Public Abstract

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Title:Numerical investigation of two phase flow using automatic controller system and chaotic approach

An automatic and intelligent system to recognize the two-phase water-air flow regime in a vertical tube based on fuzzy logic and genetic algorithm is proposed. Two approaches, volume of fluid (VOF) and Eulerian model, were used for the numerical simulation of gas-liquid two-phase flow. Four different turbulence models were employed. Image processing procedure was implemented to obtain the flow pattern. It was found that the fuzzy logic code predicts the flow pattern well. In addition, investigation of chaotic flow in a two and three dimensional closed loop pulsating heat pipe has been carried out numerically. Constant temperature and heat flux boundary conditions have been applied for the heating (evaporator) section and only constant temperature for cooling (condenser) section. Water and ethanol were as used as working fluids. Volume of Fluid (VOF) method has been employed for two-phase flow simulation. Volume fraction of liquid and vapor in the pulsating heat pipe was investigated under different operating conditions. Approaches such as spectral analysis of temperature time series, correlation dimension, autocorrelation function, Lyapunov exponent and phase space reconstruction were used to investigate chaos in the pulsating heat pipe. Thermal resistance behavior was analyzed with respect to heating power and optimal points were found in case of thermal performance of the pulsating heat pipe. Spectral analysis of temperature time series using Power Spectrum Density showed existence of dominant peak in PSD diagram indicates periodic or quasi-periodic behavior in temperature oscillations at particular frequencies. Correlation dimension values for ethanol were higher than water under the same operating conditions. High values of correlation dimension referred to high frequency, small scale temperature oscillations, caused by miniature bubbles or short vapor plugs dynamically flowing in PHP tubes. Decay of autocorrelation function with respect to time indicated finite prediction ability of the system. Change in working fluid did not lead to any particular conclusion for ACF behavior. An O-ring structure pattern was obtained for reconstructed 3D attractor at periodic or quasi-periodic behavior of temperature oscillations.