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Application of Statistical Process Control Methods to Strain Data from a Historic Steel Truss Swing Bridge

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ABSTRACT
The Rock Island Arsenal Bridge is a historic steel truss swing bridge built in 1896. The bridge was instrumented with a fiber optic strain and temperature structural health monitoring (SHM) system. Data collected during several months was temperature corrected and correlated with the bridge movements to extract features. These features represented the change in strain observed in the structure when the bridge swung open to allow barge traffic to pass beneath the bridge or locked in place again after the barge had passed. Interpreting the meaning of the data requires three steps: 1) detection of a deviation in the data features; 2) determination of likely source of deviation; 3) localization and quantization of any structural changes. The first step, discussed in this paper, was conducted by applying statistical process control (SPC) methods to the data. The goal of statistical process control is to detect deviations from the expected behavior of the structure using control charts and specified run rules that have statistical significance. The commonly used Nelson's Run Rules were used to in the control charts established for each data feature. Results showed that the behavior and configuration of the bridge were not as static but exhibited a number of stable and repeatable states beyond a statistically significant noise floor. Acceptance Control Charts were shown to work best for the SHM data collected.

KEYWORDS: