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多相流和计算流体力学

水平气液两相流流型空间图像信息复杂性测度分析

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摘要 为了考察从图像灰度序列提取的复杂性测度与气液两相流流型变化之间的关系，本文首先从高速摄影系统拍摄的60种流动工况下水平管内气液两相流流型图像中提取了三种复杂性测度（Lempel-Ziv复杂度，分形盒维数，Shannon信息熵），在此基础上研究了不同表观气速下三种复杂性测度的混沌动力学特性，以及对气液两相流流型的表征能力。实验结果表明：三种复杂性测度均能敏感地指示出流型的变化；通过对三种复杂度随两相流流动参数变化规律分析，可以得到气液两相流动力学结构反演特征，为揭示气液两相流流型转化机理和定量识别流型提供了一种有效的辅助诊断工具。

关键词

气液两相流 流型图像 Lempel-Ziv复杂度 分形盒维数 Shannon信息熵

分类号

Analysis of complexity measures of gas-liquid two-phase flow pattern image in horizontal pipe

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Abstract

To discuss the relationship between complexity measures extracted from gray image time series and flow pattern transition in gas-liquid two-phase flow，three complexity measures，including Lempel-Ziv complexity，fractal box dimension，and Shannon information entropy were extracted from sixty flow pattern image signals of gas-liquid two-phase flow in the horizontal pipe by using digital high speed video systems.Based on the above studies，the chaos dynamic characteristics of three complexity measures in different gas superficial velocities，and the recognition capability of gas-liquid two-phase flow pattern were analyzed.The results indicated that these three complexity measures were sensitive to the flow pattern transition in gas-liquid two-phase flow.By analyzing the changes of three complexity measures with gas-liquid two-phase flow parameters，the dynamics structure inversion characteristics of gas-liquid two-phase flow could be got，which provided an efficient，supplementary diagnostic tool to reveal the flow pattern transition mechanism of gas-liquid two-phase flow and quantitatively identify flow pattern.

Key words

gas-liquid two-phase flow flow pattern image Lempel-Ziv complexity fractal box dimension Shannon information entropy

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