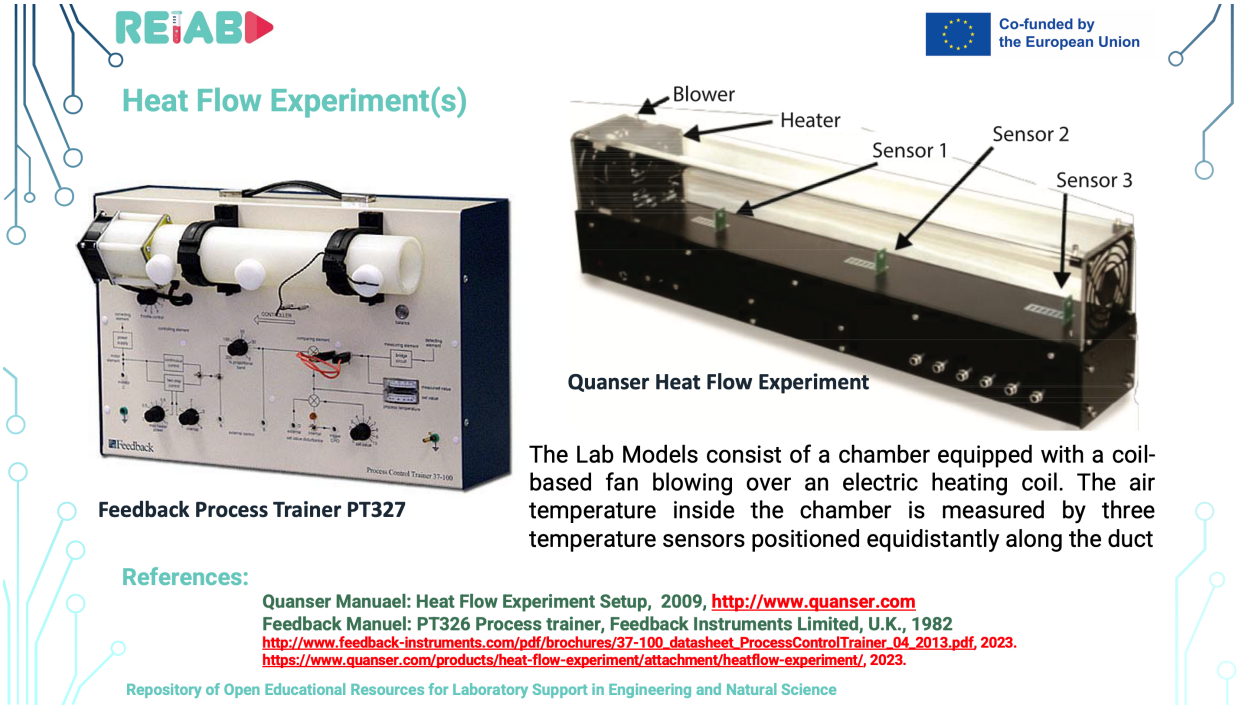
SYSTEM IDENTIFICATION ON THE HEAT FLOW EXPERIMENT

Process description



Heat flow experiments are based on following type of experimental setups 1) PT 326 Process Trainer, Feedback Instruments Limited, http://www.feedback-instruments.com, 2) Quanser Heat Flow Experiment, https://www.quanser.com, or 3) PT400 Laboratory Model, University of Kragujevac, with following general description

A heating element controlled by a thyristor circuit feeds heat into the airstream circulated by an axial fan along a polypropylene tube. A thermistor detector, which may be placed at one of three points along the tube length, senses the temperature at that point. The volume of air flow is controlled by varying the speed of the fan via a potentiometer. A change in setting represents a supply side disturbance and the effects are easily demonstrated. The detector output is amplified to provide both an indication of the measured temperature and a feedback signal for comparison with a set value derived from a separate control. A comparison of these signals generates a deviation signal which is applied to the heater control circuit such that the controlled condition is maintained at the desired value.

