Computer-based planning of structural health monitoring

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Summary

The Collaborative Research Centre (CRC) 477 at the Braunschweig University of Technology investigates and optimizes innovative methods for structural health monitoring (SHM). Its main target is the development and optimization of inspection and monitoring strategies. In project field A1 of the CRC, a framework for risk-orientated planning of SHM is developed. The basis of the framework are probabilistic models of the concerning structure, which are analysed with reliability methods. Recommendations for the monitoring process can be derived from the results of the analyses. Vice-versa data from SHM is used to assess the safety of the structure anytime during its usage. This paper describes the methodology of the framework which is currently implemented in the program system called PROBILAS. It will assist engineers in the assessment of structures and the planning of monitoring measures.

Keywords: Risk; Reliability; Structural Health Monitoring; Software;

1. Introduction

Accidents, natural phenomena or ageing processes are often followed by damages in structures. This can have significant economical and environmental consequences, e. g. if the structure is not useable for a certain time. The users are endangered when a critical limit state which can lead to a collapse is reached. In Germany, most elements of the infrastructure are investigated for critical damages during regular inspections, in most cases every 6 years. In cases where damage is growing rapidly or after heavy accidents extraordinary inspections are carried out. It would be helpful if the structure itself was able to signal whether a critical state is reached and that an inspection is required. In addition, the amount of money needed for restoration measures could be reduced, when damages would be detected early enough to carry out rehabilitation measures. Structural health monitoring (SHM) can help to detect faults before they reach a critical extent. In combination with an assessment procedure, data from SHM can be used to estimate the actual safety of the structure independently of predefined inspection intervals.

The benefit of SHM has also downsides. First, SHM is expensive and the assessment of results from SHM requires advanced knowledge of the behaviour of structures and of the capability of sensors. Additionally, SHM produces large amounts of data, which makes an automatic treatment of the data necessary.

The work of the collaborative research centre (CRC) 477 at the Braunschweig University of Technology addresses many problems regarding SHM. The CRC explores and develops innovative methods and optimizes inspection and monitoring strategies. In project field A1 of the CRC, a framework for the risk-orientated planning of SHM measures was developed. It is able to consider different failure modes, spatial variability and natural uncertainty. The identified weak points and the uncertain information are summarized in a risk-orientated probabilistic model, which is ideally

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