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The Origins of Measurement Uncertainty in SHM—NPL Footbridge Case Study

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This paper explores the effects of measurement uncertainty in structural health monitoring (SHM) applications. Uncertainty quantification is an essential part of effective design of next generation SHM systems for smart asset monitoring. Conventional measurement uncertainty analysis which is based on the GUM (Guide to the expression of uncertainty in measurement [1]) cannot straightforwardly be applied to long-duration time series data such as arise in SHM applications. We therefore discuss some alternative approaches and make recommendations for best practice in interpreting SHM datasets. This work is based on experimental data from a well-established monitoring system installed on a concrete reinforced footbridge at the UK's National Physical Laboratory (NPL). Some challenges in the development of a methodology for quantifying measurement uncertainty for civil engineering applications at sensor level and system level are described. The footbridge dates from 1960 but is no longer in use and has undergone deliberate damage and repair cycles over the period of two years, 2010-2011. The data obtained during different stages of progressively increasing damage give a unique opportunity to explore the question of the minimum level of damage that can be reliably detected for a specified degree of accuracy. Our investigation is at the early stages. Therefore only initial findings will be presented.

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