多相流和计算流体力学

基于子波能量特征的气液两相流流型辨识方法

周云龙, 王强, 杨志行, 孙斌, 陈晓波, 王丽媛

东北电力大学动力系

摘要

气液两相流的流型影响着两相流的流动特性和传热特性，同时也影响着流动参数的准确测量以及两相流系统的运行特性。针对压差信号的非平稳和非线性特点，尝试利用Hilbert-Huang变换(HHT)和小波包分解对差压波动信号进行信号处理，进而建立流型的子波能量（IMF能量和小波包能量）特征，并以此特征向量作为Elman神经网络的输入量，从而实现对流型的智能识别。实验结果表明：这两种特征向量与Elman神经网络结合都能够较准确地识别出4种流型，并且各自都有不同的优缺点。另外与BP神经网络相比，采用Elman神经网络进行流型识别可以获得更高的识别率。

关键词　　流型识别　Hilbert-Huang变换　小波包　Elman神经网络

分类号

Identification of gas-liquid two-phase flow pattern based on wavelet energy feature

ZHOU Yunlong,WANG Qiang,YANG Zhihang,SUN Bin,CHEN Xiaobo,WANG Liyuan

Abstract

Gas-liquid two-phase flow pattern affects the characteristics of flow and heat transfer of a two-phase system, the performance characteristics of such a two-phase system, and the exact measurement of flow parameters. Aimed at the nonlinear and non-stationary characteristics of pressure difference signal, Hilbert-Huang transform(HHT) and wavelet packet transform were used to decompose the pressure-difference fluctuation signals and obtain the wavelet energy (IMF energy and wavelet packet energy) features of various [HJ*3/5]flow patterns. The IMF energy eigenvectors and wavelet packet energy eigenvectors were input into the Elman neural network, and flow regime intelligent identification can be performed. The experimental study showed that these two eigenvectors combined with the Elman neural network could accurately identify the four flow regimes and each method shows its merit and shortcoming. In addition, the result of flow regimes identification by using the Elman neural network was compared with that by using the BP neural network, which showed that the Elman neural network [HJ]had higher identification accuracy than the BP neural network.

Key words　 flow regime identification　 Hilbert-Huang transform　 wavelet packet　 Elman neural network

DOI:

 通讯作者 周云龙 zyl@mail.nedu.edu.cn