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Material Fatigue Testing and Analysis as a Measurement Instrument of the Failure-Free Load Level of Steel Specimens

Statistical modelling of material fatigue supports the development of technical products to achieve a design which reliably withstands field load but avoids over-engineered and further unnecessary weight, energy consumption, and consequently, life cycle costs. In this relation, the process of statistical modelling contains test planning, model selection as well as parameter estimation. Several combinations of methods for test planning as well as analysis have been compared and treated as different measurement instrument with respect to the detection of the failure-free load level. The accuracy of the failure free level has been decomposed into true-ness and precision to detect potentially biases of the investigated methods more specifically. The results of the uncertainty measurements have been combined with aspects of effort into a desirability function which allows to tailor the selection of an appropriate case-specific combination of planning and analysis methods. An application example is shown based on material data from an engine component.

References:

Haselgruber, N., G. Oertelt and K. Boss (2025): Comparison of Material Fatigue Testing Strategies regarding Failure-Free Load Level of Steel Specimens using Bootstrapping and Statistical Models. *Procedia Computer Science* 253 (323-335). Elsevier Publishing: 10.1016/j.procs.2025.01.095.

Special/ Invited session

Classification

Both methodology and application

Keywords

Reliability, Material Fatigue, Modelling

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Track Classification: Reliability and Safety