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2012 AASRI Conference on Modeling, Identification and Control

The Flow Pattern Transition Identification and Interphases Force Detection of Gas-Liquid Two-Phase Flow

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Abstract

In this study, the gravity differential pressure fluctuation signal of Gas-liquid two-phase flow in horizontal pipeline was researched. it had no effect on the on-way resistance, and directly related to phase holdup of two-phase flow, and could reflect the variation of interphases force. The characteristic parameters of differential pressure signals were extracted by wave analysis, which was sensitive to the conversion from stratified flow to annular flow, so it proved a new way to flow pattern identification for gas-liquid two-phase flow and provided a strong evidence to reveal the flow pattern transition mechanism of gas-liquid two phase flow.

Keywords: gas-liquid two phase flow; interphases force; wave analysis; pattern transition

1. Introduction

The gas-liquid two-phase flow phenomenon exists in nature and modern industrial processes widespread, and that is closely related to the human being's life and production. The flow pattern, which is the distribution of the phase interface in the two flow media, has a great influence with the flow characteristics and the heat and mass transfer characteristics; meanwhile, it also affects the precious measurement about the flow parameters and the operating characteristics of two-phase flow system. As a result, the study of the flow pattern of the gas-liquid two-phase flow has an important practical value and academic significance; it has been therefore an important topic of the research field in gas-liquid two-phase. There are many parameters to reflect the flow pattern changes, such as void fraction, temperature signals, pressure, differential