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Company	NRG
Internal / External	External
Starting date	Any time
Exp./Num./Design	Numerical

Available for ME-SET

TU/e EINDHOVEN UNIVERSITY OF TECHNOLOGY

Project number: 58

Towards Data-Driven Modelling of Turbulent Two-Phase Flows with Large Interfaces

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INTRODUCTION

The Nuclear Research and Consultancy Group (NRG) is responsible for a continued nuclear research effort in the Netherlands. An important part of this research is dedicated to improving Nuclear Reactor Safety (NRS) using Computational Fluid Dynamics (CFD) tools.

Figure 1: The research reactor at Petten.

Modelling two-phase flows is of great importance in nuclear engineering applications. Examples of such applications include modelling Pressurized Thermal Shock (PTS), Emergency core cooling (ECC), and accident atmospheric transport. In most of these applications, multiphase flows exhibit a turbulent behaviour. The nature of turbulence can vary significantly depending on the two-phase flow regime (e.g., disperse, bubbly, slug, or annular regime). Hence, predicting such flows is a challenging task that is subject to active research. NRG, in collaboration with other research partners, is developing numerical models that can predict such two-phase flow phenomena.

This graduation project focuses on the modelling of interfacial turbulence in stratified gas-liquid flows.

/ POWER AND FLOW

Heat and mass transfer across the gas-liquid interface is dominated by turbulence at the interface. Therefore, predicting phenomena such as air entrainment or condensation requires an accurate estimation of interfacial turbulence.

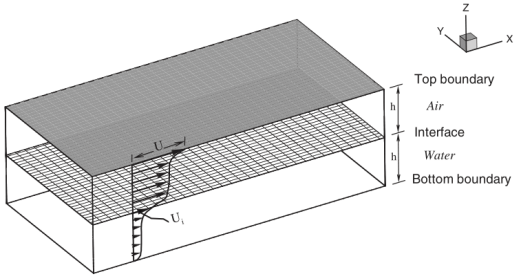

Figure 2: Illustration of a stratified gas-liquid flow

First, using direct numerical simulation (DNS), a database on detailed quantities of stratified two-phase channel flow will be generated. Next, this database will be used to address the discrepancies in the existing Reynolds-averaged Navier-Stokes (RANS) turbulence models for two-phase interfacial flows. The results of this project will support the development of data-driven machine-learning-based turbulence models for two-phase turbulent flows.

OBJECTIVES

- Extracting turbulent statistics that can be used to quantify the discrepancies between RANS model predictions and the DNS data
- Conceptualizing a data-driven strategy to improve RANS models based on the DNS data

APPROACH

- Familiarize yourself with the theory
- Learn the use of the CFD tools
- Perform DNS and RANS simulation of turbulent stratified two-phase flow
- Extract and analyze the flow statistics

The project location can be either at NRG's site in Petten or at Eindhoven University of Technology in Eindhoven. NRG offers a monthly allowance, as well as compensation for housing and transportation for the period of your stay.