Fluid Density Mapping with X-rays and γ-rays in Multiphase Pipe Flow

Figure 1. SINTEF Multiphase Flow Laboratory on the banks of the river Nidelven outside Trondheim.

Background

The life cycle of oil & gas fields starts and ends with flow assurance, or in other words multiphase transport. It covers the transmission of oil, gas and water in the same pipeline from the reservoir to the processing plant. Today, the industry can predict multiphase pipe flow using advanced simulators developed over many decades, mainly by Norwegian scientists. However, the new sophisticated mathematical models introduced into these simulators today require validation in terms of more detailed experimental data. In SINTEFs Multiphase Flow Laboratory, such data are acquired every year in industrially funded projects. We use a variety of instruments to measure key parameters in multiphase fluid pipe flow (pressure, temperature, flow rate, fluid density etc.).

Task

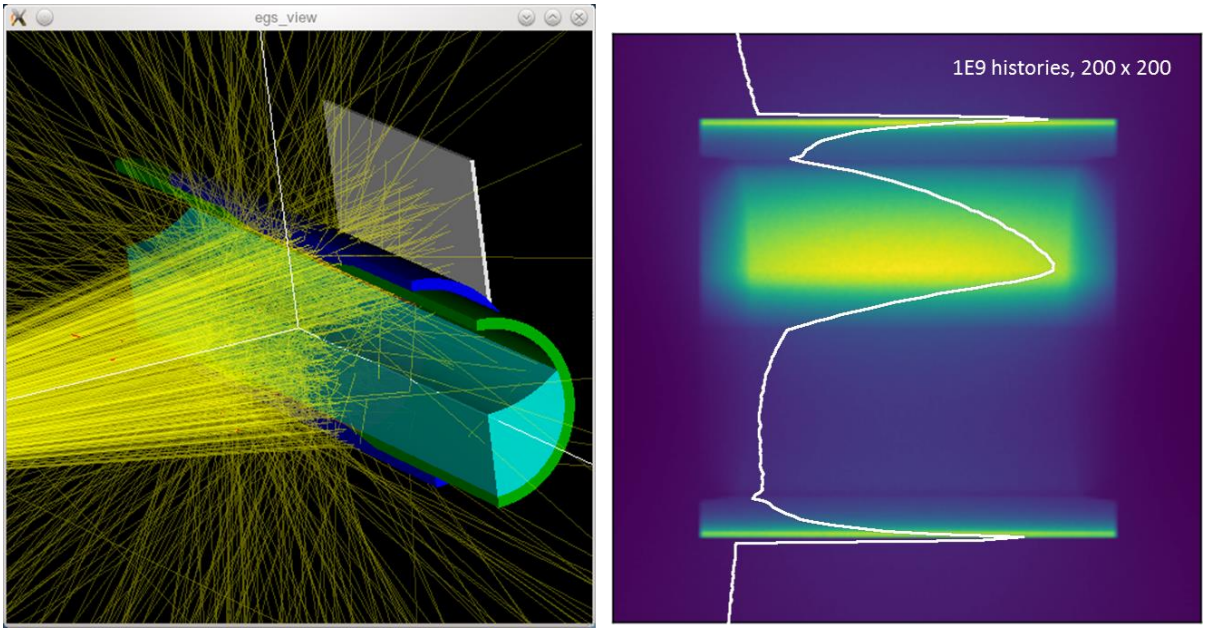

Figure 2. Initial result from EGSnrc simulations of X-ray transmission in an instrument set-up at the SINTEF Multiphase Flow Laboratory. Left: The yellow lines represents individual X-rays trajectories through a pipe spool containing air and water, with a curved air-water interface. Right: Map and profile representing energy deposition at the X-ray detector surface.

The main objective of the work is to set-up and optimize an established simulation tool (EGSnrc) for prediction of X-ray and γ-ray transmission through pipes containing gas, oil and water. EGSnrc is a toolkit for Monte Carlo simulation of ionizing radiation transport through matter. It models the propagation of photons, electrons and positrons with kinetic energies between 1 KeV and 10 GeV, in homogenous materials. Secondary objectives will be modelling of the X-ray detector response and conversion of energy deposition profiles into fluid density profiles. The work requires interest and skills within C++ programming and basic understanding of the physics of ionizing radiation and its interaction with matter.

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