# Railway ballast damage detection following the Bayesian framework

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**Abstract**

The railway ballast is an essential component of the ballasted track system. Unlike other track components, such as the rails, fasteners, and sleepers, there is currently no commonly accepted non-destructive monitoring technique for the ballast under the sleeper. Under the action of repeated train load, the ballast particles at some regions will break down, and the capability of the ballast layer in supporting the sleepers and so as the rails will certainly be reduced (this is considered as ballast damage in this study). Furthermore, the ability of the system in resisting rail buckling may also be affected.

This seminar is about the feasibility study on the detection of ballast damage utilizing measured vibration of in-situ concrete sleeper following the Bayesian model updating method. Unlike the deterministic methods, which aim in pinpointing the values of model parameters, the Bayesian method focuses on calculating the posterior probability density function (PDF) of model parameters. It is well-known that the stress-strain behavior of ballast is nonlinear under large amplitude vibration. The proposed method will capture this behavior by the modified Ludwik model. As the ballast particles are of irregular shapes, the mechanical property of ballast is highly uncertain. To explicitly address the problem of high uncertainty in the model updating problem, the Markov chain Monte Carlo (MCMC) simulation is employed to generate samples for the approximation of the posterior PDF of ballast stiffness for the purpose of ballast damage detection.

**Biography of the speaker**

Ir Prof Paul Heung-fai LAM is currently Chair Professor (Pengcheng Scholar) in Harbin Institution of Technology (Shenzhen) and Associate Professor in City University of Hong Kong (CityU). His research interest is structural dynamics, vibration tests, modal identification, structural model updating and damage detection, Bayesian system identification, ballasted track modeling and its damage detection, design and analysis of wind turbines. Prof Lam has over 90 international journal papers published with over 30 keynotes and invited lectures. A total of over HK$45 million research grant has been funded.

Prof Lam is currently the President of the Hong Kong Society of Theoretical and Applied Mechanics (HKSTAM), and the Chairman (Education and Training) of the Hong Kong Construction Metal Structures Association (HKCMSA). He is also a committee member of the Structural Division of Hong Kong Institute of Engineers (HKIE). In 2013, Prof Lam was elected as the General Secretary of the International Steering Committee (ISC) of the East Asia-Pacific Conference on Structural Engineering and Construction (EASEC), which is one of the most important structural engineering conference series in the region. Furthermore, he is a committee member of ASCE Engineering Mechanics Institute (EMI) in both the “Structural Health Monitoring and Control” and “Dynamics” Committee.