Education on automatic control for professionals through the LRA-ULE remote laboratory

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Outline

- Background
- Purpose of the remote laboratory
- Laboratory user profiles
- Architecture of the platform
- Educational contents
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- Conclusion
The SUPPRESS research group started its activity in local monitoring of industrial processes (1998), developing open systems which gave rise to technology transfer to companies.

A platform for remote monitoring of an industrial pilot plant was developed and presented on the Internet Based Control Education conference in 2001.

This led to the development of an open and flexible technology platform for remote monitoring of industrial processes through the Internet, following the proposal of the Spanish Committee of Automatic Control.

The result was the Remote Laboratory of Automatic Control of the University of León (LRA).
Integrated in several initiatives of some Spanish research groups in systems engineering and automatic control:

- Inter-university networks:
  - DocenWeb (Educational Network for Control Through Web) 2003-2004
  - Educ@ (Educational Network in Automatic Control) 2005-2006
  - e-Automática (educational network to incorporate ICTs in Automatic Control education through the integration of virtual and remote laboratories) 2007-2008

- Automatl@bs project
The **Remote Laboratory of Automatic Control** is an industrial-oriented laboratory.

The set of systems accessible from LRA belong to 4 groups:

- Pilot plants implementing real industrial processes.
- Automation, control and monitoring devices.
- Educational equipment.
- Real industrial installations

[http://lra.unileon.es](http://lra.unileon.es)
From a teaching-learning perspective, the aims of LRA are:

- To become a high-value resource for theoretical lessons, supporting the concepts with real-life examples.
- To show the links between theory and the real technical implementation.
- To facilitate shared use of costly physical resources and the development of laboratory networks.
- To favor active learning among students.
- To facilitate comparison of the technical characteristics of different technologies.
From a research perspective, the platform enables working on the following research lines:

- Remote monitoring of complex industrial processes.
- Development of advanced monitoring tools based on machine learning and dimensionality reduction techniques.
- Energy monitoring in buildings and industrial facilities.
- Intelligent data analysis.
- Critical infrastructure security and monitoring.
- Advanced control techniques.
- Smart grid.
Laboratory user profiles

- **Degrees/Masters in Engineering (~500 students/year)**
  - Mechanical
  - Industrial Electronics and Automatic Control
  - Computer
  - Aeronautical

- **Master for educators (~30 students/year)**

- **Courses for professionals (~110 students/year)**
  - Engineers, technicians and device installers.
  - Professionals in industrial automation and building energy management
Professionals and companies are increasingly demanding continuous training in novel equipment and new work methods.

The educational contents of the laboratory need to be oriented to provide effective and practical knowledge that professionals can apply in their daily activities.

The success of remote labs for university courses foresees a broad application for lifelong education of professionals.

The addition of state-of-the-art automation and control technologies to the LRA enabled professional training in industrial automation and building energy management.

Collaboration between the research group and Schneider Electric for the EcoXpert Program organized by the company to train engineers, systems integrators and installers.
Architecture of the platform
Physical systems: Pilot plants

Pilot Plant

4-Tanks Model

Electro-pneumatic Cell

4-Variable Model
Physical systems: Automation, control and monitoring devices

Robot

Drives

PLCs
Physical systems: Educational equipment

Feedback

Home automation panel
Physical systems: Real Installations

Building Management
Physical systems: Real installations

Power Management
Physical systems: Real installations

Heating, ventilation and air conditioning
- Distributed electrical meters:
  - Analyzers (CM 4000, Nexus 1252)
  - Basic meters (PM 800, Shark 100)
• Communication network:
  • Ethernet (Modbus TCP protocol)
  • Serial RS485 (Modbus RTU protocol)
University-oriented courses

Courses for professionals
The 4-tank scale model implements the problem proposed by Johansson.

This system has been developed using industrial equipment.
Educational contents for professionals: Schneider Electric EcoXpert program
The courses of the remote laboratory presented in this paper have been used in two different contexts (2011-2012):

- **Master for educators**
  Studied by people in order to teach in vocational or professional training centers.
  
  30 students/year

- **Courses for professionals.**
  Different professional profiles, ranging from engineers to technicians and device installers.
  Delivered in six different Spanish cities, corresponding to the *Schneider Electric EcoXpert program*
  
  110 students/year
Q1. Questions about the remote laboratory

- their point of view compared to traditional approaches,
- its usefulness and effect on motivation.

Q2. Questions about the structure of the course

- Appropriateness of the difficulty w.r.t. the information provided
- Ability to answer questions with the info available in the remote laboratory.
- **Questionnaire on the knowledge** they had acquired,
- **A survey** that asked **about the opinions** concerning the remote laboratory.

Both valued between 0 and 10.
The remote laboratories are excellent tools for technological training → real equipment available to users anytime and anywhere.

They should also be used to train professionals, which increasingly demand continuous training with novel control and monitoring equipment.

Remote laboratories make devices more accessible.

Professionals can handle fully operative equipment instead of working with isolated equipment within black boxes, which is the most common approach.

Received positive feedback.
Thank you
Questions?