pressure, conductivity and so on. In the references [1-9] all the differential pressure signal parallel to the horizontal flow direction has been analyzed, which has been used widely in the identification of the flow pattern. However, those have been researched under the typical flow pattern in the laboratory, few for the flow pattern transition. In 2008, Li De Fang et al., [10] have proposed one method to identificate the transition by combining characteristic of PSD and relative statistical variance. In the paper, the object to be analyzed is also the gravity differential pressure fluctuation signal perpendicular to the flow direction in horizontal pipe. Because the pressure direction is perpendicular to the flow direction,

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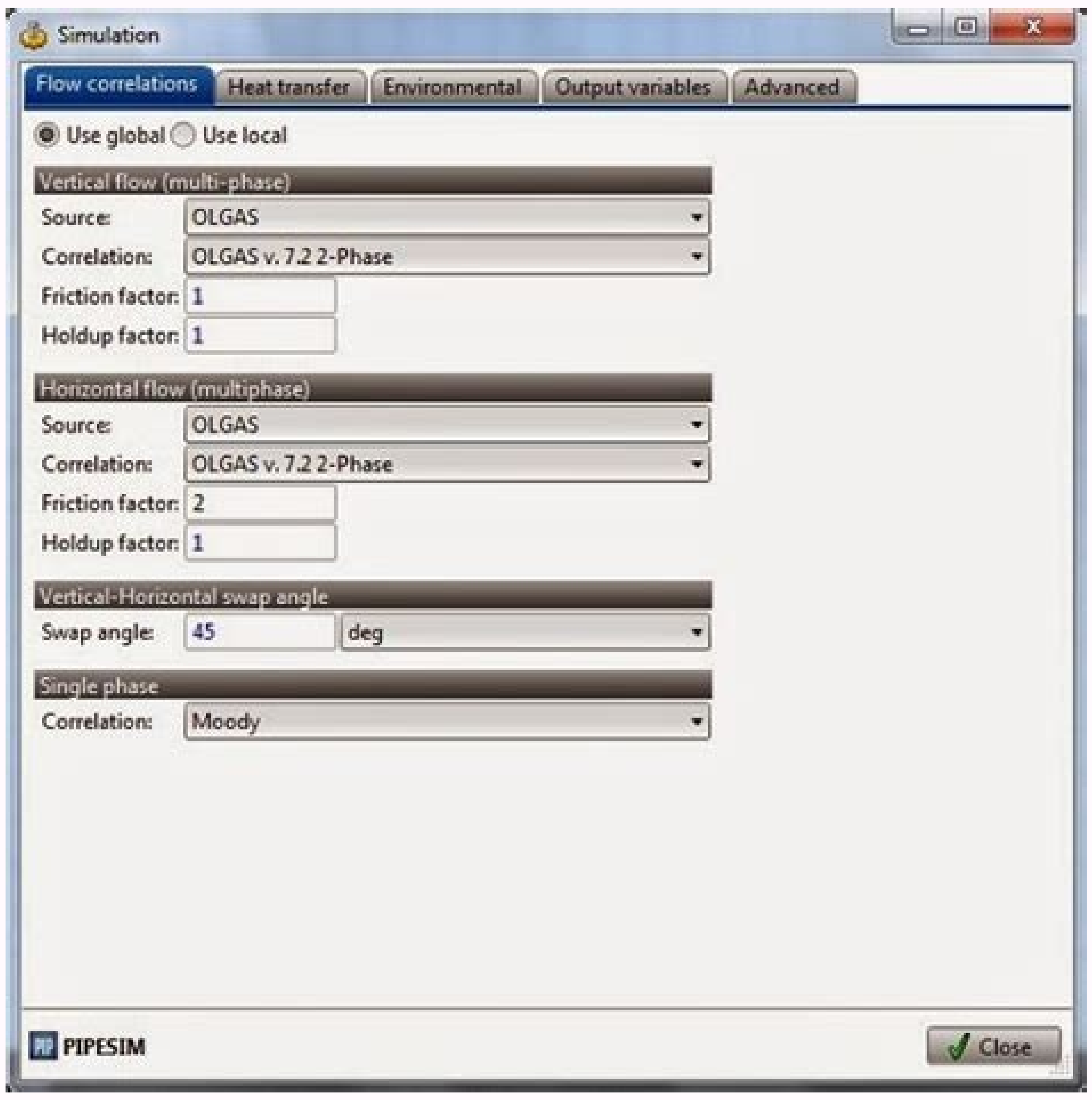
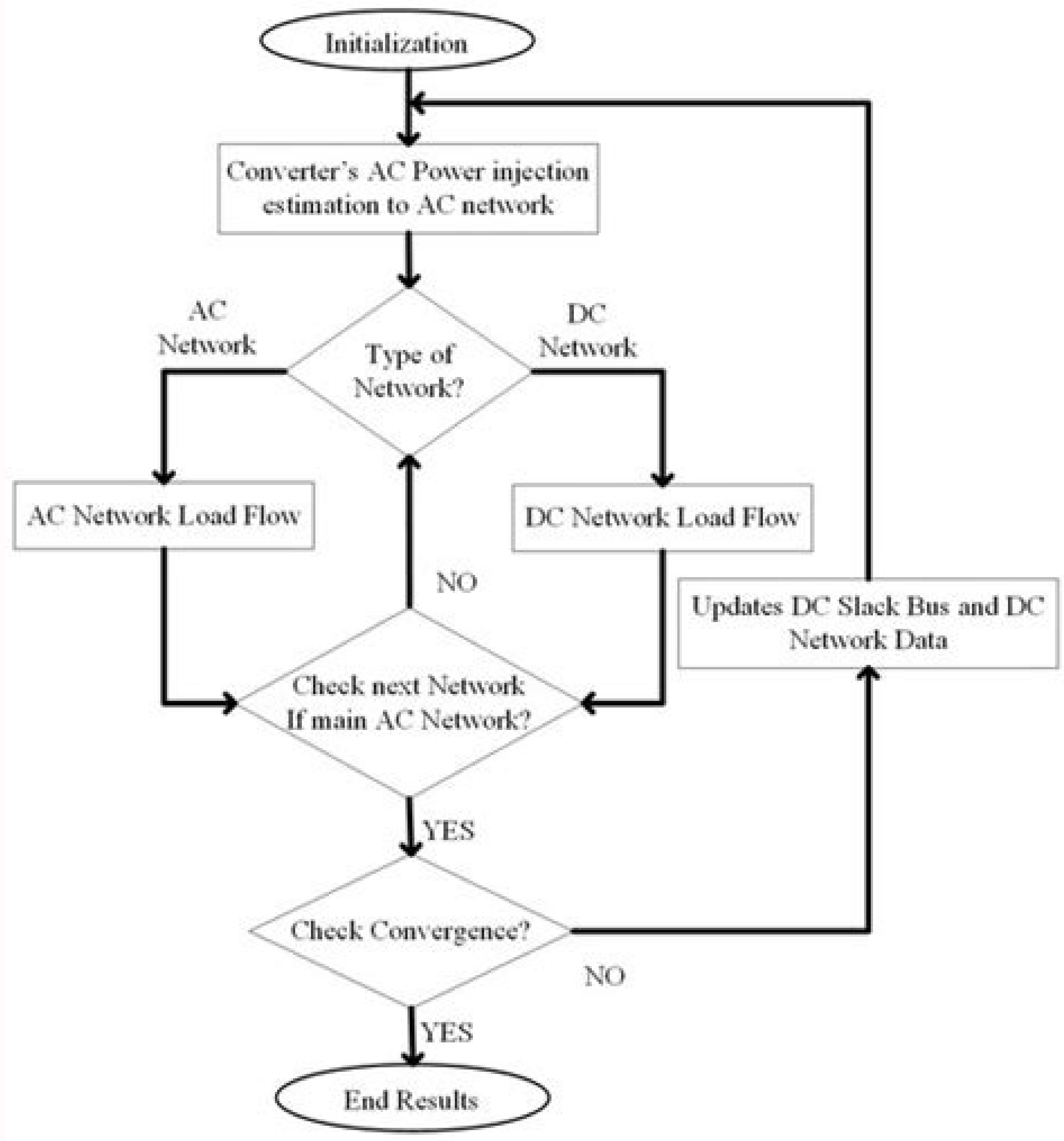
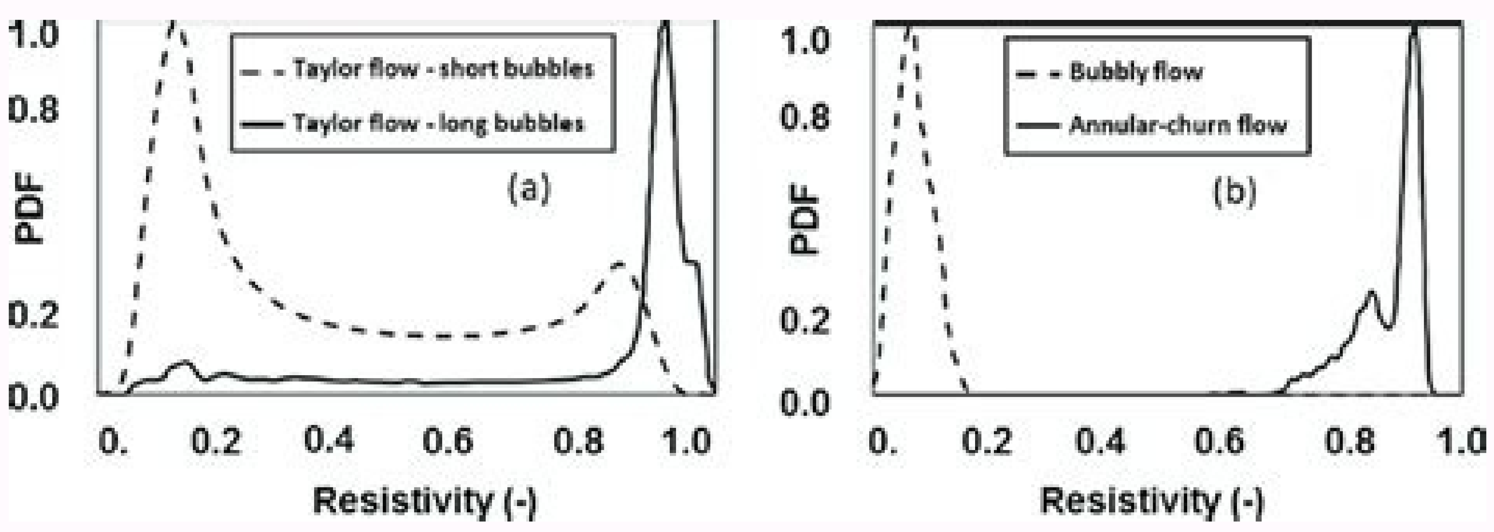
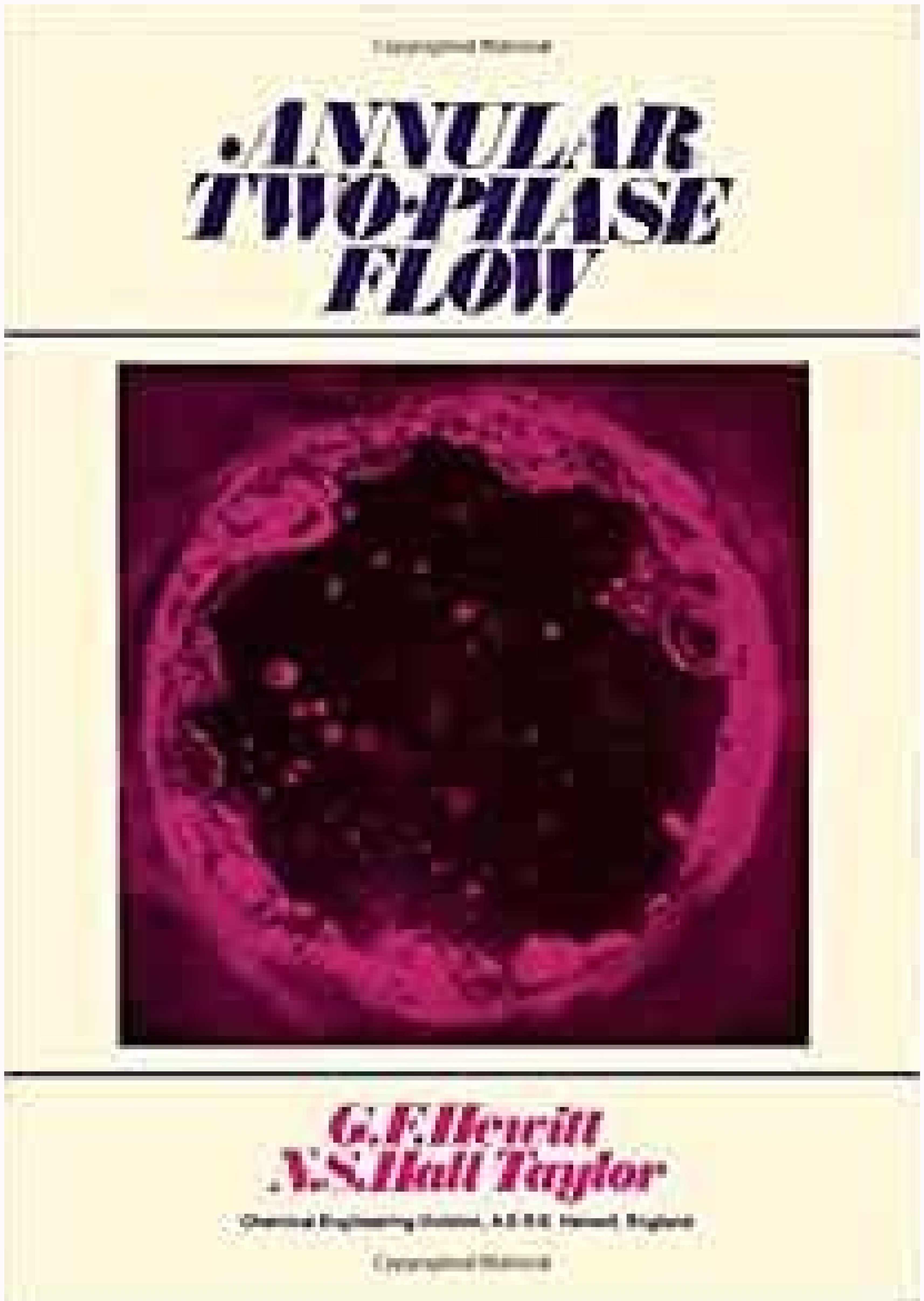
doi:10.1016/j.aasri.2012.11.084









Professor Hewitt's contributions to the field have been recognised by his election to the Royal Academy of Engineering (1985), the Royal Society (1990), and the US National Academy of Engineering (1998) in addition to several international awards including Donald Q. Heat transfer in annular flow 10.1 Introduction 10.2 Heat Transfer through the Liquid Film 10.2.1 Heat Transfer in the Absence of Nucleation 10.2.2 Onset and Suppression of Nucleate Boiling 10.2.3 Heat Transfer in the Presence of Nucleation 10.3 Temperature Difference Across the Interface in Evaporation or Condensation 10.4 Heat and Mass Transfer in the Gas Core11. Introduction2. This book discusses as well the simple modes for annular flow with consideration to the calculation of the profile of shear stress in the liquid film. Stability Against De-Wetting 7.1 Introduction 7.2 The Effects of Flow on Re-Wetting 7.2.1 Wetting in Annular Flow 7.2.2 