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油管漏磁检测的有限元建模技术研究

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摘要
有限元法广泛应用于石油管道缺陷漏磁场分析，成为替代物理试验，获得大量缺陷漏磁信号的有效手段。该文阐述了如何用有限元方法建立漏磁检测仿真模型。根据漏磁检测设备相关参数，建立静态和瞬态有限元仿真模型。通过对励磁磁场的均匀性、检测速度和缺陷尺寸3种影响因素的仿真分析，比较了静磁场模型和瞬态模型的仿真结果和效率。静磁场模型求解效率高、占用的计算资源少，但是随着检测速度的增大，求解结果明显偏高。瞬态模型没有速度带来的误差问题，但耗费大量的计算资源，仿真时间大大增加。给出了用静磁场模型分析钢管缺陷漏磁场应满足的条件。

关键词 漏磁检测 有限元法 控制方程 静磁场模型 瞬态模型

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Research on Finite Element Method Modeling Techniques of Magnetic Flux Leakage Testing for Oil Pipe

Abstract
Finite element method (FEM) is commonly used in analysis of magnetic flux leakage (MFL) of defect of oil pipe. It is effective implement to obtain large numbers of MFL signals for constructing database instead of using experimental method. According to actual parameters of inspection equipment, magnetostatic and transient finite element models are established. Parameters of exciters, inspecting velocity and size of defects are analyzed using two models respectively. By analyzing both static and transient simulation results, limitation that uses magnetostatic model to simulate MFL of defects of oil pipe is concluded. When velocity of pipe is over 5m/s, simulating with magnetostatic model suffers somewhat inaccuracy. Although accurate results are usually obtained with transient model, too many computational costs are necessary. At last, the requirements of using magnetostatic model to simulate MFL of defects in steel pipe are presented.

Key words magnetic flux leakage testing finite element method control equation magnetostatic model transient model

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