data collection. These corrections are critical because it is desirable to use the system on a floating platform to acquire a 360-degree view of the river or channel bed near bridge supports. For turbidity, the researchers examined the limits of the methods sensitivity with increasing turbidity.

The researchers next tested their method in laboratory and field experiments. The laboratory setup included developing a scour hole similar to natural ones based on published literature. In the lab, the green laser was able to map scour hole dimensions under varying turbidity conditions. Finally, the research team performed field testing near railroad and highway bridges in both stationary and stop-and-go operation, demonstrating the typical procedure to retrieve underwater topography and detect scour with the green laser mapping system.

Project Benefits

The method developed in this project may become a valuable new tool in determining bridge scour and ensuring timely maintenance and extended service life for Florida bridges.