The Stability of Rivulet Flow 7.3 Film Breakdown Under Conditions of Heat and Mass Transfer 7.4 The Role of Nucleate Boiling and "Sputtering" in the Wetting of Hot Surfaces 7.5 Conclusion8. Regimes of Flow 2.1 Introduction 2.2 Flow Regimes in Vertical Flow 2.3 Flow Regimes in Horizontal and Inclined Flow 2.4 Flow Regime Maps 2.5 Flow Pattern Transitions in Vertical Flow 2.5.1 The Bubbly Flow-Slug Flow Transition 2.5.2 Flooding and Flow Reversal 2.5.3 The Slug Flow-Churn Flow Transition 2.5.4 The Churn Flow-Annular Flow Transition 2.5.5 Transition to Wispy-Annular Flow 2.6 Regimes of Flow in a Boiling Channel3. Book sale: save up to 25% on individual print and eBooks with free delivery. Parametric trends in variations of disturbance wave properties are analyzed using the non-dimensional numbers; liquid phase Reynolds number (Re f), gas phase Reynolds number (Re g), Weber number (We) and Strouhal number (Sr). He has had a wide experience of industrial application through extensive consultancy and contract work and through his founding of the Heat Transfer and Fluid Flow Service (HTFS) at Harwell and Hexxcell Ltd., a spin-out of Imperial College London operating in the area of heat transfer and energy efficiency. Empirical Relationships for Annular Flow 5.1 Introduction 5.2 Empirical Correlations Inherently Based on the Triangular Relationship 5.2.1 Simplified Form of the Triangular Relationship in Terms of Friction Factor 5.2.2 Empirical Correlations Relating Pressure Drop and Void Fraction 5.2.3 Comparison of Empirical Correlations with Experimental Data 5.3 Gas Phase Distribution and Interfacial Interaction 5.3.1 Gas Flow Distribution 5.3.2 Correlation Between Interfacial Roughness and Film Thickness6. Page 2 Simple Momentum and Energy Balances and their Applications 3.1 Introduction 3.2 Single-Phase Flow 3.2.1 Force (Momentum) Balance for Single-Phase Flow 3.2.2 Single-Phase