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基于FEM-NN-MCS模拟应力集中系数的结构可靠性分析

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FEM-NN-MCS-Based Estimation of Stress Concentration Factors in Reliability Analysis

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摘要

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摘要 在机械结构可靠性分析中,由于应力集中系数的预测精度直接影响可靠性分析与计算结果,可见应力集中系数(SCF)是最主要的参数之一。采用理论方法通常很难获得应力集中系数,因此目前主要采用实验方法。采用实验方法尽管可以较精确地获得应力集中系数的数值解,但不能直接给出基本随机变量和应力集中系数之间的关系,为进一步的可靠性分析带来困难。作为可供选择途径,使用有限元法(FEM)获得应力集中系数的数据库,采用神经网络方法模拟应力集中系数,用BP神经网络建立结构的输入和输出关系,在此模型上,将MonteCarlo和可靠性理论相结合,提出了解决应力集中情况下的结构可靠性问题的分析方法。

关键词: 应力集中系数 有限元法 神经网络 可靠性分析

Abstract: The stress concentration factors (SCF) is one of the most important parameters in reliability analysis of mechanical structures, because the precision of the SCF predicted would affect the computation results of reliability analysis directly. Generally, the SCF is difficulty to be obtained adopting theoretical method, and at the present time some experimental methods are usually adopted. Although the numerical solution of the SCF can be obtained accurately applying the experimental methods, the relation between the basic random variables and the SCF can't be given directly and which will bring some difficulties for the further reliability analysis. As an alternative approach, the finite element method (FEM) is used to gain the SCF database, and the neural network (NN) has been developed to simulate the explicit expression of the SCF based on the database obtained by FEM. Then the back-propagation (BP) artificial neural network are used modeling the relation of structural input and output, using this model. Monte Carlo and the reliability theory have been combined to solve the structural reliability problems in the case of the stress concentration.

Keywords: stress concentration factors FEM neural network reliability analysis

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