Statistical Methods in Structural Fatigue

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Abstract:
Because of the scatter of fatigue test data, statistical methods are required for the interpretation of the data. A method, which features the Weibull distribution as the basic statistical model, is analyzed. This point estimation method is applicable in cases where the sample sizes are relatively large. Methods for estimating the parameters for the two and three parameter Weibull distributions are summarized. Furthermore, estimates of the confidence intervals for the parameters in the case of the two-parameter family are presented. The paper is a state-of-the-art summary of the methods of employing the Weibull distribution for analysis of experimental data with emphasis on practical application.

Subject Headings: Parameters (statistics) | Statistics | Fatigue (material) | Fatigue tests | Field tests | Confidence intervals | Case studies

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In materials science, fatigue is the weakening of a material caused by repeatedly applied loads. It is the progressive and localized structural damage that occurs when a material is subjected to cyclic loading. The nominal maximum stress values that cause such damage may be much less than the strength of the material typically quoted as the ultimate tensile stress limit, or the yield stress limit. Key words: fatigue, aircraft, aircraft structures, cyclic loading, crack initiation, finite element method, numerical simulation. 15. Introduction. S. EVERAL different analysis procedures are currently available for use in uniaxial fatigue life evaluations. Fatigue design against crack initiation may lead to different material selection criteria and structural design from fatigue design against crack propagation. The aim of the study is to define a complete procedure for fatigue life prediction of structural elements up to crack initiation. The procedure for fatigue life estimation is based on combining computation stress analysis with strain-life methods. Methods for stress analysis that will be used here are analytical and FE method.