Features

• For teaching the basic ideas of process control to technicians, process operators and control engineers

• A practical process in miniature

• Designed for the instruction of students at all levels

• Demonstrates closed and open-loop continuous control as well as two-step control

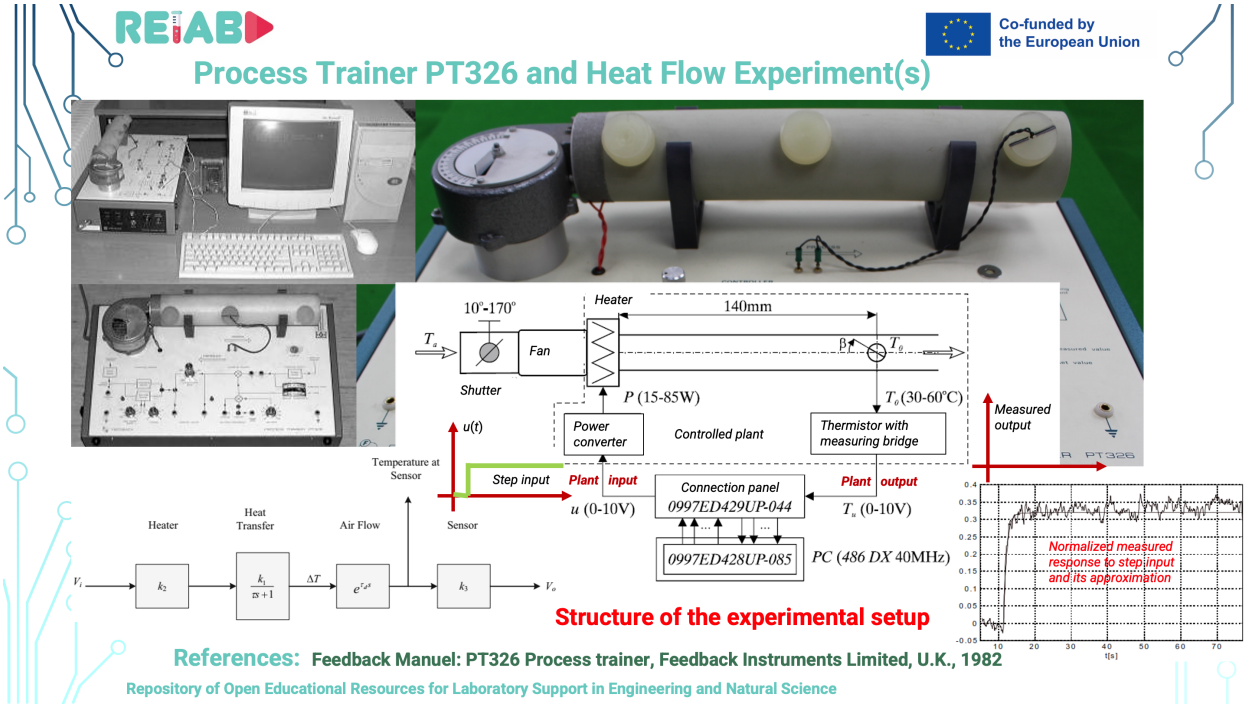
• Response times enables dynamic behaviour to be seen on oscilloscope or chart recorder

