SMART frameworks for bioreactor assessment

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Description

Computational Fluid Dynamics (CFD) has proved to be an effective tool for engineers to design and assess the performance of different pieces of equipment. In biotechnology, this tool coupled with a kinetic model allows us to estimate not only the flow patterns but the gradients of chemical species within bioreactors (i.e., Computational Reaction Dynamics) [1-3]. These gradients may play an important role in determining the efficiency of the process since the microorganisms will adapt themselves upon the fluctuations within their environment [4, 5]. Mitigating those fluctuations is the basis of the down-top design approach. However, its extensive implementation is hindered by the inherent demands of time and computational resources of the traditional CFD-CRD software packages. Various methods have been proposed as CFD substitutes, from compartment models to neural networks [6 - 10].

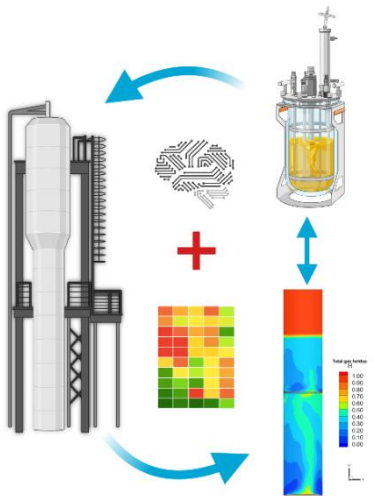

Figure 1. Iterative design process aided by a fast reconstruction of fields within a bioreactor.

In my research project, I explore how computationally less demanding models can be employed towards studying bioprocesses. We will develop a framework in which hydrodynamic- and kinetic models are combined for rapid assessment of different bioreactor configurations. Once established, the developed framework will be applied towards development and downscaling of novel bioprocesses in the framework of the zero emission biotechnology program.

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