

CHAPTER 1: INTRODUCTION

1.1 OBJECTIVES

The PCLAB software is developed based on MATLAB tools and functions including SIMULINK (a graphical simulation Toolbox). Therefore, the aim of this chapter is to introduce the student to MATLAB and SIMULINK as well as explain the basic operations and installation of the PCLAB software. A brief description of MATLAB and SIMULINK will be presented, further information can be found in printed document or online documents provided by MATLAB Inc.

1.5 INSTALLING PCLAB

For better performance, simply copy the PCLAB folder into your local hard disk. Then either add this directory to your MATLAB path using the *path* command or choose to work from the designated directory for PCLAB using the *cd* command. Note that the working directory can be adjusted directly from the menu of the MATLAB Command Window. PCLAB works for MATLAB version 5.3 and higher.

To start PCLAB, first launch your MATLAB. Once in the MATLAB program, use the path browser to change to PCLAB subdirectory. Then type **mainmenu** at the MATLAB command prompt, this will take you to the itemized menu of PCLAB from which you can select the case study you want to work on. Fig. 1.13 shows the main menu of PCLAB.

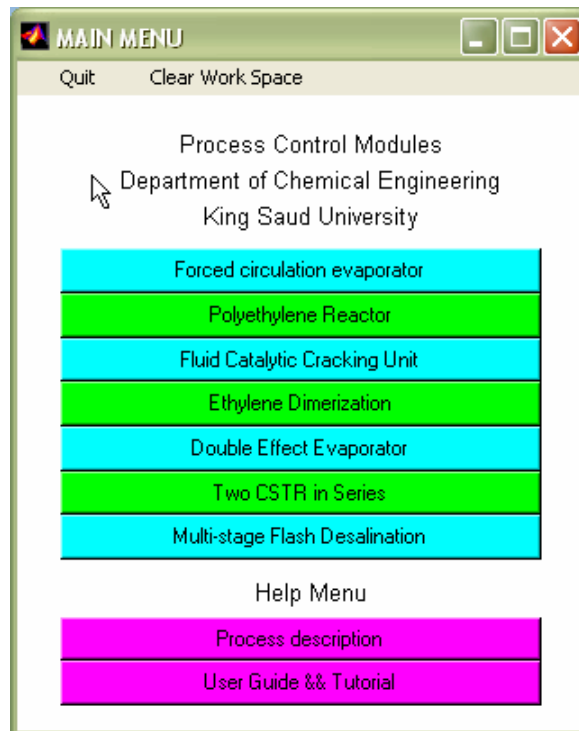


Fig. 1.13 Main menu of the PCLAB software

1.6 OVERVIEW OF PCLAB STRUCTURE

PCLAB is interactive simulation software for process control analysis and training. The process control module contains several exercises that cover basic concept of process dynamic and control. These exercises can be carried out on simulated processes that are very common in the chemical engineering industry such as distillation columns, reactors and evaporators. The exercises are unified for all case studies. This means that the user can choose a relevant case study and work on the pre-designed exercises. PCLAB is based on menu structure that allows the user to navigate through various case studies each of which has its own submenu that comprises the designated exercises. By practicing on these tutorials, the user then learns different aspects of dynamic analysis and control design.

The structure of the software is designed in a user-friendly, menu-driven framework such that the process engineer can easily navigate through the various parts of the program, carry out simulation experiments, visualize the results and draw conclusions on the effect of different design parameters, and control configurations.

There is a Main menu (Fig. 1.13) that allows the user to choose from different case studies. The case studies covered by the current version of PCLAB are as follows:

1. Forced-Circulation Evaporator
2. Polyethylene Reactor
3. Fluid catalytic Cracking Unit
4. Ethylene Dimerization Process
5. Double Effect Evaporator
6. Two-CSTR in Series
7. Multi-Stage Flash Desalination Plant

These basic case studies represents the heart of the chemical engineering industry can be used in combination with the exercises to generate a whole lot of scenarios that will enhance the understanding of the basics of control process analyses.