Energy Balance 3.3 Two-Phase Flow 3.3.1 General Momentum and Energy Balances for Two-Phase Flow Systems 3.3.2 Separated Flow Models 3.3.3 Separated Annular Flow with Liquid Entrainment 3.3.4 Experimental Determination of Individual Components of Pressure Gradient 3.4 The Homogeneous Model 3.5 The Lockhart-Martinelli Model 3.6 Pressure Losses in Expansions, Contractions, Orifices, Bends and Valves 3.6.1 Pressure Change at a Sharp Expansion 3.6.2 Pressure Change at a Sudden Contraction 3.6.3 Two-Phase Flow through Orifices 3.6.4 Flow in Bends, T's, Valves, etc. More detailsAnnular Two-Phase Flow presents the wide range of industrial applications of annular two-phase flow regimes. Disturbance wave velocity, frequency, amplitude and wavelength are estimated from the liquid film thickness measurements by following the statistical analysis methods. Drops in annular two-phase flow. At each pressure condition liquid and gas phase flow rates are varied over a large range so that the effects of density ratio, liquid flow rate and gas flow rate on disturbance wave properties can be studied systematically. The final chapter deals with the techniques that are developed for the measurement of flow pattern, entrainment, and film thickness. The Creation and Behavior of Entrained Droplets in Annular Flow 8.1 Introduction 8.2 Mechanisms of Droplet Entrainment 8.2.1 Wave Entrainment 8.2.2 Entrainment by Release of Bubbles 8.3 Onset of Droplet Entrainment 8.3.1 Definition of the Point of Onset of Entrainment 8.3.2 Experimental Observations of the Onset of Droplet Entrainment 8.3.3 Dimensional

Analysis of the Onset of Liquid Entrainment 8.4 Observations and Correlations of Entrained Fraction 8.4.1 Effect of Liquid and Gas Flowrates on Liquid Entrainment 8.4.2 Correlation of Entrained Fraction 8.5 Distribution of Entrained Droplet Flow 8.6 Droplet Size and Breakup 8.7 Droplet Mass Transfer 8.7.1 