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Master Thesis

Development and Test of an EMMS-Based Drag Model for Fluidized Beds

Onkar Shivaji Mohite

Computational Science and Engineering
Matriculation register: 61884

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Supervisor:
Dr. Massoud Massoudi

1st Examiner:
Prof. Dr. Bernd Meyer

2nd Examiner:
PD Dr.-Ing. habil. Andreas Richter

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Declaration

I hereby declare that I completed this work without any improper help from a third party and without using any aids other than those cited. All ideas derived directly or indirectly from other sources are identified as such. This declaration also refers to the representation of figures and visual material.

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Summary

Fluidisation is a phenomenon where a gas-solid mixture under certain conditions acts like a fluid with fluid like properties. This process of fluidisation occurs in a fluidized bed where the solid particulate matter is being passed by pressurized gas. Fluidized beds are used for several purposes like in reactors, catalytic separators, combustors, etc. as the high surface area contact and intermixing in the gas-solid mixture causes the interaction between two physical substances to increase. Due to the heterogeneous nature of the mixture, the two-fluid model for analysing the flow behaviour inside a fluidized bed is not accurate. For this a new drag model called as Energy Minimization Multi-Scale (EMMS) was suggested. This work deals with the development and validation of the EMMS drag model for different types of fluidized beds like bubbling, turbulent and circulating fluidized bed. For CFD simulations Fluent 19.2 was used while the EMMS drag coefficients were calculated by using python code.

Contents

Symbols

Symbol	Description	Unit
x	position	m
v	velocity	$\mathrm{m\,s^{-1}}$
a	acceleration	$\mathrm{m\,s^{-2}}$
t	time	s
F	force	N

Abbreviations

CFB Circulating Fluidized Bed
CFD Computational fluid dynamics
DEM Discrete Element Method
DNS Direct Numerical Simulation
EFM EMMS-based multi-Fluid Model
EMMS Energy Minimization Multiscale
FCC Fluid Catalytic Cracking
KTGF Kinetic Theory of Granular Flow
TFM Two-Fluid Model

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Probably the most important aspect of CFD is selecting the boundary conditions, appropriate models and a solver. In CFD, the geometry of the model is divided into cells and discretized differential equations are solved. Before starting the simulation the geometry boundaries are initialised by field values known as initial conditions. Boundary conditions represents the behaviour of the equations to be solved at the limits of the geometry. The solution is then iteratively solved for field values on all the cell locations.

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A. Appendix: Example

A.1. example diagram

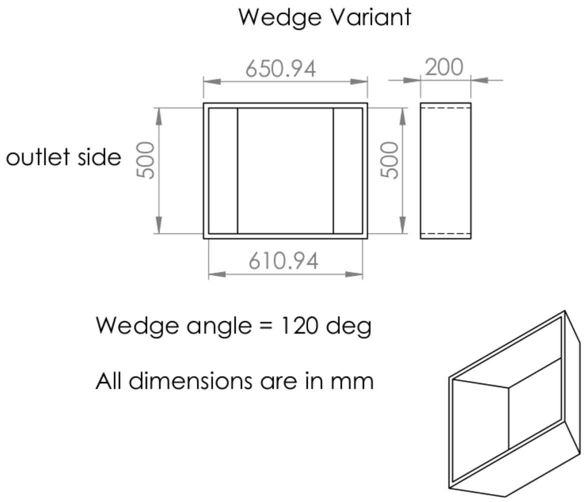

Fig. 1.: example diagram

Citing all the references: [8] [6] [17] [27] [20] [18] [22] [5] [11] [25] [28] [29] [26] [1] [16] [15] [12] [14] [10] [7] [2] [13] [9] [21] [23] [4] [3] [24] [19]