Individualised Approaches in Control Education
Courses with Large Number of Students

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ACE 2006, Madrid, June 22
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M. Fikar (STU) Courses with Large Number of Students ACE 2006, Madrid, June 22
Automatic Control Fundamentals

- 26 hours of lectures
- 26 hours of computer labs
- 250 students
- 2001 – the 3rd most negative in the students ranking
- 2006 – the 5th most positive in the students ranking
- self-learning package
Components of Internet Suite

- study materials, presentations, files for download, information about the course,
- basic operations using MWS (polynomials, matrices, pzmap, step),
- Internet version of all course topic problems,
- on-line tests and preparation for written tests,
- Moodle e-learning portal for gradebooks, attendances, quizzes, etc.

Contents of Exercises

- differential equations
- transfer function algebra
- step responses
- poles and zeros
- modelling of chemical processes
- closed-loop stability
- PID controller design
- process control
General part: Open Source LMS Moodle (unique assignments, discussions, gradebook, etc)

Scientific part: generation of individual tests, assignments
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Assignment Module

MATLAB scripts → HTML files

1. random input values for one student
2. solution and intermediary results for one student
3. A script to gather 1, 2 for all students
4. A script to generate HTML files for students and teachers
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Generation of Tests

1. MATLAB
2. XML File
3. XSLT Transformation
   1. \LaTeX produces PDF
   2. XHTML for www
   3. LMS format for Moodle
Generation of Tests /2
Problem and Solution

The closed loop system consists of a controlled system with transfer function of the form $G(s) = \frac{b_0}{s^2 + a_1 s + a_0}$ and a PID controller of the form $G_c(s) = P + \frac{I}{s} + Ds$. If the setpoint value is changed at $t = 0$ from 0 to $w$, the permanent tracking error is given as:

$$e(\infty) = \begin{cases} w \left(1 - \frac{b_0 P}{a_0 + b_0 P}\right) & \text{if } I = 0 \\ 0 & \text{otherwise} \end{cases}$$
MATLAB Computational Engine
XML File
\textbf{Problem 1}. The closed loop system consists of a controlled system with transfer function of the form $G(s) = \frac{3}{s^2 + 5s + 7}$ and a controller of the form $G_c(s) = 9 + 5s$. If the setpoint value is changed at $t=0$ from 0 to 10, the permanent tracking error is given as

- $2.06$
- $-1.15$
- $0.13$
- $0.29$
- no other choice is correct
\LaTeX{} produces versions both for students and for teachers

**Problem 1.** The closed loop system consists of a controlled system with transfer function of the form \( G(s) = \frac{3}{s^2 + 5s + 7} \) and a controller of the form \( G_c(s) = 9 + 5s \). If the setpoint value is changed at \( t=0 \) from 0 to 10, the permanent tracking error is given as

\[ \sqrt{2.06} \]

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- 0.13
- 0.29
- no other choice is correct
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Answer:  
- a. 0.29  
- b. 0.13  
- c. 2.06  
- d. no other choice is correct  
- e. -1.15  

Correct
Conclusions

- Heavy use of ICT in Education improves ranking of the course
- Individual problems for students
- Reduction (removal) of manual and repetitive tasks
- Productivity increase
- Significant amount of time and work needed to develop the course