Introduction 8.7.2 Particle Deposition: General 8.7.3 Measurements of Droplet Interchange Rate in Annular Two-Phase Flow 8.7.4 Droplet Mass Transfer in the Absence of Re-Entrainment9. This book discusses the fluid dynamics and heat transfer aspects of the flow pattern. Interfacial Waves 6.1 Introduction 6.2 The Kelvin-Helmholtz Instability 6.3 The Critical Layer 6.4 The Effect of Viscosity 6.5 An Example of an Interfacial Stability Calculation 6.6 Wave Velocity 6.7 Experimental Observations of the Interface in Annular or Stratified Flow 6.7.1 Vertical Upward Co-Current Annular Flow 6.7.2 Vertical Annular Flow (Co-Current Downwards) 6.7.3 Horizontal Parallel Flow 6.7.4 Horizontal Annular Flow7. In 2007, he was presented the Global Energy Prize by Vladimir Putin at the World Economic Forum.Emeritus Professor of Chemical Engineering, Imperial College, London, UKWrite a reviewThere are currently no reviews for "Annular Two-Phase Flow" Access through your institutionVolume 17, Issue 1, January–February 1991, Pages 59-76 91)90070-JGet rights and contentView full text Disturbance waves play an important role in interfacial transfer of mass, momentum and energy in annular two-phase flow. In spite of their importance, majority of the experimental data available in literature on disturbance wave properties such as velocity, frequency, wavelength and amplitude are limited to near atmospheric conditions (Azzopardi, B.J., 1997. Experimental Techniques for Annular Flow 12.1 Introduction 12.2 The Determination of Flow Pattern 12.2.1 Photographic Methods 12.2.2 Pressure Drop Methods 12.2.3 Probe Methods 12.3 Measurements of Liquid Film Thickness 12.3.1 Film Average Methods 12.3.2 Localized Methods 12.3.3 Point Methods 12.4 Measurements of Entrainment and Droplet Size 12.4.1 Measurement of Total Entrainment Flow 12.4.2 Sampling and Isokinetic Probe Studies 12.4.3 Droplet Size Measurement 