# Experiences with Virtual Learning Environments in Control Engineering Education

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## Structure of Presentation

1. What is Control Engineering ?
2. Control Engineering at DIT Kevin St.
3. Virtual Laboratories
4. Pedagogical Issues
5. Conclusions

## 1. What is control engineering?

*"…if every instrument could accomplish its own work, obeying and anticipating the will of others … if the shuttle would weave and the pick touch the lyre without a hand to guide them, chief workmen would not need servants, nor masters slaves."*

Aristotle, Politics, Book 1, Chapter 3

[Source: Bennett, S. (1979), "A history of control engineering 1800-1930", Peter Peregrinus Ltd., London]

***Control engineering*** is concerned with the understanding and control of machines, processes and industrial automation systems to provide useful economic products for society.

## 2. Control Engineering at DIT, Kevin St.

- ***B.E. in Electrical/Electronic Engineering*** – Years 2 to 4 (various semesters); electives also available
- ***B.E. in Electrical Engineering (part time)***: Final Year (two semesters)
- ***B.Tech. in Control and Automation Systems***: Year 3, (elective) – 1 semester
- ***B.Sc. in Medical Physics and Bioengineering:*** 1 semester
- ***M.E. in Advanced Engineering***
- ***M.Sc. in Sustainable Energy Management***

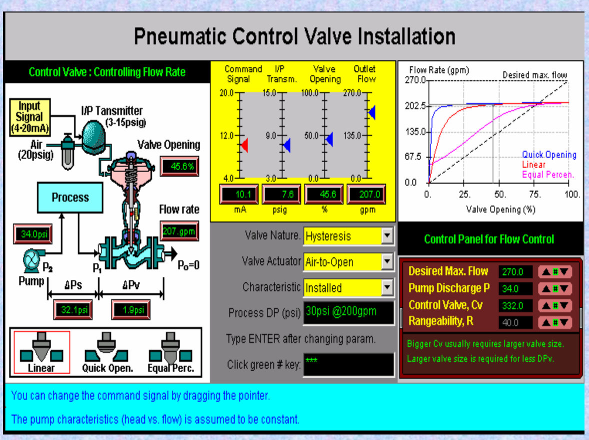
## 3. Virtual laboratories

Virtual laboratories are computer based laboratories available on the Web. They are either:

- Simulation based or
- Involve Remote Experimentation

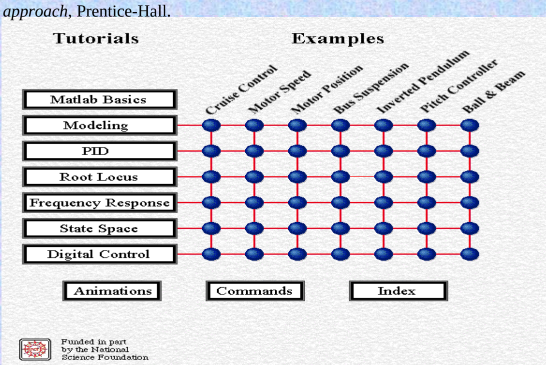
### Example 1 [www.cheric.org/education/control]

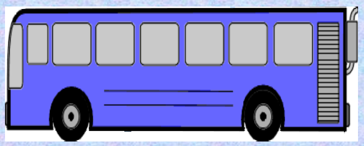

1. Introduction to Process Control
2. Understanding the Measurements: DP cell
3. Understanding the Actuator: Control Valve
4. Feedforward and Cascade Control
5. …….

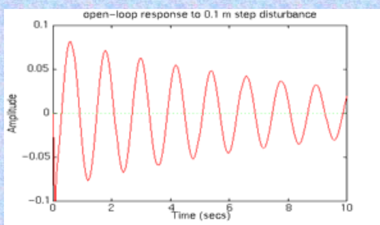


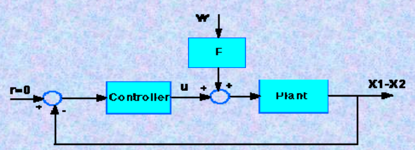
## Virtual Laboratory - Example 2

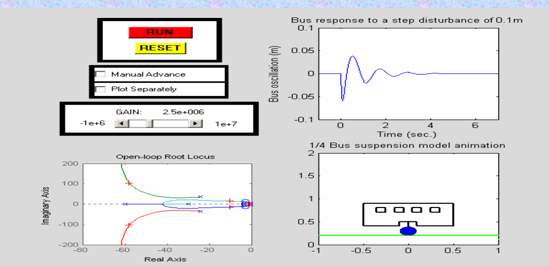
Source: http://www.engin.umich.edu/group/ctm ; also Messner, W.C. and Tilbury, D. (1999). *Control tutorials for MATLAB and Simulink: a Web-based approach*, Prentice-Hall.






## 4. Pedagogical issues – Why Virtual Laboratories ?

- Duties of the control engineering educator
- Formal classroom and laboratory time is being reduced
- The increasing diversity of student educational background
- The increasing maturity of the tools
- Students increasingly expect technical work which is practical and which motivates independent learning.

## How virtual laboratories have been used

- As backup to a more didactic teaching approach.
- As part of formally assessed assignments.

## Questionnaire

*•Virtual laboratories were a beneficial learning experience (compared to other exercises) ?*

*•Virtual laboratories are user-friendly ?*

*•The virtual laboratory complements and enhances my understanding of lecture material?*

*•Virtual laboratories are fun and sustained my interest ?*

*•I became more interested in the material because of the virtual laboratory viewed ?*

*•There is enough time to perform the virtual laboratory ?*

*•I would recommend virtual laboratories to others ?*

*•Any other comments ?*

## Student Feedback - 1

14 replies were obtained (from a total of 17 students).

Agree

•*Virtual laboratories were a beneficial learning experience (compared to other exercises)* – 4.2

•*Virtual laboratories are user-friendly* – 3.9

•*The virtual laboratories complement and enhance my understanding of lecture material* - 4.2

•*Virtual laboratories are fun and sustained my interest* – 3.6

•*I became more interested in the material because of the virtual laboratories viewed* – 3.7

•*I would recommend virtual laboratories to others* – 4.2

Unsure

• *There is enough time to perform the virtual laboratories*- 3.2.

## Student Feedback - 2

- Overall, student feedback is encouraging.
- Virtual laboratories increase student motivation, facilitate student self-learning and enhance theoretical understanding and practical ability.
- The experiences gained have shaped the design of the modules in automatic control.
- Assessment methodology has also changed.

## 5. Conclusions

- Twin pressures: the need for students to learn a wider variety of concepts, ideally in a self-learning mode, and the reduction in class contact time.
- From didactic to more learner centered.
- Appropriate use of
  - web-based virtual laboratories
  - information technology tools, and
  - real case studies.
- An improvement in learning outcomes (theoretical understanding, practical ability, motivation, self-learning)
- Further work: Deepen the learner-centered approach.