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PhD Research Activities

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Developing process control strategies for cell culture in membrane bioreactors

My research activities involve essentially **theoretical derivation of models, identification of appropriate control strategies and use of computational tools to implement the control loop**. Part of the work will involve also experimental investigation related to preliminary identification of the key parameters for the process as well as to check and possibly improve the instrumentation facilities of the plant.

The research is conducted in collaboration with *the Institute of Membrane Technology of the Italian National Research Council (ITM-CNR)*, where a **bioreactor test-rig** with different facilities is available.

A **secondment period** of one month is planned (in progress) at the end of the first year of PhD, in order to practice with the plant and collect relevant data. Improving the on-line measurement capabilities of the plant, with specific reference to control loop implementation, is also part of the research program.

In the first part of the study, the reactor was used as test-rig to identify the most significant disturbances and causes of malfunctions. In addition, after the development of simplified model the dynamic response to stimuli in the different input variables was characterized by specific tests under transient conditions.

THINGS PLANNED

In the coming future, efforts will be devoted to set-up a more accurate dynamic model of the process able to contemplate all the key aspects determining a successful cell culturing process (transport of nutrients, catabolites, control of oxygen flow, liquid level in the reactor etc.). Such a model will constitute the basis for the development of a full, multi-variable control loop. This second part of the work involves selecting appropriate sensors for on-line monitoring of relevant properties as well as the manipulated variables for control.

OVERALL OBJECTIVE

The overall objective of my project is :

- a better understanding of the transient behaviour of complex bioreactors for hepatocyte cultures and
- the development of appropriate instrumentation for improving the process efficiency and reliability, ultimately approaching conditions for such bioreactors to provide more feasible alternatives for ex-vivo treatment of severe liver diseases.