Intelligent Management, Maintenance, and Monitoring Technologies for Bridge Disaster Prevention

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To develop intelligent technologies for disaster protection and management of bridge structures, NCREE researchers have continually been involved in related studies, the implementation of bridge monitoring systems, and the applications of innovative inspection and investigation methods for structures.

Using long-term monitoring data and applying data science methods to analyze applicable parameters, key factors corresponding to the bridge inspection and monitoring procedures can be identified, and critical feedbacks from the monitoring information can be extracted. Further, the hardware architecture of the monitoring system can be made more lightweight, and the typical indicators related to structural safety, disaster prevention, or recovery can be quantified more precisely, which can be used to evaluate the overall health status of the bridge structure.

This study evaluates the application of data science methods to long-term bridge monitoring data and relevant field inspection or test data. The purpose is to extract critical information from the structural monitoring feedbacks to facilitate the use of the long-term monitoring system because constructing a representative data science model combined with a more economical monitoring system will help authorities expand the benefits of the monitoring system and refine life-cycle maintenance procedures. The contents and projects involved in the construction of the data science model for bridge monitoring data will continue to develop methods and procedures, and provide feedbacks to the research and development of long-term bridge monitoring technology in the field. In addition, the data science analysis will be beneficial for exploring the basic specifications and standards of the monitoring system, which can be used as a reference for developing technical manuals or guidelines for bridge monitoring. This study also anticipates potential combination of the technical development of strong seismic monitoring stations for domestic infrastructure with the provisional feedbacks to the research and development of structural system health diagnosis and safety assessment technologies in order to strengthen sustainable disaster prevention services. The light monitoring framework makes it easier for bridge authorities to use intelligent bridge inspection and monitoring technologies for disaster prevention, improving the efficiency of bridge maintenance and operations and extending the service life of bridges to ensure the safety of bridge users.

The research aimed to collect a large amount of data using experiments or field projects to survey and discuss the applicability of the data science models. For old bridges or bridges with unique structural systems, the field load test is a practical method to assess structural safety in detail. With the increasing trend in artificial intelligence inspired analysis, much data from field monitoring, inspection, or experiments can be reduced and transformed for evaluation via scientific data analysis

methods. We are now moving toward intelligent decision-making in bridge disaster prevention and management, ensuring bridge service safety during the bridge life cycle, achieving comprehensive life-cycle management and maintenance, improving bridge disaster prevention technology, and implementing field applications. This is the main part of the abstract. Please use font Times New Rome, size 10, and single spacing for your abstract. Please do not change the boundary of this document.

Figure 1. A Case of field bridge investigation operations, monitoring system and testing experiments.