12.5 Pressure Drop MeasurementNomenclatureReferencesAppendix: S.I. Unit Conversion Table for Chemical EngineeringIndexLanguage: EnglishCopyright: © Pergamon 1970Published: December 17, 1970Imprint: PergamoneBook ISBN: 9781483285238Professor Hewitt is an Emeritus Professor of Chemical Engineering at Imperial College London. 3.7 Critical Two-Phase Flow 3.7.1 Overall Models 3.7.2 Detailed Examination of Interface Heat and Mass Transfer Processes4. Finally, the existing correlations available for the prediction of disturbance wave velocity and frequency are analyzed and a new, improved correlation is proposed for the prediction of disturbance wave frequency. International Journal of Multiphase Flow, 23, 1–53). Other chapters consider the single momentum and energy balances, which illustrate the differences and analogies between single- and two-phase flows. Professor Hewitt has worked on a variety of subjects in the general field of chemical engineering but his speciality for several decades now has been in mutliphase flow systems, with particular reference to channel flow and heat transfer. He has published many papers and books in this industrially important area and has lectured on the subject widely throughout the world. No promo code needed. Introduction to Two-Phase Heat Transfer 9.1 Vapour-Liquid Equilibrium 9.2 Vapour Generation and Boiling 9.2.1 Bubble Nucleation 9.2.2 Bubble Growth and Departure 9.2.3 Terminology Used in the Description of Boiling 9.2.4 A General Qualitative Description of Pool Boiling 9.2.5 Forced Convective Boiling 9.3 Condensation 9.3.1 Droplet Nucleation 9.3.2 Modes of Condensation10. Simple Analytical Models of Annular Two-Phase Flow and their Applications 4.1 Introduction 4.2 Single-Phase Flow 4.3 Application of Single-Phase Flow Concepts to the Prediction of Annular Two-Phase Flow 4.3.1 Evaluation of Interfacial Shear Stress 4.3.2 Shear Stress