• The system exhibits thermal time constants and time transport lag

• Meters with side-by-side pointers indicate set and measured value

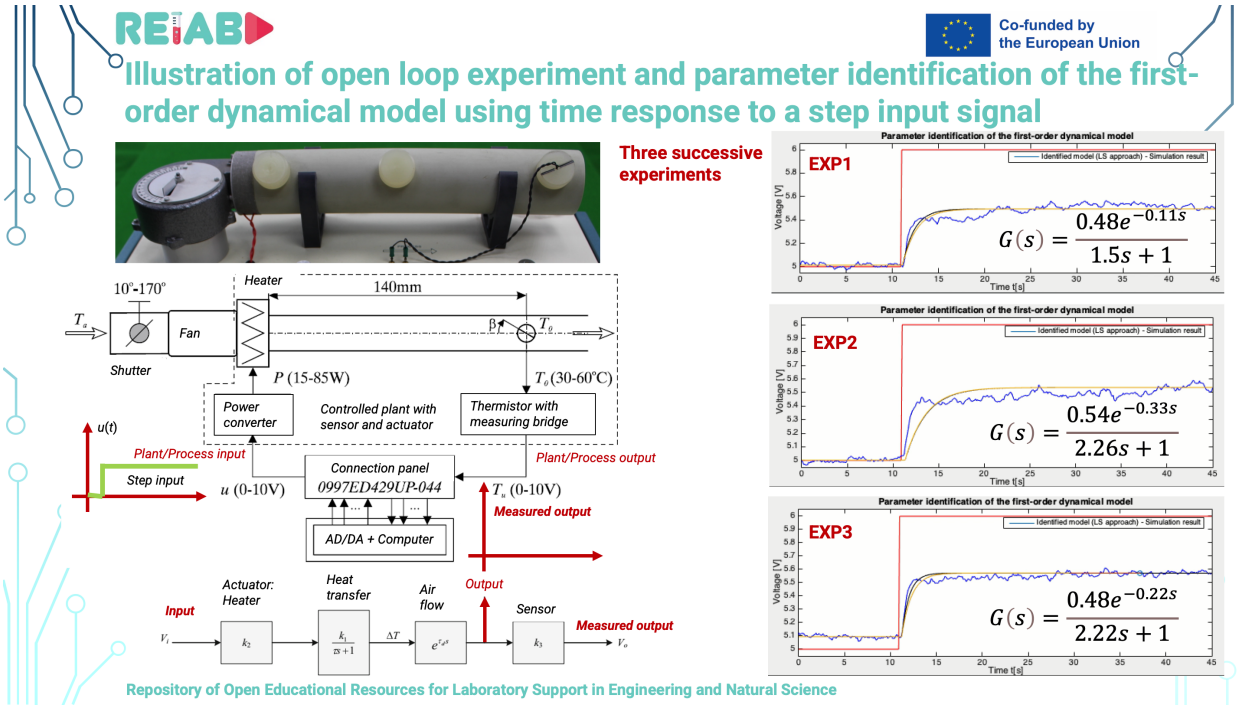
The Heat Flow Experiment demonstrates control topics related to fluid dynamics and thermodynamics. It introduces a “bump test” method, a simple technique used to find the first-order model of the system and helps students better understand temperature control strategies, such as an on-off control scheme using a relay switch, and advanced PID control topics including set-point weight and integral anti-windup.

Open loop experiment for heat flow process model identification

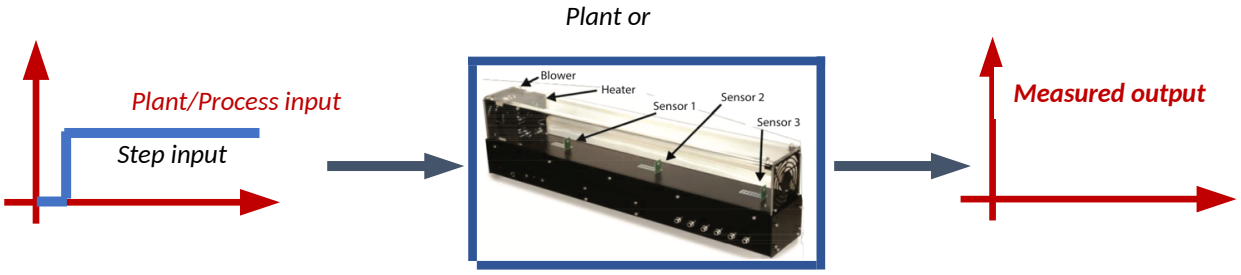


Experimental setup is laboratory model PT326 Feedback Ltd. Process trainer (PT326) is used for experiments in open loop. Input and output signals (I/O signals) are saved with sampling time Ts=0.11

[s]. I/O signals have range from 0 to 10 [V]. Input signal controls heater's power and has influence on air heating which flows through the heater and tube. Output signal represents measurement signal of air temperature in the tube of laboratory model PT326.



