Modelling and Simulating Industrial Processes to Optimise Their Operations

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The InduStore project's objective is to reveal the flexibility potential of industrial plants. As the electricity prices become more and more volatile and hard to predict, the industrial sites are more willing to adapt their production to the price variations; the evolution of the electricity market also provides opportunities for the plant to increase the revenue in exchange of some services (such as reducing the total consumption). To this end, the plants must be completely modelled to globally optimise the use of energy: the production can be scheduled, while taking into account the various consumption profiles of the machines and guaranteeing the absence of shortage in the processes.

For example, a paper mill has different consumption profiles depending on the type of paper it is producing. This consumption comes from the various fans and burners that make it up. These various components could be actuated differently while still providing the same quality of paper in order to minimise the total electricity bill. The paper machines can also be turned off when the grid operator asks for it in order to provide *flexibility services* to the electrical grid operator.

A part of this project is to model the industrial processes of the plants. For optimisation purposes, the main tool is to simplify their behaviour and make a linear model. This approach is often sufficient for many processes, but some of them are too complicated. To keep the linearity of the model while having very complex behaviours, an idea is to simulate a representative set of evolutions of the process depending on the way it is controlled (e.g., for the paper machine, increase the use of a fan and simulate the effect on the drying). These scenarios could then be extrapolated by linearising the process around them.

The goal of this master's thesis is to simulate a series of modes of operations for industrial processes and to prepare their integration into the global plant model. The student is expected to have or to be willing to acquire good knowledge of power-intensive industrial processes (such as HVAC, electrical ovens, electrolysis) and an interest in optimisation.