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过程系统工程

具有工况适应性的管道泄漏信号特征提取

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摘要

基于神经网络的管道泄漏检测的关键是特征量的提取。以基于压电式动态压力传感器的管道泄漏信号暂态过程为研究对象，分析了不同工况下首、末站泄漏信号的差异，介绍了基于小波分解的泄漏信号增强方法。提出了把动态压力信号作正负区间划分、把相邻区间信号累加值差分、相邻区间信号均值差分和相邻区间信号峰值差分作为泄漏信号识别特征的特征量计算方法和相对量化方法，分析了泄漏信号特征量的横向、纵向合理性评判依据，并以此对从实际泄漏信号中提取得到的特征量进行了检验，验证了特征量提取方法的合理性。最后，给出了以首、末站特征量共同作为输入的神经网络管道泄漏诊断模型及其训练、检验结果。长期的管道泄漏实时监测结果表明，所提出的泄漏信号特征提取方法具有较强的工况适应性，为原油输送管道泄漏的鲁棒诊断提供了较好的技术手段。

关键词 管道泄漏 特征提取 信号增强 工况适应性 神经网络模型

分类号

Features extraction of pipeline leak signal with operational conditions adaptability

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Abstract

The key technique for neural network based pipeline leak detection is features extraction. In this paper，piezoelectric dynamic pressure based leak signal transient was chosen as research object，the differences between leak signals of upstream and downstream under different operational conditions were analyzed，and leak signal enhancement with wavelet decomposition was introduced. Positive and negative interval divisions of dynamic pressure signal was proposed. The differences of weighted signal sums，signal mean values，signal peaks of every two successive intervals were selected as the features of leak signal，and their calculations and relative scaling transformations were presented. The feasibility criteria for lengthwise and breadthwise evaluation of leak signal features were presented，and evaluation was done with features extracted from field data and the feasibility was verified. At last，a neural network based leak diagnose model with both features from upstream and downstream and its training，testing results were given. Long term and real time monitoring of pipeline leak showed that the features extraction methodology proposed here had reasonable operational conditions adaptability，and provided an encouraging technical support for robust diagnosis of pipeline leakage.

Key words pipeline leakage features extraction signal enhancement operational conditions adaptability neural network model

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