OPEN LOOP EXPERIMENT

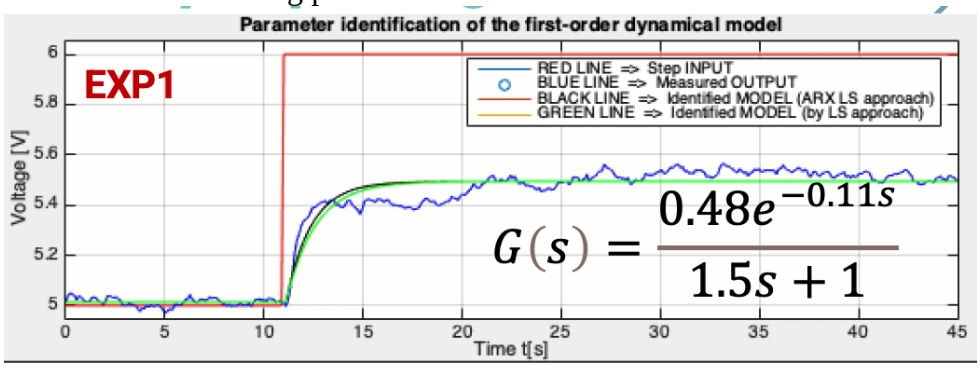


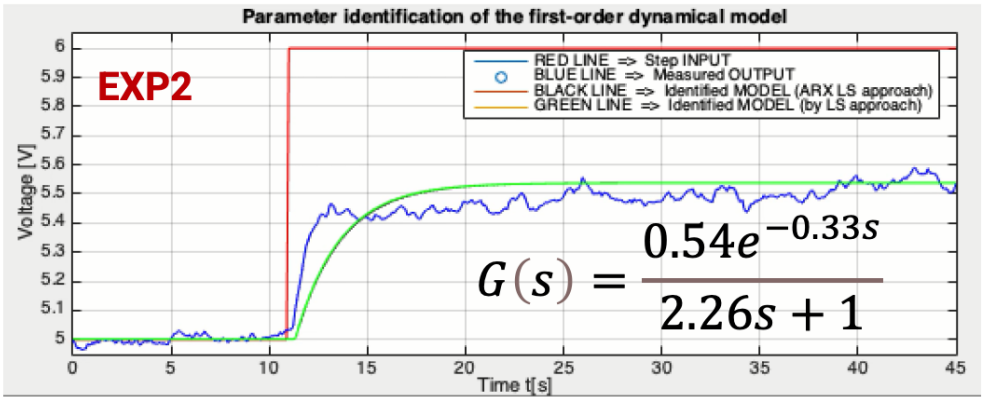
Input signal is step: 5+1*h(t-11). Output signal is step response of the system in open loop. The sampling time is T_s = 0.11 [s]. Environmental conditions are the same for all experiments. Conduction of experiments is going consequently with maximal pause about one minute.

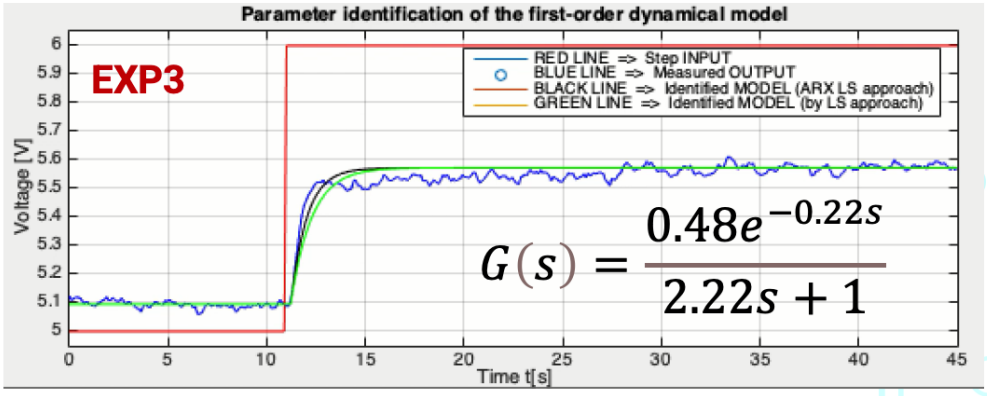
The purpose of described experimental protocol is collecting of data for identification of the process model

One example of caried out procedure of process model identification

Example of verification of identified heat flow process models based on data from 3 consecutive experiments (experiments were conducted under the same conditions and with a time delay of 1 minute) is illustrated on following picture.







Definitely, what is the process model? Or which model we choose and why?