Structural Damage Risk Assessment in Long-term SHM

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Keywords: SHM, FE Analysis, Bayesian Inference, Fragility Curve

【Background】

Structural Health Monitoring (SHM) can be beneficial for structural performance assessment over time. However, the SHM results are subject to uncertainties because of sensor errors, environmental influences, etc. How to quantify the uncertainties or risks while using monitoring data to evaluate the structural damage and develop a proper risk assessment method becomes a key issue.

【Objective】

In this study, the monitoring system is implemented in a real cable-stayed bridge, and the cable monitoring data is used to quantify the environmental uncertainties. Based on Bayesian Inference, a general structural damage risk assessment method is proposed. In this method, more information is integrated and more convincing conclusions are provided, which will support decision-makers take timely and optimal decisions.

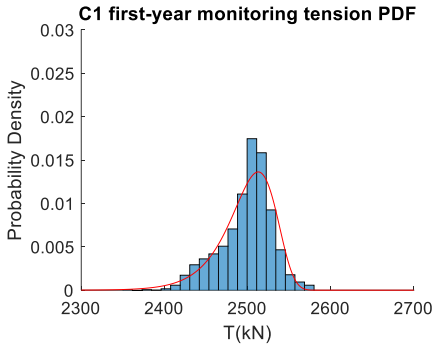
【Approach】

①Firstly, to quantify the uncertainties (except damage) affecting the cable tension during the bridge operation period, integrate one-year tension information into a probability density function (PDF). ② Secondly, build the finite element (FE) model to conduct the damage simulation and find the relationship between damage severity and tension variation. ③The tension probability distribution surface can be obtained by combining the tension variation curve in the FE damage simulation and the PDF of Long-term monitoring data. Each intercepted horizontal plane represents the damage distribution for a specific monitored tension. ④Finally, the cable damage probability for each monitored tension can be calculated and the fragility curve in the cable tension monitoring system is drawn, evaluating the risk of structural damage.

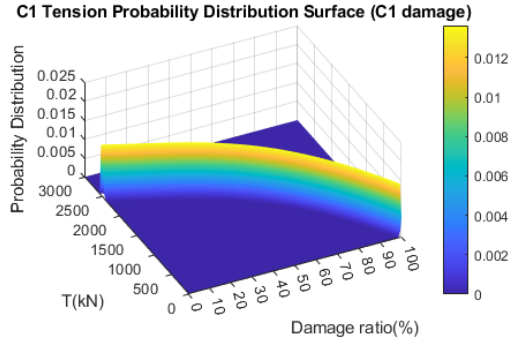
【Publication plan】

・R5 JSCE Annual Conference ・R5 JSCE Kansai Chapter Annual Conference

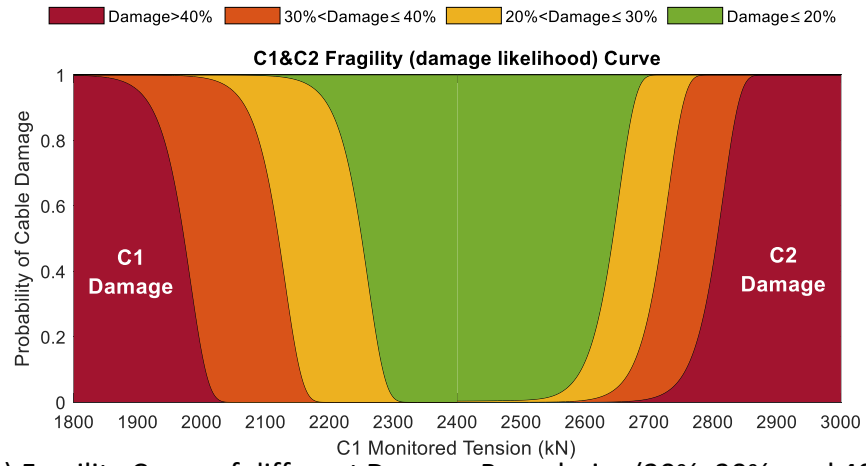
【Results】



(a) Monitoring Tension PDF



(b) Probability Distribution Surface



(c) Fragility Curve of different Damage Boundaries (20%, 30%, and 40%)