Structural Health Monitoring (SHM) is the sensing and analysis of a structure to detect abnormal behavior, damage and deterioration during regular operations as well as under extreme loadings. SHM is designed to provide objective information for decision-making on safety and serviceability. This research focuses on the SHM of bridges by developing and integrating novel methods and techniques using sensor networks, computer vision, modeling for damage indices and statistical approaches. Effective use of traffic video synchronized with sensor measurements for decision-making is demonstrated. First, some of the computer vision methods and how they can be used for bridge monitoring are presented along with the most common issues and some practical solutions. Second, a conceptual damage index (Unit Influence Line) is formulated using synchronized computer images and sensor data for tracking the structural response under various load conditions. Third, a new index, \( N_d \), is formulated and demonstrated to more effectively identify, localize and quantify damage. Commonly observed damage conditions on real bridges are simulated on a laboratory model for the demonstration of the computer vision method, UIL and the new index. This new method and the index, which are based on outlier detection from the UIL population, can very effectively handle large sets of monitoring data. The methods and techniques are demonstrated on the laboratory model for damage detection and all damage scenarios are identified successfully. Finally, the application of the proposed methods on a real life structure, which has a monitoring system, is presented. It is shown that these methods can be used efficiently for applications such as damage detection and load rating for decision-making. The results from this monitoring project on a movable bridge are demonstrated and presented along with the conclusions and recommendations for future work.

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The public is welcome to attend.