# Experimental Data of the PhD Thesis:

**TOWARDS TOMOGRAPHY-CONTROLLED MULTIPHASE FLOWS**

**A STUDY OF THE DYNAMICS AND REAL-TIME CONTROL IN GAS-LIQUID AXIAL CYCLONE SEPARATORS**

The data uploaded in this repository is related to the TU Delft PhD thesis *Towards Tomography-Controlled Multiphase Flows. A Study Of The Dynamics And Real-Time Control In Gas-Liquid Axial Cyclone Separators*, by Matheus Martinez Garcia. The dissertation is focused on the proof of concept of tomography-based real-time control of an axial cyclone. The data uploaded in this repository corresponds to the figures of the thesis, being described below for each chapter. The whole dataset consists of excel files (.xlsx). Details about the experiments performed can be found in the thesis and excel files.

1. Chapter 1 corresponds to the thesis introduction, and contains no data.
2. Chapter 2 is focused on the experimental facility and real-time electrical resistance tomography algorithm developed for the real time control demonstration. The chapter showed that:
   * In the experimental facility, one ASV Stübbe MV 310 DN25 pneumatic diaphragm valve is installed in the LPO of the axial cyclone, and one ASV Stübbe MV 310 DN50 pneumatic diaphragm valve is installed in the HPO of the axial cyclone. These valves are used to manipulate the separation performed by the axial cyclone. A hysteresis in the control pressure-valve opening relation of both valves was experimentally measured, and presented in Figure 2.10. The plotted data is presented in the excel file “Chapter 2 - Control Valves.xlsx”
   * Since the LPO valve is used to control the separation, its dynamics was measured for sine inputs of different amplitudes, and presented in the Bode plot of Figure 2.11. The plotted data is presented in the excel file “Chapter 2 - LPO Dynamics.xlsx”
   * A centrifugal pump is used to create the liquid flow rate in the experimental facility, which results in the coupling between the pressure downstream of the pump and the liquid flow rate created by the equipment, determined by the pump speed. Since the liquid flow rate and pressure are coupled, changes in the pressure of the flow loop in the generation of process disturbances and tomography-based control result in changes in the liquid flow rate, that is always disturbed during the tomography-based control experiments. The pressure-liquid flow rate relation of the experimental facility pump was measured, and presented in Figure 2.12. The plotted data is presented in the excel file “Chapter 2 – Pump.xlsx”.
   * An application-specific electrical resistance tomography algorithm was developed to measure the gas core in the cyclone upstream of the pickup tube orders of magnitude faster than traditional general ERT algorithms, allowing the use of the distribution of phases for real-time process control. The data related to the image reconstruction algorithm and measurement delay, related to Figures 2.18, 2.19, 2.21, 2.22 and 2.23, can be found in the excel file “Chapter 2 – ERT.xlsx”.
3. The vertical upward swirling gas-liquid pipe-flow patterns are experimentally mapped for four swirl elements, and the flow pattern transitions mechanistic modelled, in chapter 3.
   * The data contained in the experimental flow pattern maps of chapter 3, corresponding to Figures 3.13, 3.14, 3.20, 3.21, 3.22 can be found in the excel file “Chapter 3 - Experimental Flow Pattern Maps.xlsx”.
   * The gas core diameter time-average, gas core diameter standard deviation, and interface friction factor of weakly oscillating columns are measured for different conditions to obtain correlations used in the proposed mechanistic models. The experimental data of Figures 3.16, 3.17 and 3.18, related to these quantities, can be found in the excel file “Chapter 3 - Core Diameter and Interface Friction Factor.xlsx”.
4. Chapter 4 investigates the relation between axial cyclone performance, time-average gas core diameter upstream of the pickup tube (measured by electrical resistance tomography) and time-average Pressure Drop Ratio, providing an approximation of the axial cyclone performance with process controllers which suppress (slow) process disturbances without acting on the flow pattern fluctuations. The entire dataset of the chapter can be found in the excel file “Chapter 4 - Complete Data.xlsx”.
5. The axial cyclone phase distribution dynamics and tomography-based real-time control are investigated in Chapter 5.
   * The phase distribution upstream of the swirl element, and at x=5.7D downstream of the swirl element, are presented in Figures 5.5-5.8, to show the intrinsic phase distribution dynamics due to the gas-liquid flow patterns. The data of these figures, and the cross-correlation plot of Figure 5.9, can be found in the excel file “Chapter 5 - Gas Fractions.xlsx”.
   * The gas fraction time-averages and standard deviations, and the delay between the wire-mesh sensor and camera that maximizes the cross-correlation for each point investigated, presented in Figure 5.10, can be found in the excel file “Chapter 5 - Cross-Correlation Delay.xlsx”.
   * The gas core dynamics upstream of the pickup tube, presented in Figure 5.12, can be found in the excel file “Chapter 5 - Gas Core Dynamics.xlsx”.
   * The gas core diameters upstream of the pickup tube related to the tomography-based controller implementation, presented in Figures 5.16, 5.18, 5.19, 5.20, are documented in the excel file “Chapter 5 - Tomography-Based Control.xlsx”.
6. Chapter 6 is the thesis Conclusion, and contains no data.

No research data was presented in the Appendices of the thesis.