

From experimentation to modeling via an iterative and collaborative teaching approach in food and bioprocess engineering

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The objective of this project developed in AgroParisTech is to implement an innovative pedagogical method whose aim is to clarify the **continuum between experimentation, data acquisition, modeling and simulation**. We wish to apply this methodology to the design of heat exchangers at different scales. Through this project, we would like to effectively weave links between experimentation at the laboratory and pilot scales, data acquisition, modeling and simulation.

To do this, we propose to set up a demonstrator based on the case of a well-known unit operation (heat exchangers). The steps of the method will be : (1) small-scale experimentation with real data acquisition; (2) numerical treatment of these data and comparison with a theoretical model; (3) enrichment of the model with the experimental data acquired; (4) simulation of the operation on a larger scale with use of correlations between adimensional numbers and (5) comparison with measurements obtained on a larger equipment already available in our pilot-plant laboratory.

The first point will be carried out in the form of practical work sessions using micro-pilot heat exchangers proposed by G.U.N.T company (Barsbüttel, Germany) specialised in the development of equipment for engineering education. The equipment acquired will therefore consist of various small heat exchanger modules (coaxial, multitubular and plate) connected to a data acquisition system and a supply unit of hot and cold fluids. The small size and the flexibility of use of these devices should hence allow students to obtain in a short time of experimentation a consequent experimental data base.

The other parts concerning data processing, modelling and simulation will be carried out in the form of tutorial sessions with the objective of developing digital notebooks in Jupyter ecosystem using Python as programming language.

The main impact of the project is the alignment of our pedagogical method with the reality of practices observed in the industrial and research worlds in process engineering applied to food and bioproducts. It seems obvious that the experimental and theoretical tools developed during the project can be applied in a second phase to the case of other unit operations.