

多相流

气液两相流差压测量波动信号的符号序列统计分析

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收稿日期 2006-1-20 修回日期 2006-5-8 网络版发布日期 2007-3-9 接受日期

摘要 将符号时间序列分析方法应用到两相流测量波动信号分析, 并讨论了关键参数对符号统计量影响问题。在此基础上, 利用垂直上升管中采集到的80组气液两相流差压动态波动信号, 提取了时间不可逆性 T_{fb} 及 χ^2_{fb} 统计量。当气相表观速度小于 $0.02 \text{ m} \cdot \text{s}^{-1}$ 时, 随着气相表观速度增加, 泡状流随机可变的运动特征逐渐加剧, 其动力学特性变得相对复杂; 当气相表观速度大于 $0.02 \text{ m} \cdot \text{s}^{-1}$ 时, 在流型从泡状流向段塞流转变过程中, 随着气相表观速度增大, 流型演化的动力学特性逐渐变得相对简单; 在流型从段塞流向混状流转变过程中, 随着气相表观速度增加, 混状流的动力学特性逐渐变得愈加复杂。研究表明, 时间不可逆性 T_{fb} 及 χ^2_{fb} 统计量两个符号是表征气液两相流流型的敏感特征量, 考察这两个统计量随两相流流动参数变化规律有助于更好地理解两相流流型动力学特性。

关键词 [气液两相流](#) [流型表征](#) [符号时间序列分析](#) [时间不可逆性](#) [\$\chi^2_{fb}\$ 统计量](#)

分类号

Symbolic sequence statistical analysis of differential pressure measurement fluctuating signal of gas/liquid two-phase flow

Abstract

Symbolic sequence analysis method was applied to analyze two-phase flow measurement fluctuating signals and some issues about selecting key parameters which were used in the algorithm were discussed. Based on the above study, we gathered eighty groups differential pressure fluctuating signals of gas/liquid two-phase flow in vertical upward pipes and extracted the time irreversibility and chi-square statistics. The study indicates when the gas superficial velocity is less than 0.02 m/s , the dynamic character of bubble flow becomes complex with the gas superficial velocity increasing. When gas superficial velocity exceeds 0.02 m/s , the dynamic character becomes relatively simple from bubble flow to slug flow and the dynamic character becomes more and more complex from slug flow to churn flow with the gas superficial velocity increasing. This shows that time irreversibility and chi-square statistics can reflect the evolution character of gas/liquid flow patterns, and is a supplementary tool to understand two-phase flow pattern phenomena.

Key words [gas/liquid two-phase flow](#) [flow pattern characterization](#) [symbolic time series analysis](#) [time irreversibility](#) [chi-square statistics](#)

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