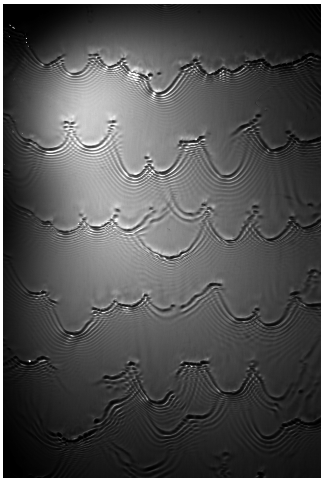
Counter-current turbulent gaz-liquid flows in channels are encountered in a wide variety of technological applications (evaporators, cooling towers, chemical reactors columns …). Complex surface waves arising from a primary instability of the liquid film (see figure) drastically intensify heat or mass transfer between the film and the surrounding gas. On the other hand, these patterns also affect the mechanical interaction between liquid film and gas flow, which may lead to critical conditions such as flooding, when liquid obstructs the entire channel cross-section, drastically increasing the pressure drop. The challenge is then to delay the flooding while sustaining the tranfers. A deep understanding of the fundamental mechanisms in play is then essential.

The aim of this experimental thesis project is to understand the dynamics of a falling liquid film submitted to a counter-current flow in a confined rectangular channel, using an experimental device with careful controlled boundary conditions. The overall goal will be to identify the key parameters that control the onset of flooding and to suggest strategies to delay the phenomenon in industrial processes.



Non-invasive optical techniques will be used to measure the liquid film thickness (synthetic Schlieren method, Chromatic Confocal Imaging method), the gas velocity (PIV) and the temperature field in the liquid phase (Liquid Cristal thermometry).

This study will take place within the framework of the ANR project entitled “WavyFilm”, in collaboration with Air Liquide’s Paris-Saclay Research Center and Laboratoire LIMSI in Orsay. A PhD thesis using a numerical approcach will be conducted in parallel in LIMSI laboratory.

Figure 1 : *Shadowgraph showing the free surface of a water film falling down an incline (flowing from top to bottom) and submitted to a counter-current air flow in a rectangular channel. The surface waves intensify inter-phase heat and mass transfer but are also responsible for flooding phenomenon.*