Proposal for Master thesis

**Topic:** The use of GHz radar in measurement of solids flows

In recent research at Chalmers, it has been demonstrated that submillimeter wave radar can be used as an effective tool to investigate industrial processes in fluidized bed reactors. Fluidized bed techniques are used in many application areas connected with green energy production and circular resource flows.

**Measurement of the solids circulation in circulating fluidized beds**

The solids circulation is a key parameter in the closure of mass and solids balances in circulating fluidized bed (CFB) units, but very hard to estimate and monitor through current measurement techniques. Radar technology combines measurement of both solids concentration and velocity and thus opens the door to accurately determining the solids circulation. However, the optimal placement of the radar and the methodology for the data processing need to be studied.

The aim of the work is to gain understanding of the optimal radar placement, set-up and data processing in order to provide accurate measurement of the solids circulation in CFB units. The cold flow model at the Chalmers lab is unique not only in that it resembles the design and flow of commercial-scale CFB boilers but it also allows direct measurement of the solids circulation through an automated fluidized and instrumented valve in the cyclone leg. This enables validation of the different estimations of the circulating solids flow provided through the radar measurement and thus optimization of the latter.

The thesis can be performed individually or in pairs.

Location: Emerson office in Mölnlycke and Chalmers

**Contact information**

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Radar-based measurement of the solids circulation in circulating fluidized beds

Fluidized bed technology find application in several industries, ranging from energy conversion and CO₂ capture, to chemicals synthesis, metallurgy, and catalytic cracking, and pharmaceutics. While fluidized bed reactors are key elements in the development and performance of new processes, especially in the fields of carbon capture and conversion of biomass into chemicals and fuels, their design and operation is highly challenging. The main complexity lies in that the overall performance of the unit is governed by highly chaotic interactions with the surrounding gas and other solids. To tackle this, measurement of the solids flow is desired, but historically there has been a lack of experimental techniques able to characterize the solids flow pattern accurate enough.

Recent advances at Chalmers have demonstrated that THz-radar can provide non-intrusive accurate and well-resolved measurements of the solids under flow conditions and geometries relevant or industrial conditions. The present MSc thesis is framed within a collaboration between Chalmers and Emerson to develop the measurement technique, and deals with the application of novel THz-radar technology to describe solids dynamics in fluidized beds. A unique scale model resembling a commercial (220 MW) FB biomass boiler will be used for this purpose. The student/s will be directly involved in planning and performing experiments and processing and analysis of collected data. The methods developed are expected to have a significant impact in the understanding of the solids flow governing the performance of fluidized bed reactors for biomass conversion and CO₂ capture.

Eligibility
MSc student with a technical background
Skills in signal processing are valued, but not strictly required.
Skills in LabView and MatLab are valued, but not strictly required.

Aim
Assessment and optimization of a novel radar-based measurement technique.

Content
Literature reading, acquaintance with measurement method and experimental unit, adequation of experimental unit, experimental campaign, data processing, analysis of results

Organization
1-2 students. Flexible working time with weekly supervision meetings.

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