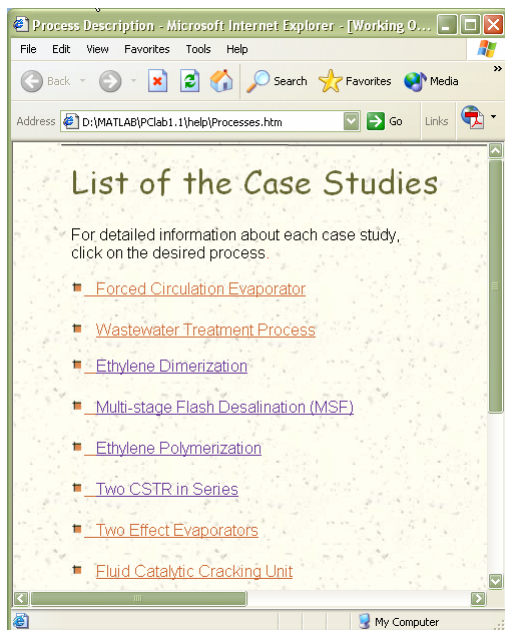


Fig. 1.14 Process description help option

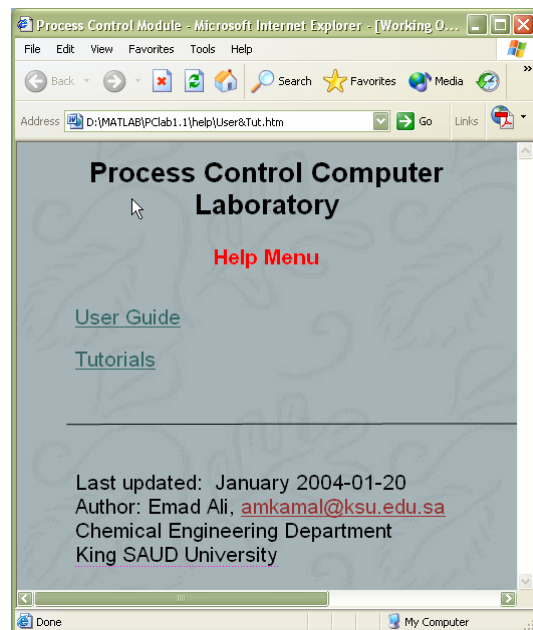


Fig. 1.15 User guide help option

The main menu has two Help option's buttons namely process description and user guide & tutorial. The help documents can be accessed online using typical web browser. The first help option (fig. 1.14) provides online information about case studies such as flow sheet, modeling equations, and typical values of the process parameters. These pieces of information can be accessed by double clicking the desired case study

name. The second option (fig. 1.15) has two sub-options which provide overview of PCLAB and procedure for carrying out certain tutorials.

By clicking one of the case studies, a sub menu will appear. See for example Fig. 1.16 which shows a typical sub-menu for the forced-circulation process. This submenu allows the user to select a specific tutorial within several exercises that are ordered as follows:

1. Open-Loop
2. Closed-Loop (PID control)
3. Multi-Loop (PID control)
4. Feed Forward Control
5. Steady State Disturbance Analysis
6. System Identification.

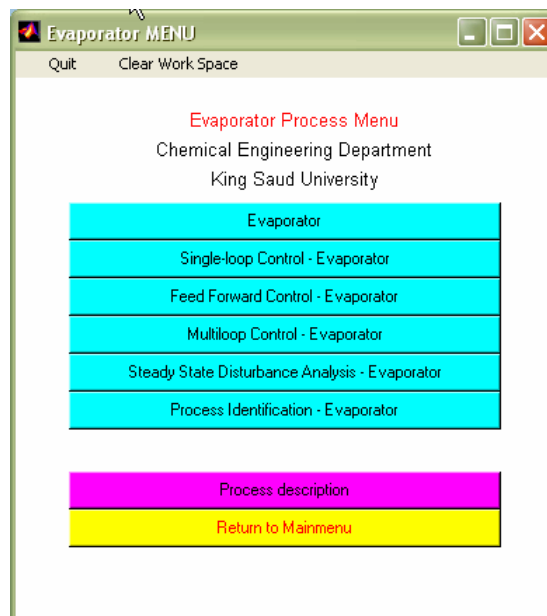


Fig. 1.16 Evaporator menu

The aforementioned exercise focuses on the following objectives:

- Modeling of the process
- Controller design and tuning
- Sensitivity analysis and system identification

The Tutorial is organized in such a way as to lead the user to the proper understanding of process dynamics. First the process is developed for steady state predictions. Since chemical process systems do not reach steady state instantaneously, accurate modeling must capture both the steady state and transient behavior of the system. The transient behavior is the time-dependent trajectory of an output in response to a particular input or class of inputs. After that control synthesis is the next step, where the control structures are selected and tuned. Finally the designed controlled system is analyzed for proper performance. Future versions of the software can examine advance control algorithms such as Internal Model Control (IMC) as well as Model Predictive Control (MPC).

The sub menu in Fig. 1.16 has additional navigation buttons. The “process description” button allows the user to access a document file containing the description of the current active (selected) case study. The yellow button simply closes the current submenu and returns the user to the main menu.

PCLAB also includes additional features which will be discussed as we progress in the manual.