Distribution in the Liquid Film 4.3.3 Velocity Profile and Mass Flowrate in Laminar Film Flow in a Vertical Tube 4.3.4 Velocity Profile and Mass Flowrate in Turbulent Film Flow 4.4 Applications of the Smooth Film Theories 4.4.1 Direct Tests of the Triangular Interrelationship between Liquid Film Flowrate, Liquid Film Thickness and Pressure Gradient 4.4.2 Minimum Pressure Drop and Zero Wall Shear Stress 4.4.3 Flooding 4.4.4 Empirical Correlation of Flooding for Liquids of Low Viscosity 4.4.5 Results and Correlations for Viscous Liquids 4.5 Horizontal Annular Flow (Liquid Film Distribution)5. Burnout 11.1 Introduction 11.2 Comparison of Burnout in Pool Boiling and Channel Flow 11.3 Studies of Mechanisms of Burnout in Annular Flow 11.3.1 Visual Studies 11.3.2 Liquid Film Flowrate Measurement 11.3.3 The Entrainment Curve and its Applications 11.3.4 Droplet Deposition Control 11.4 Parametric Effects 11.5 Burnout Correlations for Water 11.5.1 Burnout Correlations for Water Flow in Vertical Round Tubes 11.5.2 Rectangular Channels 11.5.3 Annuli and Rod Bundles12. This book is a valuable resource for chemical engineers.Preface1. This text then examines the various regimes of two-phase flow with emphasis on the regions of occurrence of the annular flow regime. A liquid film thickness is measured by two flush mounted ring shaped conductance probes located 38.1mm apart. Kern Award by AIChE (1981), Max Jakob Award by ASME (1995), and the Luikov Medal by ICHMT (1997). In view of this, air–water annular flow experiments have been conducted at three pressure conditions (1.2, 4.0 and 5.8bar) in a tubular test section having an inside diameter 9.4mm. The new correlation satisfactorily predicted the current data and the data available in literature. Organized into 12 chapters, this book begins with an overview of the classification of the various types of interface distribution observed in practice.