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Ultrasonic welding of chemical optical sensors supporting O_2, pH and CO_2 imaging in microfluidic systems

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Abstract:

Scour monitoring, as part of bridge maintenance, can prevent scour-induced damage and failure of overwater bridges. Results from laboratory flume experiments aimed at evaluating two scour sensing schemes are presented. First, in-house piezoelectric sensing rods were driven into the soil surrounding a mock bridge pier. As the scour hole extended, the exposed length of the sensor changed, causing the flow-induced voltage signal to also vary. Scour depth at the sensor location was determined based on the fact that the natural frequency of the cantilevered sensing rod is inversely related to its length. The second sensing system utilized commercially available miniature dissolved oxygen (DO) probes. DO levels acquired from sensors installed at multiple depths along the buried length of the pier were used to obtain discrete measurements of the maximum scour depths. The measured DO increased to water DO levels once scour exposed the sensing tip of the probes to flowing water. The sensing concepts behind both scour monitoring schemes were confirmed through comparing the detected and observed scour depths. The PVDF-based sensors are designed to provide continuous scour depth measurements, as opposed to discrete ones offered by the DO sensing system. Following separate analyses of the results, future research was suggested for the two sensing techniques to gain a better understanding of their advantages, shortcomings, and potential applications.

Keywords: Bridge, Dissolved Oxygen, Piezoelectric, Scour, Sensor, Structural Health Monitoring