MSc Project proposal (2 students)

Correlations for the hydrodynamics of spouted bubbling fluidized beds using CFD, ANNs & experiments

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Figure 1. **Design - Cold fluidized bed setup [1]**

Introduction

Fluidized beds have been studied for multiple decades as alternative reactors for energy conversion and fuel generation from a wide variety of feedstock. There are various kinds of physics that are relevant in a fluidized bed, namely hydrodynamics, heat & mass transfer, and chemical kinetics. Several experimental and computational models have been defined to correlate the interplay of these physics. However, despite several correlations being employed, there is still a need to provide simplistic models to study the various interactions between the physics and chemistry involved for industrial-scale reactors. This is especially the case for spouted bubbling fluidized beds.

Background of ideal candidates

Pursuing MSc studies in EFPT (3mE), Chemical Engineering (Applied Sciences), Computer Science (EWI), Biomass track (SET).

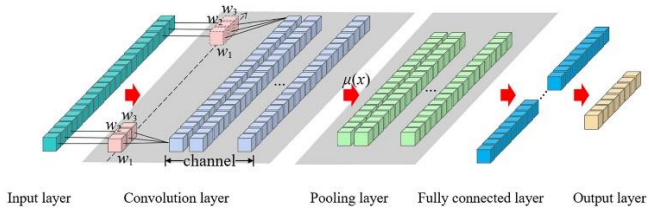

Figure 2. **CNN used for bubbling fluidized beds [2].**

Goal

The main aim of this collaborative project is to develop a one-dimensional lumped model by combining physical conservation equations with artificial neural networks (ANNs). The idea of this model is to enhance the speed of calculations instead of employing full-scale 3D CFD calculations, which is useful for engineering calculations and the design of control systems for industry-scale applications. This model will then be validated using experiments.

To generate training data for the ANNs, a two-fluid CFD model will be used, which will then been validated using lab-scale experiments. Thus, one of the students will be involved in the assembly of the experiments and performing in-depth measurement campaigns, while the other will assist in creating an ANN from CFD data.

Experimental work:

- Assembly of cold fluidized bed setup using help from lab technicians & GIDARA Energy.
- Measurement campaigns and validation studies with ANN developed model.

Computational work:

- Creating an ANN from two-fluid model CFD data.
- Validate results with experimental measurements.

Final outcome

The final results are to be published in a conference in September 2024.

Sources

[1] Halliwell, B., "Design of a Modular, Cold Fluidisation Bed", BSc thesis, 2023
[2] Zhong, H. et al. (2023). Development and Evaluation of Deep Learning Models for Predicting Instantaneous Mass Flow Rates of Biomass Fast Pyrolysis in Bubbling Fluidized Beds. Industrial & Engineering Chemistry Research.