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Bayesian model update framework for actual bridges

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【Background】

In the next 20 years, the proportion of bridge infrastructures in Japan built over 50 years ago will increase at an accelerating pace. Many existing bridges require inspection and maintenance to repair possible degradation damages, while the shortage of human resources and increase in maintenance costs are inevitable problems. For many engineering considerations, it is desirable to effectively obtain a validated numerical model to evaluate the structural performance of early-built bridges.

【Objective】

This study aims to obtain a digital Twin finite element (FE) model that can be considered for several analysis purposes where the uncertainties of the model are reduced to a minimum and the simulation results agree with measurements. In this case study, uncertain model parameters of a continuous steel-concrete composite girder are estimated based on structural responses measured from the static loading test.

【Approach】

Bayes' theorem is used to quantify uncertainties of FE model parameters by inferring the posterior probability density function (PDF). A Transitional Markov Chain Monte Carlo (TMCMC) sampler is applied to generate samples for the representation of the posterior PDF. The relative errors of vertical displacements are considered in the goodness-of-fit function for nonlinear model updating.

【Publication plan】

- A journal paper on the linear and nonlinear model updating of a steel-concrete composite bridge.
- 25th International Summer Symposium of JSCE National Conference.

【Results】

Marginal PDFs of updated model parameters are estimated successfully. The error between the measured displacement and the simulated displacement using the updated FE model decreases significantly.